Psychological Mechanisms in Embodied Cleansing

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Contents

Chapter 1

Metaphors for the Mind

Rene Descartes, in his "Treatise on Man", was the first to systematically introduce the machine metaphor for living objects (Vaccari, 2008). Inspired by the gardens of Versailles with their elaborately designed fountains, he described the functioning of the human body, which he refers to as a machine, in hydraulic and mechanical terms. For example, in Descartes's model, contraction of muscles are caused by hydraulic inflation which are caused by animal spirits originating from a literal fire in the heart (Descartes, 1662/1985).

> One may compare the nerves of the machine I am describing with the pipes in the works of ... fountains, its muscles and dendons with the various devices and springs which serve to set them in motion, its animal spirits with the water which drives them, the heart with the source of the water, and the cavities of the brain with the storage tanks. ... these functions follow from the mere arrangement of the machine's organs every bit as naturally as the movements of a clock or other automaton follow from the arrangement of its counter-weights and wheels. (Descartes 1662/1985, pp. 100–108)

Descartes uses a great number of elaborate mechanical metaphors for different functions of the human body and mind. A model for the workings of the human brain, for example, can be found in church organs: Like a melody depends not on the physical arrangement of the pipes but only the distribution of air in the pipes, the brain's working does not depend on the physical anatomy but only on the distribution of animal spirits in the brain's cavities. And the way sensations create reactions can be explained by looking at how the gardens of Descartes's time were equipped with weight-sensitive spots on the floor, connected to movement devices for figures, which made the statues retreat or advance towards the person who had triggered the mechanism—creating the illusion of interacting with the person.

1.1 Metaphors

Descartes's hydraulic metaphor for the workings of the human body relies on the idea of pressure as the driving force. This highlights how sensations can be transmitted from one body part to another, showing how coordinated movements of different body parts are possible. But other physiological aspects are not captured by this metaphor, like, for example, any operation that requires a transformation of the information, instead of a mere transmission. These aspects are thus not salient when thinking about the human body using a hydraulic metaphor. On the other hand, such incongruities come easily to mind when thinking in terms of another metaphor. Indeed, Descartes's metaphor of the workings of the body strikes us as amusingly reductionist nowadays when electrical and chemical mechanisms are an integral part of the prevailing metaphor about the workings of the human body.

But not only Descartes's metaphor was wrong—every metaphor is wrong. Metaphors describe one thing in terms of a different thing; for example, Descartes describes brain activation by the workings of a musical organ. The explanatory power of a metaphor partly relies on the dissimilarity of the to be explained and the explaining object. However, the objects being dissimilar necessarily implies that the comparison has glitches. Some aspects of the metaphorical object do not fit with the parts or way of functioning of the described object. And some other aspects of the to be described object have no corresponding counterpart in the metaphorical object. For example, information transformation, and in fact any non-deterministic influence of the organism itself is not represented by the mechanistic metaphor of how sensation leads to action. Those aspects will not be represented by the metaphor, and thus are easily overlooked, compared to other parts of the object that are highlighted by the metaphor (Lakoff & Johnson, 1980, 1999).

Usually, we are not aware of the shortcomings of metaphors we are using—indeed, often we do not even realize that we are using metaphors at all. Still, the metaphors we use for an abstract object influence how we think about this object (cf., Lee & Schwarz, 2014b). For example, problems in romantic relationships are evaluated differently depending on the active metaphor for relationships (Lee & Schwarz, 2014a). *Relationships as perfect unities* leads to a much more detrimental evaluation of problems than *relationships as journeys*—a metaphor that implies ups and downs as a normal part of relationships. Similarly, only when the metaphor *the state as a body* is surreptitiously activated, does the detrimental power of germs increase negative attitudes towards immigration. If, on the other hand, the state is only referred to in literal terms, germs, and how they are represented, does not influences attitudes (Landau, Sullivan, & Greenberg, 2009; see also Keefer, Landau, Sullivan, & Rothschild, 2014; Landau, Oyserman, Keefer, & Smith, 2014).

Yet, despite their imperfections—many of which are shared by all kinds of models—metaphors are very useful. First, good metaphors depict aspects of the

described object with sufficient accuracy to facilitate understanding these aspects. Descartes' model, for example, can help us understand how reflexes work, how sensations in one part of the body can be transmitted to another part of the body and there initiate fast and unintended reactions. Second, metaphors can be very fruitful in generating hypotheses, in raising ideas whether new aspects of the original object might be described in terms of the metaphor. In other words, each metaphor throws into relief some aspects of the original object; this heightened attention to one detail that might otherwise be missed, is fruitful for noticing details and generating new ideas.

1.2 The Computer Metaphor

The general observations on metaphors also hold for the computer metaphor—the idea that the workings of the human mind can be adequately explained by the workings of a computer. Since the cognitive revolution, the human mind has generally been seen as a complex information processor, working in large parts like a computer. In fact, in the 1950s and 1960s, usage oscillated back and forth between humans being a model for computers and computers being a model for human cognition (Gigerenzer & Goldstein, 1996). Cognition is thought of as computation. That means, it is described as performing operations of formal logic to manipulate abstract symbols (Pylyshyn, 1980). Moreover, memory is usually referred to in terms of *storage* or *retrieval* of representations, suggesting memories to be static entities and thereby hiding their constructive and context-sensitive nature (Smith & Semin, 2007). Even basic and supposedly neutral terms like *information processing* for thinking come from a computational perspective of cognition and entail aspects of this metaphor.

One feature of the computer metaphor is a sequential order of cognitive operations. Information processing—in the human mind as well as in computers—can be thought of as a 3-staged process (e.g., Newell, Shaw, & Simon, 1958; Pylyshyn, 1980). Input is perceived by the information processor and re-described into abstract and symbolic information. Then, this information is manipulated, transformed in some way, for example, according to prior information or the state of the system. Lastly, the result of the computation appears. It may be a change in the internal system (for instance in the contents of the information processor's memory storage) or an output to the world which manifests itself in action. Crucially, the middle stage, the information processing proper (i.e., deciding, thinking, memorizing) is largely independent of the input and the output phase. In fact, in such a model, "the senses and muscles are simply peripheral input-output devices" (Killeen & Glenberg, 2010, p. 68).

A related aspect of the computer that has been applied to human information processing is the notion that computation is largely independent of the physical properties of the "hardware", the physical structure that implements the computational functions (Fodor, 1983). As long as the interplay between the different components works and the system is sufficiently large and complex, every computational device has the properties of a general Turing machine, which implies that all computable transformation can be computed by the system. In short, according to the computer metaphor, "minds may be realized in flesh, silicon, or even cream cheese" (Putnam, 1985, as cited in Gibbs, 2006, p. 3).

For decades now, the computer metaphor has been the prevailing metaphor for human cognition (e.g., IJzerman & Cohen, 2011; Niedenthal, 2007; Pylyshyn, 1980; Spellman & Schnall, 2009), making it difficult to see that the mind could be anything else, and leading Johnson-Laird to prophesy "The computer is the last metaphor; it need never be supplanted" (Johnson-Laird, 1983, p. 10). Nevertheless, the computer metaphor, however dominating it might be, is just that: a metaphor. Like every other metaphor, it highlights some aspects of human cognition, while hiding or misrepresenting others. And indeed, the computer metaphor has been under attack for obscuring one material aspect of human information processing: the interaction of higher cognitive functions with sensations and actions—in short, with the body (Glenberg, 2010; Smith & Semin, 2004).

1.3 Embodiment

The two highlighted aspects of the computer-metaphor, independence of information-processing from the nature of the body and independence of information-processing from input and output, have been called into question by embodiment research. For example, the influence of the nature of the body can be seen in handedness's influence on preferences for horizontally arranged objects (Casasanto, 2009; Eelen, Dewitte, & Warlop, 2013). Additionally, distance estimates in short ranges are influenced by "reaching potential" (Linkenauger, Witt, Stefanucci, Bakdash, & Proffitt, 2009; Witt, Proffitt, & Epstein, 2005; see also Maravita & Iriki, 2004), in longer ranges by chronic or situational bodily fitness (Proffitt, Stefanucci, Banton, & Epstein, 2003; Witt et al., 2009). The dependence of higher cognition on the body's sensori-motor states (i.e., concurrent input and output) has also been widely demonstrated. For example, moving one's hands (vs. legs), impairs working memory for hand- (vs. leg-)related words (Shebani & Pulvermüller, 2013). By now, a huge number of findings highlight the interdependence of higher level cognitive processes with low-level bodily states and experiences. This tight connection between body and mind contradicts the computer metaphor, where the two should be separated by many layers of abstraction and re-description and should therefore

operate largely independently.

In contrast to the cognitive perspective with its reliance on the computer metaphor, the embodiment approach assumes that thinking is intimately connected to acting and perceiving. Indeed, from an embodiment standpoint, there is no clear distinction between perception and conception (Lakoff & Johnson, 1999). The notion that information is processed and stored in symbolic, amodal fashion is rejected in favor of the notion that both information processing and storage rely heavily on modality specific brain regions and bodily states—so that any stored information contains motor and sensory aspects. In fact, knowledge is grounded in the state that is active during the acquisition of the information. Retrieval from memory triggers a partial reenactment of these actions and sensations (Glenberg, 1997). Therefore, knowledge is a partial simulation of sensory, motor, and interoceptive states (Barsalou, 1999, 2003). Accordingly, internal representations are meaningful, instead of being just arbitrary symbols. In this sense, high-level cognitive processes like language or problem solving are modal, even when they deal with abstract concepts, for example morality (e.g., Zarkadi & Schnall, 2013) or mathematical operations (e.g., Novack, Congdon, Hemani-Lopez, & Goldin-Meadow, 2014).

Thus, embodiment gives a more prominent role to the body in human mental life altogether. In Western intellectual tradition, the body has only ever been seen as a vessel of the human brain and mind—if it was taken into account at all. Embodiment on the other hand, stresses the notion that human beings' actions, in the real world, with their specific bodily capabilities, fundamentally shape their cognitive processes (Caligiore, Borghi, Parisi, & Baldassarre, 2010; Meier, Schnall, Schwarz, & Bargh, 2012; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). Thus, embodiment is inherently an ecologically informed and action-oriented approach, where the real world in which humans live, and the affordances it offers, are integral to understanding the human mind. Moreover, understanding the development of the human organism within the world—both on a phylogenetic and an ontogenetic scale—essentially contributes to our understanding of the human mind. Thus, evolutionary, developmental, and learning perspectives are also integral in an embodiment viewpoint of human cognition (Glenberg, 1997). Because of this holistic and integrative capacity of embodiment, it has been suggested as a unifying account for psychological sub-disciplines (Glenberg, 2010; T. Schubert & Semin, 2009).

In sum, embodiment expressly rejects the computer metaphor as a model for the human mind, mainly for neglecting the role of the body and its interaction with the environment in mental life. One might even say embodiment is that part of cognition that is not well explained by the computer metaphor and its implications. Instead, embodiment stresses the role of the body in cognition—its morphology, current state, capabilities, perceptions, and actions.

1.4 Aim of This Thesis

The aim of this thesis is to deepen our understanding of the psychological processes in embodiment. By examining cognitive processes in embodiment, the present approach combines a social cognition perspective with embodiment's emphasis on the role of the body. In a sense, therefore, while theories and many experiments in embodiment are integrally concerned with implementation considerations (or with a computational level of analysis), I am examining embodiment on an algorithmic level of analysis (Marr, 1982).

For this, I first (Chapter 2) describe and compare three psychological mechanisms through which the body can influence cognition: *direct state induction*, *modal priming*, and *sensorimotor simulation*. They all have qualitatively different effects and different operating characteristics; moreover, I argue, in combination they can explain the bulk of embodiment findings. However, as yet they are not routinely tested in embodiment research. Therefore, apart from explaining the mechanisms and their characteristics, I will focus on ways of testing them. By providing a concrete guideline, I hope to foster mechanism research in embodiment, which will ultimately improve our understanding of human cognition.

Then, I apply this knowledge about embodiment mechanisms to one specific effect in detail—embodied cleansing—out of the huge family of embodiment effects (Chapters 3–5). First, in Chapter 3, I review the related literature. Specifically, I emphasize two different plausible explanations for embodied cleansing, the *moral purity* and the *clean slate* explanation, which differ in emphasis and scope. Importantly, I argue that the two classes of embodiment effects might also be driven by two different mechanisms. While moral purity effects are best explained by *modal priming*, clean slate effects are more likely a result of *direct state induction*.

Chapter 4 reports two experiments aimed at testing the contribution of the two different explanations for embodied cleansing by pitting them against each other or examining them in unison. Chapter 5 examines one explanation, the *clean slate* notion, in more detail, testing its operating conditions and underlying mechanisms. Specifically, the chapter reports three experiments that manipulate different aspects of the physical act of cleansing—its motor and sensory properties, the awareness of cleansing and the self-referentiality of the cleansing. I argue that not so much the sensorimotor components but the intention and self-reference of the cleansing action are instrumental in embodied cleansing. From this I conclude that clean slate effects are most likely caused by a combination of *direct state induction* and *conscious inferences*.

Chapter 2

Embodiment Mechanisms

Up to now, demonstration experiments have dominated embodiment research while in-depth understanding lags behind. Especially, boundary conditions, mediators, and, above all, underlying mechanisms of embodiment effects are not clear yet (Barsalou, 2010; Glenberg, Witt, & Metcalfe, 2013; Meier, Schnall, et al., 2012; T. Schubert & Semin, 2009). Recently however, some progress has been made towards answering these questions for some embodiment effects. For example, the influence of weight on importance is moderated by interoceptive sensitivity (Häfner, 2013) and the influence of fishy smells on distrust can be explained by a chain of associative semantic activations (Lee & Schwarz, 2012). Here, I want to first portray three basic mechanisms for explaining embodiment effects and illustrate them briefly with findings from the cognitive, social, developmental psychology, and neuroscience literature (for more extensive reviews of the embodiment literature, see for example Barsalou, 2008; Glenberg et al., 2013; Landau, Meier, & Keefer, 2010). Then, I will integrate current knowledge about experimental paradigms to test these mechanisms.

Sensations and actions can have three qualitatively different effects on the person experiencing the manipulation. First, they can directly influence a person's state of mind, feelings or information processing (*direct state induction*). Second, they can change how readily specific information comes to mind, thus rather influencing the contents instead of the mode of cognition (*modal priming*). Third, they can lead to compatibility effects with concurrent automatic simulations, changing, for example, fluency and preferences (*sensorimotor simulation*).

2.1 Mechanism 1: Direct State Induction

Some bodily states seem to induce a (non-affective or affective) feeling directly, without mediating cognitive processes such as attributions or inferences (Barsalou,

Niedenthal, Barbey, & Ruppert, 2003; Niedenthal, 2007; Neumann, Förster, & Strack, 2003). For example, inducing an upright, expanded posture that might generally indicate confidence or power can increase levels of testosterone and decreases cortisol (Carney, Cuddy, & Yap, 2010), and lead to a greater sense of power (L. Huang, Galinsky, Gruenfeld, & Guillory, 2011). Furrowing one's brow may create a feeling of effort or disfluency (Alter, Oppenheimer, Epley, & Eyre, 2007; Larsen, Kasimatis, & Frey, 1992; Stepper & Strack, 1993; see also Tamir, Robinson, Clore, Martin, & Whitaker, 2004; Topolinski & Strack, 2009a). And keeping arm muscle tension associated with increasing or decreasing distance between oneself and an object may results in a motivational orientation of avoidance or approach (Cacioppo, Priester, & Berntson, 1993, for a review and theoretical integration see Neumann et al., 2003).

The resulting psychological state or mindset can, in turn, influence judgment or behavior. Thus, expanded posture has been shown to influence risk taking behavior (Carney et al., 2010), persistence in a difficult task (Riskind & Gotay, 1982), dishonesty (Yap, Wazlawek, Lucas, Cuddy, & Carney, 2013), and pain tolerance (Bohns & Wiltermuth, 2012). Furrowed brows influence confidence (Alter et al., 2007), comprehension (Miele & Molden, 2010), judgment of recognition (Phaf & Rotteveel, 2005) and fame (Strack & Neumann, 2000), and feeling of satiation (Redden & Galak, 2013). Distance changing muscle contraction influences valence judgment (Cacioppo et al., 1993; Centerbar & Clore, 2006; Priester, Cacioppo, & Petty, 1996) recognition of valenced information (Förster & Strack, 1997, 1998), consumption (Förster, 2003, 2004), tendencies to judge others as similar or dissimilar to oneself (Nussinson, Seibt, Häfner, & Strack, 2010), and recruitment of different cognitive resources (Förster, Friedman, Özelsel, & Denzler, 2006; Friedman & Förster, 2000, 2002, 2005; Koch, Holland, & van Knippenberg, 2008). As can be seen from these examples, states that have been induced via embodiment can influence diverse judgments and behaviors.

This mechanism, the bodily configuration inducing a psychological state, is the most direct one as it is assumed to be unmediated by any kind of psychological mechanism. In fact, the mechanism is similar to William James's theory of emotion elicitation (1884) and also to some later theories of emotion, like the *hard interface theory* (Zajonc & Markus, 1988). Therefore, it should generally be stable, in terms of both context influences and temporal dynamics. Regarding the latter, once the embodiment manipulation has been present for a sufficient time to alter participants' state, this said state should persist for a short stretch of time even offline (M. Wilson, 2002), that is, for some time after the manipulation is no longer active. For example, the lessened confidence induced by a slumped body posture (compared to an upright and expanded posture) occurs after participants no longer hold the posture; in fact, participants had walked to another room and sat down in whatever manner they pleased before the task that tested their persistence even began (Riskind & Gotay, 1982).

Direct state induction is similar to procedural or mindset priming. Both are content-free (Förster, Liberman, & Friedman, 2009; Gollwitzer, 1990), which means that rather than distinct concepts being activated, information processing is altered, (sometimes referred to as a *processing shift*, see Schooler, 2002) influencing cognitive functions in completely unrelated domains. Moreover, it does not matter how the altered mindset came about. The same motivational state influences cognitive processes in the same manner, whether the state came about in a cognitive or embodied task. For instance, an avoidance orientation should result in a tendency to evaluate neutral stimuli as negative and to have a narrow attentional scope, no matter if it was induced by walking backwards (Fayant, Muller, Nurra, Alexopoulos, & Palluel-Germain, 2011), by arm extension (Cacioppo et al., 1993), or by performing a task of guiding a mouse through a maze to avoid a bird of prey (Friedman & Förster, 2005).

Even though direct state induction works largely independently of contextual and situational factors, the elicited state does not necessarily influence behavior. In general, the state or feeling is one of several possible sources of influence on a given decision, and thus does not necessarily determine each related behavior. Moreover, the feeling that was caused by a bodily state might be attributed to a source that is perceived to be irrelevant for the behavior (Schwarz, 2011). Consequently, the feeling might be actively rejected as a source of information. Therefore, finding high context sensitivity for an embodiment manipulation does not preclude direct state induction as the underlying mechanism. Instead, the distinction between the induced state on the one hand and behavior resulting from that state on the other hand is crucial. While the former is assumed to follow directly from the embodiment manipulation, the latter is highly flexible and context sensitive.

Moreover, even the altered psychological state itself can be altered by influences other than the bodily state. Other external or internal influences, like cognitive inferences can also influence the state that has been altered by the embodiment manipulation. For example, if the elicited feeling seems inappropriate, given the current environmental conditions, cognitive resources might be used to alter one's subjective experience of one's current state.

2.2 Mechanism 2: Modal Priming

In modal priming sensorimotor states activate abstract concepts. For example, holding a warm object affects interpersonal warmth (Williams & Bargh, 2008; see also Fay & Maner, 2014; Kang, Williams, Clark, Gray, & Bargh, 2011; Kolb, Gockel, & Werth, 2012; Sassenrath, Sassenberg, & Semin, 2013; Zhong & Leonardelli, 2008); holding a heavy (vs. light) object increases the perceived significance of an object or topic (Alban & Kelley, 2013; Häfner, 2013; Jostmann, Lakens, & Schubert, 2009;

Kaspar, 2012; Schneider, Rutjens, Jostmann, & Lakens, 2011; M. Zhang & Li, 2012); and handling a rough (vs. smooth) object leads to judging social interactions to be less coordinated (Ackerman, Nocera, & Bargh, 2010). The general idea for this mechanism is that representations of psychological states contain sensory and motor elements (e.g., movements or bodily, facial, or sensory states). Activating the bodily states partially activates the associated semantic concepts (by means of spreading activation in a multi-modal associative store; see Smith & DeCoster, 2000; Strack & Deutsch, 2004); and the active semantic concepts can, in turn, influence behavior.

Modal priming effects have gained much attention by relying on surprising associations. Instead of being semantically associated, the bodily states or actions and the abstract concepts are connected via conceptual metaphors (Lakoff & Johnson, 1980, 1999; Landau et al., 2010). For example, a faint smell of fish decreases trust in social interactions (Lee & Schwarz, 2012). Yet, the connection between fish and trust consists solely in the metaphoric expression of "something smelling fishy" for untrustworthiness.

Apart from its distinct mode of activation, modal priming operates similar to priming more generally (Lee & Schwarz, 2012; Meier, Schnall, et al., 2012). Specifically, the bodily manipulation increases the accessibility of associated concepts, making them more likely to be used in subsequent tasks (Loersch & Payne, 2011). Importantly, accessible concepts can be used to either construct a target or a standard of comparison (Bless & Schwarz, 2010; Schwarz & Bless, 1992), leading to assimilation or contrast effects respectively. Also, they can be discarded altogether when they are attributed to a source that is irrelevant for the task at hand (see also Wheeler, DeMarree, & Petty, 2007 for a similar account).

However, modal priming might be different from other forms of priming regarding the flexibility of attribution. Take a person who washes herself; she gets clean, maybe even cleaner than her surroundings. Thus, physically cleansing oneself is a specific activation of the cleaning concept, namely with oneself as a target, while activating the semantic concept of cleanness might refer to anything and could thus lead to oneself being perceived as rather less clean than one's surroundings. Therefore, modal priming is more specific than semantic priming in what it refers to, what it can be attributed to.

Like the example about cleaning, many embodiment manipulations have a clear origin in terms of the source of the feeling. The sensation either originates from an external object or from the self, and in general, humans are well-aware of the difference (Glenberg et al., 2013). This might be an essential difference between modal and conceptual priming. If people are aware of what an activated concept refers to, they should judge themselves according to the activated concept (in case of interoceptive sensations) or contrasting to the activated concept (in case of external sensations). If on the other hand, the change in accessibility was induced by

less "organic" means, for example by semantic priming, its source is more easily attributed to many different sources. Therefore, the attribution of accessible information could be rather less flexible in modal priming than in other forms of priming.

Up to now, evidence for a difference between embodied and conceptual priming is scarce. In the context of embodied cleansing (Lee & Schwarz, 2010b; A. J. Xu, Zwick, & Schwarz, 2012) conceptual priming has been used as a control condition. While participants in the embodiment condition used a cleaning product on their hands, participants in the control condition examined the cleaning product without using it, and therefore also experienced an activation of the cleaning concept. Yet, only actually cleaning oneself annihilates the influence of the previously induced state (Lee & Schwarz, 2010b; A. J. Xu et al., 2012). For similar findings in other content domains, see Adam and Galinsky (2012) and Schneider et al. (2011). Somewhat differently, L. Schubert, Schubert, and Topolinski (2013) found that elevating a target person can result in different evaluations of that person depending on whether participants see the person only on a computer screen or face them in a real life setting, where they get the embodied sensation of looking up to the target. But to test the hypothesis that modal priming is less flexibly attributed compared to other forms of concept activation, research needs to be done that directly tests flexibility of attribution. For that, the effect of subtle attribution manipulations in modal and semantic priming could be compared.

Directly derived from the spreading activation idea, modal priming embodiment effects should in general (though not necessarily always) be bidirectional. This means that in addition to bodily states activating abstract concepts, activating abstract concepts also affects modal states. Thus, while a fishy smell activates the concept of suspiciousness, inducing suspicion also lowers the sensory threshold to detect fishy smells (Lee & Schwarz, 2012). Similarly, walking slowly activates the elderly concept (Mussweiler, 2006), while, conversely, activating the elderly concept decreases walking speed (Bargh, Chen, & Burrows, 1996). Although some studies have convincingly argued for the unidirectionality of some effects from concrete to abstract but not vice versa (e.g. Boroditsky, 2000; Casasanto & Boroditsky, 2008) and conceptual metaphor theory predicts unidirectional effects (Lakoff & Johnson, 1980, 1999), the majority of metaphoric effects have been shown to work bidirectionally; and for priming as a general mechanism, bidirectionality is rather the rule than the exception.

A similar analogy holds for *modal* and *semantic priming* to the previously described analogy of *direct state induction* and *mindset priming*. As long as a concept is activated and attributed to one's own judgment about a currently perceived stimulus, similar effects result whether the concept is activated semantically or physically (IJzerman & Semin, 2010; see also DeWall & Bushman, 2009; Dimmock, Jackson, & Clarke, 2013). From this analogy follow some properties of *modal priming* and *direct state induction*: modal priming influences specific associated concepts while di-

rect state induction affects a broader range of behaviors. Moreover, the time course should differ. While content activated through priming gets deactivated quickly, altered information processing generally lasts longer after the manipulation has ceased (Smith & Branscombe, 1987).

2.3 Mechanism 3: Sensorimotor Simulation

Perceiving a stimulus automatically triggers the simulation of interacting with it (Barsalou, 1999, 2008). For instance, seeing objects that afford handling evokes the simulation of grasping (Tucker & Ellis, 1998), reading words elicits the simulation of pronunciation (D'Ausilio et al., 2009; Fadiga, Craighero, Buccino, & Rizzolatti, 2002; Topolinski & Strack, 2009b), and reading sentences leads to a multi-sensory simulation of the experiential content (Fischer & Zwaan, 2008). This automatic simulation is very similar to the action or sensation itself—even employing the same brain regions (Gallese, 2007). Taking this notion farther, mental representation might essentially be "the reenactment of previous experiences" (Pecher & Winkielman, 2013, p. 396).

As a result, actions that are congruent with the simulated action are facilitated while incompatible actions are hampered. The same holds for sensations. Consequently, one way of showing automatic simulation is showing compatibility of the simulation with another task. For example, a button has to be pressed with the left or right hand to indicate whether a depicted object is upright or inverted. Some aspect of the movement is compatible or incompatible with the automatic simulation—in the present example, the hand (left vs. right) to be used for classification with the position (left vs. right) of the object's handle. Compatible movements—e.g., responding with the left (vs. right) hand to an object with its handle on the left (vs. right) side—are faster and more accurate than movements that are incompatible and therefore interfere with the automatic grasping simulation (Tucker & Ellis, 1998; see also Bub, Masson, & Lin, 2013; Ellis & Tucker, 2000; Tucker & Ellis, 2001, 2004; Symes, Ellis, & Tucker, 2007).

Using similar experimental methods, simulation has been shown to play a causal role in the processing of sensorimotor stimuli in general. When processing action words or sentences, not only responsible effectors are activated (Buccino et al., 2005; Hauk, Johnsrude, & Pulvermüller, 2004; Tettamanti et al., 2005; see also Fadiga et al., 2002), but also more specific aspects like the sagittal or rotational movement direction (Borreggine & Kaschak, 2006; Glenberg & Kaschak, 2002; Glenberg et al., 2008; Matlock, 2004; Zwaan & Taylor, 2006). Moreover, perceptual properties like shape, orientation, location, color, texture, sound, scent, or taste of objects are also simulated (Connell, 2007; Goldberg, Perfetti, & Schneider, 2006; González et al., 2006; Lacey, Stilla, & Sathian, 2012; Richardson, Spivey, Barsalou, & McRae, 2003; Simmons et al., 2007; Stanfield & Zwaan, 2001; Zwaan, Stanfield, & Yaxley, 2002;

see also Van Dantzig, Pecher, Zeelenberg, & Barsalou, 2008; Pecher, Zeelenberg, & Barsalou, 2003, 2004; Solomon & Barsalou, 2004). This extensive set of simulated properties suggests a rich experiential simulation of a scene—even when isolated sentences are read without context that would invite immersion in a text.

Simulation has also been shown to play a role in social interactions. Understanding actions in others involves simulations in respective modality-specific systems. Indeed, a network of brain regions (sometimes referred to as mirror-neuron system) is activated both when an action is performed and when it is observed in others (Buccino et al., 2001; Gazzola & Keysers, 2009; Rizzolatti & Craighero, 2004; S. M. Wilson, Saygin, Sereno, & Iacoboni, 2004). Evidence for a causal role of these brain regions in action understanding comes from lesion studies and rTMS studies (e.g., Pazzaglia, Pizzamiglio, Pes, & Aglioti, 2008; Pobric & de C Hamilton, 2006; Urgesi, Candidi, Ionta, & Aglioti, 2007). For example, temporarily impairing participants' hand (vs. lip) area of the premotor cortex (by repetitive transcranial magnetic stimulation) increases error rates in understanding pantomimed hand (vs. lip) actions (Michael et al., 2014).

Simulation has also been shown to play a causal role in various other mental faculties, such as memory (Shebani & Pulvermüller, 2013; Yang, Gallo, & Beilock, 2009), processing emotion (Foroni & Semin, 2009, 2012; Havas, Glenberg, & Rinck, 2007; Niedenthal, Winkielman, Mondillon, & Vermeulen, 2009; Oberman, Winkielman, & Ramachandran, 2007) or representing meaning (Klatzky, Pellegrino, McCloskey, & Doherty, 1989; Zwaan & Taylor, 2006)—even the meaning of abstract contents (e.g., information transfer, Glenberg & Kaschak, 2002). Moreover, preference and aesthetic appreciation also rely on sensorimotor simulation (Leder, Bär, & Topolinski, 2012; Sparenberg, Topolinski, Springer, & Prinz, 2012; Topolinski, Maschmann, Pecher, & Winkielman, 2014), and specifically its fluency (Beilock & Holt, 2007; Topolinski & Strack, 2009b).

Automatic simulation depends on previous experience and skills (Beilock, Lyons, Mattarella-Micke, Nusbaum, & Small, 2008). Accordingly, participants trained in a specific movement are better than untrained participants at visually recognizing similar movements (Casile & Giese, 2006). And participants with severe spinal cord injury show impaired detection of similar biological motion (Arrighi, Cartocci, & Burr, 2011). Moreover, young children learn about goal directed object manipulations in other people by learning to interact with objects themselves (Sommerville, Woodward, & Needham, 2005; see also Campos et al., 2000; Held & Hein, 1963; for an application of the understanding-as-enactment idea in teaching, see, for example, Broaders, Cook, Mitchell, & Goldin-Meadow, 2007; Goldin-Meadow, Cook, & Mitchell, 2009; Kontra, Goldin-Meadow, & Beilock, 2012; Novack et al., 2014).

A unique feature of the simulation mechanism is that it works offline, that is, in absence of the particular bodily state or action that is simulated (M. Wilson, 2002;

see also Niedenthal et al., 2005). A stimulus is processed and elicits a simulation even without any particular sensorimotor state; this simulation—its ease or the associated sensorimotor activity—affects information processing, judgment, and behavior. From this property it follows that a bodily manipulation can be used to both facilitate and interfere with the simulation (e.g., Beilock & Holt, 2007; Elder & Krishna, 2012).

Crucially however, the influence of the simulation holds only while the simulation takes place. That is, this mechanism has no aftereffects. In this respect it differs from the other two mechanisms: in the first two mechanisms, the embodiment mechanism changes the psychological state or the accessibility of some concepts for some little time. Here, the manipulation does not change the psychological state directly. It only interferes with a simulation triggered by information processing, and does so only for as long as the simulation takes place. Thus, sensorimotor simulation effects should be sensitive to slight timing variations.

2.4 The Role of Conscious Inferences

In addition to the three automatic mechanisms discussed above, inferential processes also play a role in some embodiment effects. This means the bodily state or action is consciously perceived as such and some kind of inference is drawn, resulting in the embodiment effect. One such inferential process could be *self-perception*. However, self-perception has usually been ruled out as a driving mechanism in embodiment by the use of unobtrusive bodily manipulations and elaborate funneled debriefings.

An example where the influence of self-perception has been tested explicitly concerns leaning forwards or backwards (Chisholm, Risko, & Kingstone, 2013). Here, leaning direction without conscious inferences about one's orientation did not influence concentration. Only when participants were instructed to lean forwards or backwards as if focused or unfocused, did reliable differences on performance emerge (Chisholm et al., 2013).

Inferential processes can also influence the accessibility of concepts. A conscious classification of an action that is inherently ambiguous can be necessary for the activation of a concept, and thus for spreading activation to a related concept, to occur. For example, clothes make the man—depending on man's interpretation of the clothes: Wearing a white coat increases participants' performance in attention-related tasks when the coat is introduced as a doctor's coat compared to a painter's coat (Adam & Galinsky, 2012; see also Boroditsky & Ramscar, 2002; Casasanto & Dijkstra, 2010; Haazebroek, van Dantzig, & Hommel, 2013 for similar notions about the influence of a movement's subjective meaning).

Conscious inferences can also influence, even reverse, compatibility effects of sensorimotor simulation. In general, changing distance leads to a compatibility effect with the valence of a stimulus (i.e., moving towards a positive stimulus and away from a negative one are faster than vice versa) (e.g., M. Chen & Bargh, 1999; Solarz, 1960). However, giving a different meaning to the same behavior can reverse the effect (Eder & Rothermund, 2008; Markman & Brendl, 2005; Seibt, Neumann, Nussinson, & Strack, 2008). Interestingly, when combining recategorization of the behavior and automatic tendencies to increase or decrease distance, both factors yield compatibility effects (Krieglmeyer, Deutsch, De Houwer, & De Raedt, 2010).

One might argue that inferential processes should not be included in a list of embodiment mechanisms. Although in inferential processes the body is used as a source of information, the information processing is essentially amodal; this means the sensory information is perceived, re-described in abstract amodal symbols, classified and used in (propositional) reasoning. Thus, here the sensory information about the bodily state is processed in a manner incompatible with embodiment. And indeed, one essential feature of most embodiment experiments is an elaborate cover story that prevents participants' conscious classification of their current embodied state or action. Then why include an amodal embodiment mechanism? Because, as will follow shortly, many embodiment effects are not process-pure. They are not driven by one single mechanism, but rather several mechanisms can contribute (to varying degrees) to one embodiment effect. Thus, inferential processes and automatic embodiment effects interact in various ways.

2.5 Mixed Forms

So far, I have explained mechanisms that contribute to embodiment effects and have tried to illustrate them with exemplary effects. These effects were chosen to demonstrate the characteristic properties of the mechanisms. For some of them, there is empirical evidence for the proposed mechanism; in other cases, the respective mechanism has been proposed without empirical prove. In any case however, I do not assume that all or even most effects are process-pure. On the contrary, I assume that more often than not, effects are influenced by more than one of the above mentioned processes.

A way of showing that cognitive inferences and simulation can interact involves providing labels for automatically simulated stimuli. Facial expressions on pictures are automatically mimicked (Dimberg, 1982; Dimberg, Thunberg, & Elmehed, 2000; Hess & Blairy, 2001; Wallbott, 1991). However, this automatic mimicry tends to resemble to some degree emotional labels given to that expressions (Halberstadt, Winkielman, Niedenthal, & Dalle, 2009). Thus, both processes influence viewers' facial expressions: automatic simulations of seen faces and conscious inferences

about what theses faces show.

Concerning the influence of weight on importance judgments, the two most plausible—and most discussed—underlying mechanisms are modal priming and sensorimotor simulation; and indeed, both seem to be at work. Modal priming seems reasonable because weight and importance are connected by metaphors in many languages; for example, an opinion can "carry weight" (Jostmann et al., 2009). The sensation of a large weight could increase the accessibility of the concepts "importance" or "difficulty", which, in turn, could make those concepts more likely to be used when making judgments. And indeed, M. Zhang and Li (2012) discuss spreading activation as mechanism and suggest that the influence of weight on importance judgments is mediated by semantic activation of the weight concept (measured by reaction times in a lexical decision task). Moreover they found similar results from carrying weight and semantic weight priming.

On the other hand, importance might be (at least partly) grounded in simulating carrying a heavy object. That is, when thinking about importance and difficulty, people might automatically simulate the physical strain involved in holding a heavy object. Thus, simulation might be the mechanism by which importance and weight are connected, as suggested by Schneider et al. (2011) and Häfner (2013). According with the simulation idea, interoceptive awareness moderates the influences of weight on judgments: greater interoceptive awareness augments the influence of weight on judgment (Häfner, 2013). Simulation should be facilitated by weight experiences in a greater degree for people with a strong perception of this weight experience compared to people who hardly notice bodily changes. Therefore, simulation can explain the moderation by interoceptive awareness, while a priming explanation cannot (Häfner, 2013). Moreover, Slepian and Ambady (2014) found different weight estimates after one-time exposure to a new weight-related metaphor which, they argue, speaks against priming as a mechanism because the formation of new associations needs repeated pairings of the stimuli.

2.6 Disentangling the Mechanisms

The current topology of mechanisms in embodiment does not only parsimoniously cover the bulk of existing embodiment effects with a few basic principles, it also provides empirical tests of their respective contributions to a given phenomenon. And whenever more than one mechanism can plausibly explain an embodiment effect, testing their relative contribution seems important. In some embodiment effects, e.g., regarding the mechanism of power postures, the relative influence of the different underlying mechanisms is not clear yet. In others, there is some evidence for or against the working of specific mechanism.

For example, concerning the influence of horizontal position on valence judgments, stored associations (i.e., priming) and automatic simulation and the hedonic quality of its fluency have been pitted against each other (Casasanto, 2009). In linguistic expressions, good (vs. bad) and right (vs. left) are associated (e.g., "right hand man", "linke Nummer", "cero a la izquierda"). At the same time, for the right-handed majority of people, interacting with objects on their right is more easily simulated, because it is more fluent. Both processes could explain why people generally favor objects on their right side (Casasanto, 2009; Casasanto & Chrysikou, 2011; de la Vega, Dudschig, De Filippis, Lachmair, & Kaup, 2013; Jasmin & Casasanto, 2012; Shen & Sengupta, 2012; see also Brunyé, Gardony, Mahoney, & Taylor, 2012; de Nooijer, van Gog, Paas, & Zwaan, 2013). In contrast, for left-handed people and people who experienced a reversal of their "body side fluency", the two mechanisms predict contradicting effects. While linguistic associations remain unchanged, simulation should favor a reversed mapping, namely "left is good and right is bad". As the latter mapping prevails, simulation predominates over modal priming in influences of horizontal position on valence (Casasanto & Chrysikou, 2011).

Another embodiment effect where experimental evidence on the underlying mechanism exists concerns the so-called pen manipulation (Strack, Martin, & Stepper, 1988). Here, participants hold a pen either between their teeth with their lips not touching the pen, facilitating smiling, or between their lips, inhibiting smiling. While the smile facilitation condition yields higher funniness ratings of cartoons compared to a neutral control condition, inhibited smiling yields lower funniness ratings (Strack et al., 1988).

The pen manipulation could reasonably be based on all three proposed mechanisms. First, operating through direct state induction, smiling might improve mood. Yet, when assessing participants' affective state, generally no influence of the pen manipulation can be detected (Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001; Strack et al., 1988). Therefore, the pen manipulation works not through altering participants' mood. Second, operating through modal priming, smiling could activate concepts associated with fun and positive emotions, which could, in turn, lead to changes in funniness ratings. However, this is also unlikely to be the case, as holding a pen between one's teeth does not lead to faster responses for positively valenced words in a lexical decision task (Havas et al., 2007). Third and most likely, automatic simulations of subtle smiling could be triggered when evaluating funniness. These smiling simulations are facilitated or inhibited by the pen manipulation, leading to respective effects on evaluations (Havas & Matheson, 2013). Moreover, only sensorimotor simulation explains the decrease in funniness ratings by an inhibition of smiling compared to a no-interference control condition.

2.6.1 Testing Direct State Induction

Direct state induction consists in the activation of a global psychological state, emotion, motivation, or mindset, which allows for the following tests.

Presence of the induced state. As its name says, the most straightforward test of direct state induction is assessing the presence of the induced state. Recurring to the smile facilitation example, smiling could improve positive mood which could lead to cartoons being judged funnier. But as the effect on cartoon judgment has been repeatedly observed without concurrent mood change, this mechanism is unlikely. Of course, assessing the focal state depends on the measure's sensitivity—for instance, the smile induction might elicit affect too subtle to be caught by mood reports—and agreement on what the state might be—for instance, the focal state for expanded posture could be the feeling of power or pride or some related state.

Thus, as long as it is not clear, which is the basic state that is induced by the posture, the proposed test of measuring the induced state is not conclusive. For example, unless one assumes that more risk-seeking behavior is a direct consequence of an expanded posture, showing its context-sensitivity gives no evidence against expanded posture directly altering a psychological state (cf., Cesario & McDonald, 2013). Therefore, for the current debate about whether expanded posture directly alters participants' state or whether the observed effects are rather due to modal priming or some other mechanism (Cesario & McDonald, 2013; L. Huang et al., 2011; L. E. Park, Streamer, Huang, & Galinsky, 2013), it is essential to find out which psychological state is supposed to be directly induced. Moreover, where no generally agreed upon test exists, as in the case of motivational orientation, a direct test of the state is likewise impossible. Still, if the proposed state indeed varies with the manipulation, and if this variation statistically mediates the effect of the manipulation on the dependent measure, then direct state induction seems responsible for producing the embodiment effect at hand.

Universal state induction. As direct state induction does not rest on stored semantic or linguistic associations, inducing a certain sensorimotor state should invariably result in a similar state change—across languages, cultures, and other factors that shape semantic memory. Thus, cross-cultural replications of the same effect speak in favor of direct state induction. In contrast, particularly modal priming, often involving culturally idiosyncratic language metaphors, should be substantially modulated by culture (see the next section).

Diversity of the consequences. Usually, states induced by embodiment are global psychological states, such as emotions or motivational orientations, prompting a

broad variety of cognitive, affective, and behavioral consequences. Thus, the scope of impact should usually be broader for direct state induction than for the other mechanisms—particularly concerning consequences in content-domains not connected to the bodily manipulation. For instance, the link between arm movements and performance in the Stroop task (Koch et al., 2008) cannot be explained by semantic associations.

2.6.2 Testing Modal Priming

Modal priming generally conforms to the rules of spreading activation in a multimodal associative store (Strack & Deutsch, 2004), which allows for the following tests.

Activation of concepts. In modal priming, embodiment manipulations invariably activate associated concepts. Indeed, this concept activation is thought to mediate any effects. Therefore, the most direct test is to measure concept accessibility, for instance, via a lexical decision or word stem completion task. In the case of suspicious behavior increasing the detection of fishy smell, Lee and Schwarz (2012) show that suspicious behavior increases the accessibility of the concept of distrust; this, in turn, activates fish related concepts which increases the likelihood of labeling a fishy smell as such (Lee & Schwarz, 2012). Thus, although in this case the different steps in the argumentative chain were measured in different experiments so that no mediation analysis is possible, the pattern suggests modal priming as the mechanism for the effect of suspicion on fish smell detection. If the concepts supposedly mediating an embodiment effect are not activated by the manipulation, modal priming is an unlikely mechanism—as in the case of no heightened accessibility of positive valence words by the pen manipulation (Havas et al., 2007). In contrast to the rather broad affective, cognitive, and behavioral consequences following direct state induction (see the previous section), concept activation should be relatively more narrow and specific and always traceable through associative links.

Dependence on associative structures. As any other priming form, modal priming depends on the architecture of the associative network and thus on cultural, linguistic, biographic, and many other factors shaping this associative structure. Therefore, for example, cultural practices, linguistic metaphors, expertise, and interindividual differences should influence the presence and direction of modal priming effects. This is, for instance, the case for the mental representation of time which varies with linguistic metaphors in a culture. Specifically, the association between time (past vs. future) and body orientation (in front of vs. behind), exists in cultures using metaphors like "the future lies in front"(Boroditsky, 2000; Boroditsky & Ramscar, 2002; Miles, Nind, & Macrae, 2010), but are replaced by different

associations in cultures like the Pormpuraawans who associate time with cardinal direction (Boroditsky & Gaby, 2010).

Arbitrariness and flexibility of associations. One unique feature of modal associations is that they can be arbitrary. Although for many associations an ecological connection might be construed (e.g., physical warmth could be evolutionarily associated with interpersonal closeness, Williams & Bargh, 2008), this is not necessarily the case. Arbitrary cultural conventions, for instance, showing hostility by extending one's middle finger (Chandler & Schwarz, 2009), can form strong associations via learning and thus yield embodiment effects (for another example, see Topolinski & Sparenberg, 2012). Expanding this idea, Topolinski (2011) found an association between participants' preferences for phone numbers (when typing them on a mobile phone) and the meaning of words with the same key sequence—a completely arbitrary connection. Furthermore, these associations can be transformed via learning, so that experimental conditioning of associations should alter embodiment effects that rest upon modal priming. In contrast, the bodily conditions in direct state induction are rather phylogenetically shaped and rigid states.

Bidirectionality. Bidirectionality has sometimes (e.g., Schneider et al., 2011; Slepian & Ambady, 2014) been suggested as a criterion for distinguishing between simulation-based and priming-based explanations, with unidirectionality speaking for priming, while bidirectionality indicating simulation as a mechanism. As already stated, conceptual metaphor theory (CMT) (Lakoff & Johnson, 1999) only predicts effects from the concrete to the abstract concept. Setting CMT aside, with priming as a more general psychological mechanism, bidirectionality is perfectly plausible. Therefore, bidirectionality, or a lack thereof, does not speak for or against any embodiment mechanism.

2.6.3 Testing Sensorimotor Simulation

Simulation takes place automatically, in the absence of the sensation or action that is simulated, which allows for the following tests.

Interference and facilitation. The unique feature of sensorimotor simulation is its susceptibility to interference and complete blockade (e.g., Beilock & Holt, 2007; Topolinski & Strack, 2009b). Thus, to test simulation, a concurrent task that engages the same sensorimotor resources as the simulation should interfere with the simulation. If an effect relies partly on simulation, the effect should be diminished under such interventions. For example, participants with blocked frowning muscles are slower to read negative emotional sentences (Havas, Glenberg, Gutowski, Lucarelli,

& Davidson, 2010). Similar conclusions have been drawn from lesion studies and experiments that temporarily disrupted brain regions involved in sensorimotor simulations (e.g., Adolphs et al., 1999; Calder, Keane, Manes, Antoun, & Young, 2000; Goldenberg & Karnath, 2006; Pobric & de C Hamilton, 2006).

Note that a facilitated simulation effect is not as strong support for simulation as an inhibited simulation effect. Both effects would be expected when simulation contributes to an effect, but facilitation could also be explained by modal priming while inhibition could not. Having all three conditions in the same experiment (i.e., facilitation, inhibition, and a neutral condition, where simulation is neither facilitated nor inhibited) constitutes a strong test for simulation. Even more so, as alternative explanations (e.g., distraction) are ruled out if the manipulations for interference and facilitation are similar.

Training. Another—and where feasible particularly neat—test for simulation consists in influencing the fluency of the simulation. Participants trained in a specific movement are better than control participants at simulating that movement, and consequently profit at related tasks (Casile & Giese, 2006; Leder et al., 2012; Topolinski, 2010). If simulation fluency is altered by training a more disfluent action or "untraining" a more fluent action, like for example the reversal of the body-side fluency by Casasanto and Chrysikou (2011), this altered fluency should also influence the embodiment effect if the effect relies on fluency. This kind of temporarily altering fluency by training has the advantage that no manipulation has to be present in the test-phase where the effect is measured. Moreover, for an untraining of the more fluent simulation priming accounts would rather make the opposite prediction form simulation, as the untraining increases frequency of prior concept activation and thereby should lead to an increase in accessibility.

2.7 Chapter Summary

In the present Chapter, I have elaborated three basic psychological mechanisms for how the human body, its actions and states, can influence human cognition and behavior—each with distinct properties and distinct consequences. Crucially, these mechanisms and their joint impact can account for all existing embodiment effects, irrespective of psychological sub-discipline. Additionally, I have derived empirical standards for how the working of each of these mechanisms can be tested for a given effect. With that, I aim to provide a guideline for research targeted at understanding the operating mechanisms that drive embodiment. A systematically spelled-out distinction of underlying processes with tests to distinguish the processes is vital when trying to resolve debates about what might cause a certain embodiment effect.

The main aim of the following chapters is to contribute to our understanding of embodiment by examining one specific effect more closely—embodied cleansing. I chose to examine embodied cleansing as a model embodiment effects for several reasons: First, a number of independent research groups had already observed embodied cleansing which I took as a sign that it is easy to replicate. Second, a purely accessibility driven explanation seemed unlikely, as a difference between cleaning oneself and priming the concept of cleaning had already been shown; therefore, a start on determining underlying processes had already been made. Finally from a practical perspective quite a few interesting factors seemed manipulable which promised the chance of precisely determining necessary and sufficient factors for embodied cleansing effects.

After a detailed overview of the current state of knowledge regarding embodied cleansing in the next chapter, I will discuss potentially underlying mechanisms of embodied cleansing, namely *direct state induction* and *modal priming*. In Chapter 4, I will present experiments testing the idea that possibly both mechanisms might contribute at the same time. In Chapter 5, I will present experiments that examine embodied cleansing regarding performance-related self-esteem. The aim is to find out which features of the hand washing action are instrumental in producing embodied cleansing and what can be learned from that about the mechanisms that drive embodied cleansing.

Chapter 3

Embodied Cleansing

In this thesis, I report several studies about embodied cleansing. The basic idea in embodied cleansing is that cleaning the body affects the mind. It influences moral judgments and moral behavior—through morality's being influenced by disgust, and disgust being alleviated by purity. But it also influences non-moral domains—through the metaphor of wiping the slate clean.

In the following, I will first explain the possible sources of a connection between physical cleaning and its psychological consequences. Then, I will give an overview on the empirical support for this connection and derive two possibly separate explanations for embodied cleansing findings, which will be tested in Chapter 4.

3.1 Theoretical Accounts for Embodied Cleansing

3.1.1 Physical and Moral Disgust

Disgust is generally assumed to have originated as a food-related emotion (Darwin, 1872; Haidt, Rozin, McCauley, & Imada, 1997; Rozin & Fallon, 1987; Rozin, Haidt, & Fincher, 2009). Things are considered disgusting if they are contaminated or may contaminate food by contact (e.g., animal—including human—products). Contaminants elicit nausea and avoidance behavior, thereby preventing people from ingesting these potentially noxious substances (Curtis & Biran, 2001). Thus, disgust keeps humans safe from disease (Chapman & Anderson, 2013; Schnall, Benton, & Harvey, 2008). An extension of this so-called *core disgust* is *animal reminder disgust* (Haidt, McCauley, & Rozin, 1994; Rozin & Fallon, 1987). Bodily aspects that remind us of our animal nature, of functions that we share with other animals, elicit disgust, for example body violations, sexual "deviance", or poor hygiene.

Bodily hygiene is one of the cultural practices to deal with, and supposedly keep a lid on, our animal nature, by regulating the proper use and maintenance of the human body (Oaten, Stevenson, & Case, 2009; Rozin, Haidt, & McCauley, 2008). Accordingly, hand washing behavior, as a basic hygienic action, can be efficaciously fostered by disgust-based interventions (Porzig-Drummond, Stevenson, Case, & Oaten, 2009). On a more cognitive level, feeling disgusted by touching fake disgusting objects (like a plastic bag filled with food mash resembling vomit) orients participants' attention towards cleaning-related pictures (Vogt, Lozo, Koster, & De Houwer, 2011). As another indication for a connection between disgust and cleanliness, greater disgust sensitivity increases participants' detecting slight violations of purity (Sherman, Haidt, & Clore, 2012).

However, not only physical objects but also socially noxious behavior elicits disgust, across a range of cultures (Curtis & Biran, 2001; Haidt et al., 1997). Violations of important social relations, like abandoning one's elderly parents, hypocrisy, moral violations, or differing political attitudes are often labeled as disgusting (Haidt et al., 1997). Yet these behaviors generally do not involve ingestion or food. Often they do not even involve the body. Still, it is no mere polysemy that both physical and moral disgust are called disgust. Both on an emotional and on a behavioral level, people experience moral transgressions as disgusting (Schnall, Haidt, Clore, & Jordan, 2008), react by feeling nauseated (Royzman, Leeman, & Sabini, 2008) and show avoidance behavior (Rozin et al., 2008; Rozin, Haidt, McCauley, Dunlop, & Ashmore, 1999). Additionally, the two forms of disgust share overlapping brain areas (Borg, Lieberman, & Kiehl, 2008; Moll et al., 2005), and elicit the same facial expressions (Chapman, Kim, Susskind, & Anderson, 2009; Cannon, Schnall, & White, 2011).

Moreover, the different kinds of disgust have been shown to influence each other. Being confronted with physically disgusting surroundings (e.g., a disgusting room or bad smell), leads to more severe condemnation of the violation of social norms, for example, eating one's dead pet or keeping cash from a found wallet (Schnall, Haidt, et al., 2008). Other incidental sources of disgust yield comparable results (Eskine, Kacinik, & Prinz, 2011; Horberg, Oveis, Keltner, & Cohen, 2009; Schnall, Haidt, et al., 2008; Wheatley & Haidt, 2005). Additionally, people high in disgust sensitivity are more likely to condemn crime (Jones & Fitness, 2008), purity-related transgressions (Horberg et al., 2009), suicide (Rottman, Kelemen, & Young, 2014), and homosexuality (Inbar, Pizarro, Knobe, & Bloom, 2009; see also Dasgupta, DeSteno, Williams, & Hunsinger, 2009). Similarly, higher germ-aversion leads to more out-group stereotypes when contamination is salient (J. Huang, Sedlovskaya, Ackerman, & Bargh, 2011). The converse direction of influence has been shown as well, in that moral transgressions were found to increase judgments of physical disgust (Eskine et al., 2011; Ritter & Preston, 2011; Skarlicki, Hoegg, Aquino, & Nadisic, 2013).

In sum, findings suggest that physical disgust and moral disgust are closely related. Eliciting one form of disgust seems to predispose a person to experience the other form of disgust as well. Similarly, as physical cleanliness was shown to alleviate physical disgust (van den Hout, Engelhard, Toffolo, & van Uijen, 2011), this alleviated disgust might influence one's views on immoral behavior. Thus, the influence of hygiene on physical disgust, and of physical disgust on moral judgments, provides a plausible rationale for a connection between hygiene and morality: by alleviating disgust, physical cleanliness might influence moral judgment and behavior.

3.1.2 Metaphors of Dirt and Cleansing

In addition to the influence via disgust, there is another possible connection between physical cleanliness and morality: metaphoric associations. When we talk about morality, we often use expressions related to cleanliness and purity. For example, a "clean conscience" indicates feeling free from guilt, and "dirty tricks" are unfair. The adjectives "rotten" and "filthy" are more often used to describe something as ethically wrong than as physically spoiled or dirty; similarly "corruption" and "decay" rarely refer to biological decomposition. Indeed, a great number of metaphoric and literary expressions associate being dirty with being immoral, being clean with being moral, and the act of cleaning with removing moral "stains".

Many cultural practices are consistent with this link between physical and moral purity. The Indian caste system promotes social segregation in order to prevent "pure" groups from being "polluted" by contact with "impure" people (e.g., Milner, 1994). Additionally, in most religions, washing rituals are essential to purify the soul (Burschel & Marx, 2011). For example, baptizing, as a form of symbolic cleansing, is important for Christians, Sikhs, and Hindus; and for Muslims, ritual washing is prescribed prior to worship.

According to conceptual metaphor theory (Lakoff & Johnson, 1980, 1999; see also Landau et al., 2010), metaphors are no mere linguistic devices. Instead, linguistic metaphors can usually be organized into coherent systems. For instance, all metaphors mentioned above indicate that immorality is like dirt. Thus, linguistic metaphors reflect conceptual metaphors (Lakoff & Johnson, 1980). This means, linguistic metaphors reflect underlying cognitive organizations, that is, people's conceptions of the world around them (Landau et al., 2010). Put plainly, to the degree that immorality and dirt are cognitively associated, our thinking about morality should reflect our thinking about dirt.

More generally, according to conceptual metaphor theory, metaphors are cognitive tools that people use to understand abstract concepts in relatively easier to understand concrete concepts (Lakoff & Johnson, 1980). The two—the concrete

concept and the abstract concept—are associated by conceptual mapping where corresponding elements of the concepts are mentally associated. Through these associations, pieces of knowledge about the concrete concept can be used as a framework for reasoning about the abstract concept (Lakoff & Johnson, 1980, 1999). Relations of corresponding aspects as well as properties get transferred from one concept to the other.

In the case of dirt and immorality, transferred properties include permanence and contagion (Zhong & House, 2014). "Washing away one's sins", for example, refers to the non-permanence of guilt. Dirt can be removed and this property is transferred to moral transgressions. Similarly, contagiousness holds for dirt as well as immorality. Like clean objects get contaminated by contact with dirty objects, and therefore are usually kept away from contaminants, people try to avoid contact with immoral persons, for fear of its "rubbing off". This can lead not only to avoiding contact with immoral persons, but even to avoiding contact with objects allegedly once owned by an immoral person, like the helmet of a Nazi-officer (Rozin et al., 1999) or a laundered sweater previously worn by a murderer (Rozin, Markwith, & McCauley, 1994). Thus, concrete bodily concepts are mapped onto more abstract concepts and their properties get matched and transferred. And this mapping influences not only language but also our experiencing and thinking about abstract concepts. Indeed, experiments show that influencing bodily states leads to systematic changes in associated abstract concepts, thereby supporting conceptual metaphor theory, see Chapters 2.2 and 3.2.

Interestingly, some metaphoric expressions associate dirt and cleaning with morally neutral concepts. For example, a "quick and dirty solution" to a problem is usually imperfect, but not in any moral sense of the word but rather technically imperfect. More generally, "dirty" can refer to non-standard constructions, that is atypical objects or arrangements (Lizardo, 2012). Similarly, cleaning can be associated with removing morally neutral things, such as in the expression "to wash one's hands of" something, which indicates a dissociation between oneself and the "something", a reestablishment of a standard, ordinary state by removing the non-standard aspect. This altered metaphoric meaning of cleaning is also used in literature; for example, "For world's judgment, I wash my hands thereof. For man's opinion, I defy it" from Charlotte Bronte's *Jane Eyre* (1847/2012, chap. 23). Moreover, cleaning as neutralization is also reflected in cultural practice. For example, in the Dai festival in parts of Southeast Asian countries, sprinkling water on people is meant to remove ethical misdeeds, but also worries and misfortunes—non-moral negative states (Yan, Ding, & Yan, 2011).

This association of cleaning with reestablishing a standard state of mind poses the possibility that those linguistic metaphors might reflect another conceptual metaphor in the human mind, termed *clean slate metaphor* (Lee & Schwarz, 2011). Though clean slate expressions are probably not as frequent as metaphors of moral

cleanliness, they might still reflect a conceptual mapping in the human mind. And if so, then influencing bodily cleanness might not only influence morality but might also lead to a more general neutralization of the past.

In sum, the association between cleaning and morality is supported by the *moral purity metaphor* and additionally by an association via disgust. The association between cleaning and a neutralized state of mind is supported by the *clean slate metaphor*. In one sense, the *clean slate metaphor* can be seen as an extension of the *moral purity metaphor*. Both imply a removal of negative moral taints by cleaning, but the clean slate metaphor more broadly implies a removal of the remnants of the past whether immoral or unrelated to morality. Moreover, the clean slate metaphor is not even restricted to negatively valenced influences. When wiping the slate clean, positive states should vanish as much as negative ones. See Chapter 3.3 for a detailed discussion about the two embodied cleansing explanations.

3.2 Empirical Evidence for Embodied Cleansing

3.2.1 Morality–Cleanliness Link

On a purely conceptual level, there is an association between morality and cleaning. Cleansing words are more accessible for participants reminded of some immoral behavior they committed in the past compared to participants reminded of morally positive behavior (Zhong & Liljenquist, 2006). Even reading immoral (vs. neutral) vignettes about unknown people leads to an increased accessibility of cleansing words (Jones & Fitness, 2008). Similar results were found in a semantic priming paradigm (Yan et al., 2011). Moreover, activating the cleanliness concept leads to altered judgments concerning moral transgressions (Helzer & Pizarro, 2011; Schnall, Benton, & Harvey, 2008). Additionally, the concepts of religion and cleanliness are associated. Semantic priming of the concept of religion increases accessibility of cleaning words (Preston & Ritter, 2012).

Another line of research connecting cleanliness and morality concerns *mental contamination*. Mental contamination refers to a feeling of dirtiness and an urge to wash that arise without physical contact with a contaminant (Fairbrother, Newth, & Rachman, 2005; Rachman, 1994). Mental contamination often has a moral quality: feeling contaminated is associated with being a worthless or immoral person. Accompanying emotions include disgust, anxiety, humiliation, shame and contempt (Elliott & Radomsky, 2012; Herba & Rachman, 2007; Rachman, 1994, 2004). Moreover, threatening participants' moral self-worth increases the urge to act in a way that alleviates contamination situations (Doron, Sar-El, & Mikulincer, 2012; see also Abramovitch, Doron, Sar-El, & Altenburger, 2013).

The fear of contamination encompasses social as well as physical contamination. People seem to have an urge to exclude the unclean and the foreign alike (Strejcek & Zhong, 2012). Social segregation is often couched in cleanliness-related terms—outgroups are seen as unclean and socially and morally inferior (Kurzban & Leary, 2001; Markel & Stern, 2002). This can even go so far as to try to extinguish a social group by "ethnic cleansing". Thus, outgroup prejudice seems to some extent based on contamination fear (Faulkner, Schaller, Park, & Duncan, 2004; Navarrete, Fessler, & Eng, 2007; J. H. Park, Faulkner, & Schaller, 2003). Moreover, increasing participants' concern with bacterial contamination debases their attitude towards immigration when the state was described using body metaphors (Landau et al., 2009).

3.2.2 Cleaning Urge

Morality's activation of cleanliness also has behavioral consequences. Participants who feel guilty judge cleansing products to be more attractive and more likely choose them as a gift over another object compared to participants who feel morally good about themselves (Zhong & Liljenquist, 2006, see also Denke, Rotte, Heinze, & Schaefer, 2014; Jones & Fitness, 2008; Kim & Cohen, 2010). A similar effect of product preference can be found in an applied setting. Here, law students and lawyers who, for legal reasons, have to act contrary to their convictions are more likely to choose a cleaning product (over another product) compared to participants who can act according to their convictions (Bilz, 2012). Moreover, similar preferences for cleaning products have been found after being sexually objectified (Z. Chen, Teng, & Zhang, 2013), after imagined contact with homosexual people (Golec de Zavala, Waldzus, & Cypryanska, 2014), after feeling moral distress because of playing a violent video game (Gollwitzer & Melzer, 2012), after feeling dirty as a consequence of professional networking (Casciaro, Gino, & Kouchaki, 2014) and after violating eating restraints (Sheikh, Botindari, & White, 2013). This greater desire for cleaning products can be interpreted as resulting from an increased urge to cleanse oneself.

Interestingly, the influence of a current moral state on product desirability seems to be modality specific (Lee & Schwarz, 2010a), that is, specific to the body modality involved in the transgression. Feeling guilty (compared to feeling morally good) because of something done with one's hands, makes hand cleaning products especially desirable. At the same time, feeling guilty (again compared to feeling morally good) because of a verbal transgression, makes mouth wash especially desirable.

However, several studies failed to replicate the increased desire to cleanse after immoral compared to moral recall recounted above (Earp, Everett, Madva, & Hamlin, 2014; Fayard, Bassi, Bernstein, & Roberts, 2009; Gaméz, Díaz, & Marrero, 2011), in spite of closely following the original procedure, and—in the case of Earp

et al. (2014) and Fayard et al. (2009)—with a considerable increase in power. Unfortunately, the interpretation of these non-replications is difficult as none of these experiments report manipulation checks to ensure that the moral state had indeed been altered by the morality manipulation. I will discuss this point in great detail in Chapter 4.8.

In addition to cleaning product desirability, increased subjective dirtiness or an urge to cleanse oneself can also be inferred from cleaning duration. For example, highly disgust sensitive people tend wash their hands longer than less disgust sensitive participants (Thorpe, Barnett, Friend, & Nottingham, 2011). And participants who have previously written about a guilt inducing event take longer to cleanse their hands than participants who have written about a neutral event (Cougle, Goetz, Hawkins, & Fitch, 2011). Similarly, hand washing takes longer for participants who are contaminated by shaking hands with an immoral person (Xie, Yu, Zhou, Sedikides, & Vohs, 2013).

3.2.3 Embodied Cleansing

The increased desirability of cleaning products, presumably resulting from an urge to remove moral stains, raises the question whether cleaning indeed alleviates guilt. The answer seems to be yes. Guilty participants who washed their hands subsequently show less prosocial behavior—here, uncompensated helping out in another experiment—and report feeling less guilty than guilty participants who did not wash their hands (Zhong & Liljenquist, 2006, Exp. 4). This finding can be explained by the notion that, in general, feeling guilty increases prosocial behavior (Carlsmith & Gross, 1969). By cleaning their hands, participants remove this guilt (H. Xu, Begue, & Bushman, 2014) and consequently do not need to behave prosocially anymore. Reuven, Liberman, and Dar (2013) as well as H. Xu et al. (2014) replicated this finding; however, see Fayard et al. (2009), Cougle et al. (2011), and Gaméz et al. (2011) for non-replications.

Reuven et al. (2013) found this effect to be significantly more pronounced in participants who suffer from obsessive–compulsive disorder (OCD) compared to a non-clinical control group. OCD-participants show both more willingness to help after not cleaning their hands when feeling guilty and less willingness to help after cleaning their hands when feeling guilty compared to the control group. This might be explained by OCD-participants' having a stronger connection between feeling dirty and feeling immoral. Indeed, washing is the most common forms of compulsions in OCD—about 50% of the people diagnosed with OCD report contamination concerns and associated washing compulsions (Rachman & Hodgson, 1980). It seems that washing rituals in OCD reduce uncomfortable feelings of guilt.

Cleansing also diminishes another form of threat to one's moral self. The morality of one's behavior can be challenged by seeing another person refuse to do what oneself has done if the person refuses on moral grounds (e.g., the morality of one's having just eaten a sausage is called into question when seeing another participant decline to eat a sausage because he/she considered it unethical to eat meat; Cramwinckel, van Dijk, Scheepers, & van den Bos, 2013). This generally leads to less positive self-evaluations and also less positive evaluations of the moral refuser compared to being confronted with someone who refuses on non-moral grounds (e.g., someone who refuses because he/she does not like the taste of meat). These two reactions to a threat to one's moral self-worth are likewise diminished by cleaning one's hands after performing the ethically questionable behavior (Cramwinckel et al., 2013).

Disgust can also be alleviated by cleaning one's hands, whether the disgust resulted from watching a physically disgusting video clip (Schnall, Benton, & Harvey, 2008) or by contact with outgroup religious beliefs (Ritter & Preston, 2011). Moreover, washing one's hands reduces out-group bias in highly germ-averse participants (J. Huang et al., 2011).

Concerning judgments about the (im)morality of other's behavior, the influence of physical cleansing seems to depend on one's previous state. On the one hand, Schnall, Benton, and Harvey (2008) found less severe moral condemnations in participants who washed their hands after watching a disgusting video clip compared to participants who did not wash their hands after watching the disgusting video clip. As washing alleviates feelings of disgust, moral condemnations can be less harsh when disgust has been washed away compared to when disgust has not been washed away (but see Johnson, Cheung, & Donnellan, 2014 for a non-replication). On the other hand, Zhong, Strejcek, and Sivanathan (2010) observed more severe moral judgments for participants who washed their hands compared to control participants (see also Helzer & Pizarro, 2011). In this case, no specific state had been induced before cleaning. Thus, only the *moral purity explanation* would predict this difference. Taken together, it seems that a clean self can judge more harshly, while a self that has been cleansed from disgust tends to judge more leniently.

3.2.4 The Clean Slate Effect

Embodied cleansing also affects other domains of human judgment and behavior—domains quite unrelated to morality. The first extension concerns product evaluations and choice (Lee & Schwarz, 2010b). Participants usually show a post-decisional dissonance effect; that is, after choosing one of two equally attractive products, their evaluations for their chosen product gets comparatively more favorable. However, participants who clean their hands show no post-decisional dissonance effect. Their

relative evaluation of both products does not change systematically. Thus, the need to justify a choice by bolstering the difference between two almost equally attractive products seems lessened by cleaning compared to not cleaning (De Los Reyes, Aldao, Kundey, Lee, & Molina, 2012; Lee & Schwarz, 2010b).

A similar effect of cleaning one's hands can be found concerning the endowment effect (Florack, Kleber, Busch, & Stöhr, 2014). Participants who receive a product and are afterwards asked if they want to exchange it for a similar product generally stick with their initial product; that is, they exchange it less often than people who are given the choice between the two products from the outset. However, this endowment effect is less pronounced if participants wash their hands before they are given the chance to exchange products. Participants who clean their hands choose to switch products more often than participants who do not clean their hands. Both, post-decisional dissonance effect and endowment effect result from an increased preference for products that one possesses. Therefore, the reduction of these effects by cleaning one's hands can be interpreted as "detaching the ties of ownership" (Florack et al., 2014, p. 284).

Embodied cleansing also reduces the influence of previous luck on later gambling behavior (A. J. Xu et al., 2012). Luck in previous gambling trials increases the amount of money participants are prepared to bet compared to bad luck. This effect disappears in participants who clean their hands before making their final bet. Thus, the reliance on previous experiences in betting is influenced by cleaning. To date this remains the only demonstration that a desirable state can be attenuated by cleaning one's hands—the other states are neutral or undesirable.

Generalizing the influence of embodied cleansing to yet another domain, Kaspar (2013) found that cleaning one's hands attenuates consequences of failure. After receiving negative feedback on an initial performance task, participants who wash their hands are more optimistic about improving their future performance than participants who received the same feedback but do not wash their hands. Regarding their actual performance in a second achievement task, participants who wash their hands perform as well as participants who did not get negative feedback before. However, both groups are outperformed by participants who experience failure and do not wash their hands between the two performance tasks—presumably because the latter participants increase their effort to compensate for their negative performance. Thus, two consequences of failure, pessimism about future performance and increased effort, can be washed away by physical cleaning.

3.3 Embodied Cleansing Explanations

Comparing the experimental logic of all clean slate experiments (see Chapter 3.2.4), reveals a common basic set-up. Participants experience something that influences their judgment or behavior on a subsequent task. Between the experience and the measurement of its consequence, some participants clean their hands. As a result, those participants act in the next task as if the original experience had not taken place (or at least as if its influence had diminished), while control participants are still influenced by the original experience. Recall, for example, that participants who cleaned their hands are not influenced by previous failure, while control participants react by being pessimistic and increasing their effort. From this common basic set-up, Lee and Schwarz (2011) concluded that embodied cleansing literally wipes the slate clean. It removes residues of the past, be they morally relevant or completely unrelated. In this sense, cleaning produces an attenuation of the effect that can be observed without cleaning.

This notion of embodied cleansing as neutralizing any previous experience elegantly explains embodied cleansing effects in non-moral domains (e.g., Florack et al., 2014; Kaspar, 2013; Lee & Schwarz, 2010b; A. J. Xu et al., 2012). And as Lee and Schwarz (2011) interpret the clean slate experiments as an expansion of previous embodied cleansing experiments to broader content domains, it might be tempting to infer that the clean slate explanation is an adequate explanation for all embodied cleansing. At a closer look however, some experiments do not agree with this. Some studies in the domain of morality did find an effect of cleansing, even though no specific state had been induced before. For example, cleaning one's hands without any preceding manipulation can lead to harsher moral judgments compared to not cleaning (Zhong et al., 2010). This accords with a nuance of moral cleansing not captured by the clean slate metaphor. Getting morally pure is more than the removal of a negative state but is itself an active positive state (Schnall, 2011). Therefore, getting pure from a neutral state should still increase one's moral standing, while wiping the slate clean when there is nothing on that slate to be wiped away should not change anything.

On the other hand, it might be possible that two different effects are responsible for the different embodied cleansing effects. For experiments in the domain of moral judgment and moral behavior, cleaning might produce a main effect. Specifically, cleaning oneself might increase the feeling of being a moral person—along the line of the *moral purity* explanation. At the same time, for experiments in non-moral domains, cleaning might reduce the influence of any previous experience—along the line of the *clean slate* explanation. Both explanations make converging predictions for embodied cleansing when feeling guilty (Lee & Schwarz, 2010a; Zhong & Liljenquist, 2006); Chapter 4 will build on this and discuss it in detail. However, the effects of cleaning on moral judgment (Helzer & Pizarro, 2011; Schnall, Benton, & Harvey, 2008; Zhong et al., 2010), as well as the experiments showing associations

between cleaning and morality or morality-related domains (e.g., Jones & Fitness, 2008; Preston & Ritter, 2012) can only be explained by the *moral purity* explanation. Yet the effects on luck (A. J. Xu et al., 2012), achievement (Kaspar, 2013), and ownership (Florack et al., 2014; De Los Reyes et al., 2012; Lee & Schwarz, 2010b) can only be explained by the *clean slate* notion. Thus, the two explanations can explain largely non-overlapping findings.

In addition to explaining the literature more fully, assuming two largely independent explanations has another advantage: different effects might be driven by different mechanisms and have differing operating conditions. Concerning operating conditions in the morality domain, cleanliness priming seems to have the same effect as cleaning (Helzer & Pizarro, 2011; Liljenquist, Zhong, & Galinsky, 2010; Preston & Ritter, 2012; Schnall, Benton, & Harvey, 2008; Zhong et al., 2010); however, in other domains, cleanliness priming has been shown to have different effects from cleaning (Florack et al., 2014; Lee & Schwarz, 2010b; A. J. Xu et al., 2012). Thus, the different role of concept activation in moral purity effects and clean slate effects can be seen as a first instance that the two explanations might have different operating conditions.

Concerning the embodiment mechanisms discussed in Chapter 2, modal priming seems the most likely underlying mechanism of moral purity effects. As reviewed in Chapter 3.2.1, cleaning and morality (as well as related concepts, e.g., religion) are associated on a semantic level (Jones & Fitness, 2008; Preston & Ritter, 2012; Yan et al., 2011; Zhong & Liljenquist, 2006), and semantic associations between concepts points to modal priming as mechanism (see Chapter 2.6.2). However, direct state induction seems the most plausible underlying mechanism of embodied cleansing effects in non-moral domains. Cleaning softens previous experiences in different domains unrelated to morality, influencing behavior like choosing products or increasing one's effort. These broad consequences point to direct state induction. The induced state might be a motivational state of turning a fresh leave, feeling more open for new experiences and less bagged down by one's past.

3.4 The Present Research

The present work examines two distinct questions about embodied cleansing that arise from the previous discussion of embodied cleansing effects and their possible underlying mechanisms. Which cleansing explanation dominates when they are pitted against each other (Chapter 4) and what are the operating conditions and possible underlying mechanisms for embodied cleansing (Chapter 5)?

In Chapter 4, I will examine the two explanations for embodied cleansing, the *moral purity* and the *clean slate* explanation, vis a vis each other. For morally negative

states, both explanations make the same predictions. Namely, a negative moral state should be attenuated by cleaning, either because any state is attenuated by cleaning (clean slate explanation) or because moral purity is increased by cleaning (moral purity explanation). For morally positive states, however, the two explanations make diverging predictions. The *moral purity* explanation predicts that cleaning always leads to a morally pure state, and therefore, moral purity should be enhanced by cleaning, even when the state was already positive to begin with. The *clean slate* explanation on the other hand predicts the opposite: after a positive moral state has been induced, cleaning should reduce the positive moral state and therefore should lead to a less moral state than not cleaning. Thus, cleaning in a morally positive state could show which of the two explanations dominates. Up to now, no published experiment has pitted the two explanations against each other. Specifically, all experiments examined effects where both explanations concur or where one explanation is mute. Therefore, by examining which explanation predominates I will address an important gap in the literature. To this end in Chapter 4, I report two experiments that compare cleaning one's hands with a control action after either a positive or a negative moral state has been induced.

In Chapter 5, I examine operating conditions and underlying mechanisms of the clean slate effect. As discussed above, if there are indeed two different embodied cleansing mechanisms, they are likely to differ in their operating conditions. Therefore, determining the operating conditions of clean slate effects and moral purity effects could be useful for finding out, whether there are indeed two different embodied cleansing mechanisms. In Chapter 5, I report three experiments that examine operating conditions in clean slate effects. Specifically, I examined four aspects—motor action, sensory properties, cleaning intention, and self-reference of the cleaning—that seemed reasonable aspects for producing embodied cleansing.

Chapter 4

Washing away Moral Compensation Effects

4.1 Moral Compensation

Being a moral person is central to most people's self-concept (Aquino & Reed, 2002). And indeed, most people consider themselves to be moral (Allison, Messick, & Goethals, 1989; Aquino & Reed, 2002). In a representative survey of US high school students, for example, 99% stated it was important for them to be a person with good character, and 81% felt that their behavior was comparatively moral (Josephson Institute of Ethics, 2012). At the same time, being always good is much more costly than being selfish from time to time. Therefore, people tend to balance their moral and immoral behavior—a feat that allows them to act to their own advantage from time to time while still holding a positive moral self-view (Ayal & Gino, 2011; Mazar, Amir, & Ariely, 2008; Merritt, Effron, & Monin, 2010; Miller & Effron, 2010; Monin & Jordan, 2008).

In accordance with the notion of balancing moral with immoral behavior, people tend to act more prosocially to compensate for previous selfish behavior (e.g Baumeister, Stillwell, & Heatherton, 1994; Carlsmith & Gross, 1969; Darlington & Macker, 1966; Freedman, Wallington, & Bless, 1967; Sachdeva, Iliev, & Medin, 2009). However, people act less prosocially when a certain amount of *moral license* has been accrued; that is, after previous good deeds, people tend to slacken in their prosocial behavior (Jordan, Mullen, & Murnighan, 2011; Khan & Dhar, 2006; Mazar & Zhong, 2010; Sachdeva et al., 2009). Combining both effects, more prosocial behavior after previous immoral behavior and less prosocial behavior after previous moral behavior, leads to the idea of *moral compensation*—acting opposite to one's previous behavior.

In one exemplary line of experiments on moral compensation, participants were asked to recall and describe a situation where they had either helped (moral recall condition) or harmed (immoral recall condition) another person. Compared to participants in the neutral control condition, participants in the moral recall condition intended less prosocial behavior (e.g., donating to charity or volunteering) in the coming month. However, the reverse is true for participants in the immoral recall condition. They increase prosocial intentions compared to the neutral control condition (Jordan et al., 2011).

More recently however, research showed that previous (im)moral behavior does not always lead to moral compensation (Hayley & Zinkiewicz, 2013; Gaesser & Schacter, 2014; Young, Chakroff, & Tom, 2012; S. Zhang, Cornwell, & Higgins, 2014). Rather, a prosocial (vs. self-serving) initial task that is thought about in terms of goal commitment leads to consistent behavior in a resource allocation task. Specifically, participants who have generated ideas for others (prosocial condition) give more resources to others than participants who have generated ideas helpful for themselves (self-serving condition). Therefore, under some circumstances moral behavior tends to be consistent instead of compensating (Susewind & Hoelzl, 2014).

By now, several moderators have been proposed that lead people to either behave consistently with their previous behavior (or the behavior they have been reminded of) or to compensate for their previous behavior: Increasing temporal distance to the remembered event, and more generally higher level of construal (Conway & Peetz, 2012; see also Henderson & Burgoon, 2014); focus on goal commitment (vs. goal progress) (Susewind & Hoelzl, 2014; see also Gneezy, Imas, Nelson, Brown, & Norton, 2011); proactive (vs. damage control) reputation concerns (Joosten, van Dijke, Van Hiel, & De Cremer, 2013); and rule-based (vs. outcome-based) moral mind-set (Cornelissen, Bashshur, Rode, & Le Menestrel, 2013) all lead to consistent (vs. compensating) behavior.

However, experience sampling data by Hofmann, Wisneski, Brandt, and Skitka (2014) suggest that moral compensation might be the default mechanism. In the present experiments, I try to side-step the possibility of consistency by choosing manipulations that should foster moral compensation.

4.2 Aim of the Experiments

The goal of the present experiments is to examine moral compensation effects in combination with embodied cleansing. As has been discussed in the previous chapter, after previous immoral behavior, prosocial behavior is reduced by cleaning compared to not cleaning (Zhong & Liljenquist, 2006). Recall that both explanations for embodied cleansing, the *clean slate* and the *moral purity* explanation, predict

this effect. Specifically, the *clean slate* hypothesis postulates that the influence of any previous experience can be attenuated by embodied cleansing. Accordingly, cleaning should also reduce attempts to compensate for moral transgressions. Thus, the clean slate hypothesis predicts less prosocial behavior after cleaning compared to not cleaning subsequent to immoral behavior. Differently but to the same effect, the *moral purity* hypothesis assumes that cleaning increases one's subjective moral standing irrespective of previous manipulations. This positive moral standing should also attenuate attempts to compensate for moral transgressions. Thus, the moral purity hypothesis also predicts less prosocial behavior after cleaning compared to not cleaning subsequent to immoral behavior.

However, for embodied cleansing after positive moral behavior, the predictions differ. According to the *clean slate* hypothesis, moral license should be removed by cleaning one's hands, like any other remnant of the past. And as moral license decreases prosocial behavior, removing moral license should increase prosocial behavior. Thus, the clean slate explanation predicts more prosocial behavior after cleaning compared to not cleaning subsequent to positive moral behavior. On the other hand, according to the *moral purity* hypothesis, one's moral standing improves by cleaning, no matter what preceded the cleaning, because cleanness is associated with moral purity. Therefore, cleaning one's hands should always lead to less prosocial behavior compared to not cleaning—after a positive as well as after a negative moral manipulation. Thus, the moral purity explanation predicts less prosocial behavior after cleaning compared to not cleaning subsequent to positive moral behavior.

Thus, while the *clean slate* hypothesis makes opposite predictions for positive and negative moral compensation effects (cleaning should increase prosocial behavior after moral behavior and decrease prosocial behavior after immoral behavior, compared to not cleaning), the *moral purity* hypothesis makes the same predictions for both (cleaning should decrease prosocial behavior compared to not cleaning). Therefore, testing the influence of embodied cleansing after a positive moral state seems a good way of pitting the two explanations for embodied cleansing against each other to find out which dominates. Moreover, comparing the effect sizes of embodied cleansing after positive and negative manipulations might give a hint as to whether both mechanisms work at the same time. Specifically, if both mechanisms work at the same time, the effect for negative moral states should be larger (as both effects should strengthen each other) than for a positive moral state (as the two effects should counteract each other).

4.3 Overview of the Experiments

I conducted two experiments to compare hand washing with a neutral control condition.[1] In both studies, I first manipulated participants' moral standing. Then the embodiment manipulation followed, under the guise of testing a product—either hand sanitizer or a neutral product. Afterwards prosocial behavior was assessed, by asking participants to volunteer for unpaid studies to help fellow students. The general idea was that the moral manipulation influences prosocial behavior. This influence should be moderated by cleaning one's hands, while it should not be influenced by the non-cleaning control condition.

The main difference between the studies consisted in the valence of the moral manipulation. In the first Experiment, people were made to feel particularly moral and should, therefore, feel licensed to behave less prosocially. In contrast, in the second Experiment, people were made to feel particularly immoral and should, therefore, feel obliged to compensate by acting more prosocially. Cleansing should influence both effects.

To spell it out, my hypotheses were as follows. In Experiment 1, participants in the non-cleaning condition should feel licensed to behave not very prosocially as a consequence of the initial moral manipulation. Compared to that, participants who washed away their moral license by cleaning their hands should behave more prosocially according to the clean slate hypothesis; however, they should behave less prosocially according to the moral purity hypothesis. The opposite should occur for Experiment 2. Here, participants in the non-cleaning condition should feel a need to compensate by behaving especially prosocially as a consequence of the initial immoral manipulation. Compared to that, participants who washed away their moral transgression by cleaning their hands should behave less prosocially according to both explanations (see Chapter 3.3 and Chapter 4.2 for more detailed explanations).

4.4 Power Analysis

The targeted sample size was planned based on Zhong and Liljenquist (2006, Experiment 4) which served as a model for the present experiments. Specifically, Experiment 2 is a close replication of Zhong and Liljenquist (2006, Experiment 4) and Experiment 1 is similar, except for examining positive instead of negative moral compensation. The power in Zhong and Liljenquist (2006, Experiment 4) was calculated to be medium to large, Cohen's d = 0.71. Taking the mixture of successful

[1] In all studies, there were other conditions as well, but as they do not pertain to the current hypotheses, they will not be mentioned any further.

and failed replications into account and deciding on a rather conservative estimate, half this effect size (i.e., d = 0.35) was used as an effect size estimate for the present experiments. A power-analysis for a two-sided two-sample t-test with a power of 0.80 revealed a required sample size of 252. Therefore, 252 was the targeted sample size for Experiments 1–2.

4.5 Experiment 1: Washing Away Moral License

Experiment 1 tests, for the first time, the hypothesis that moral license can be altered by physically cleaning one's hands. For this, participants were reminded of previous moral behavior and then cleaned their hands or performed a control task. Afterwards, their prosocial behavior was measured as an index for moral licensing.

4.5.1 Method

4.5.1.1 Participants and Design

235 people (144 women, 91 men) aged between 17 and 58 years (M = 24.0 years, SD = 6.3 years) participated. Participants were invited via flyers, via e-mail, or in person. Participants were compensated for their time by receiving chocolate or €7 for a multi-experiment session. They were randomly assigned to one of two conditions (cleaning vs. control) of a between-participants design.

4.5.1.2 Materials

Autobiographical Priming. For the manipulation of salient previous moral behavior, participants were asked to recall and describe an event where they had done a moral deed. The alleged reason was that the experiment examined autobiographic details people keep in memory. After being assured that their data would be protected, treated anonymously, and only used for scientific purposes, participants were asked to recall one autobiographical story and describe it in as much detail as possible. They were to recount an incident where they had done a morally good deed that had made them proud. To facilitate recollection, a few possible examples of suitable topics were named. Participants were asked to select the most recent matching incident (see Conway & Peetz, 2012) and to describe their behavior and feelings as detailed as possible (see Strack, Schwarz, & Gschneidinger, 1985)[2]. Participants were informed that they had 7 minutes for the task and were informed about the remaining time towards the end.

[2]There were slight wording changes for the different data collection batches, which, however, did not yield significantly different results.

Embodied Cleansing. The second task constituted the embodied cleansing manipulation, under the guise of a product test. Participants in the cleaning condition were asked to use a sanitizing gel by dispersing it on the surfaces of their hands and form an impression of the product. Afterwards, in order to keep up the credibility of the cover story, participants completed a short questionnaire about the product. Participants in the non-cleaning condition were asked to evaluate a neutral product (a packet of tea bags), which took about the same time as the product evaluation in the cleaning condition.

Prosocial behavior. As a dependent measure, participants were casually asked to volunteer with some of their time to help students by participating in experiments. The context made it clear that participation was entirely voluntary and unrelated to the present study. More specifically, the experimenter casually handed participants an appeal from four (fictitious) students who were looking for participants for their diploma/bachelor theses. To make participating easy, all studies allegedly consisted of questionnaires that would be sent by e-mail, could be completed at participants' leisure and sent back within a few weeks. All four experiments were provide with a name and estimated duration. Underneath each of them, a column for entering e-mail addresses was partly filled. All participants received identical sheets, including previous sign-ups. The total amount of time for which participants singed up (from 0 to 70 minutes) constituted the dependent measure.

This measure for prosocial behavior is widely used (e.g., Conway & Peetz, 2012; Greitemeyer, 2009; Meier, Moeller, Riemer-Peltz, & Robinson, 2012; Schnall, Roper, & Fessler, 2010) and has even been successfully used in embodied cleansing experiments (e.g., Zhong & Liljenquist, 2006). However, often it is used dichotomously, i.e., volunteering for one (longer) unpaid study or not; I asked for volunteering in up to four studies to have finer gradations of the amount of prosocial behavior in order to increase statistical power. This has also been done before, either by asking for participation in more than one experiment (e.g., Tai, Zheng, & Narayanan, 2011; Twenge, Baumeister, DeWall, Ciarocco, & Bartels, 2007), or by stating that the experiment consisted of multiple parts of a few minutes duration each, and assessing how much time participants volunteered (e.g., Bartlett & DeSteno, 2006; Chiou & Cheng, 2013). Similar to these latter experiments I took as a main dependent measure time for which participants volunteered. As ancillary analyses I also used proportion of participants who volunteered (vs. did not volunteer to participate at all) as a dependent measure.

4.5.1.3 Procedure

Data collection took place in five different data collection batches under nearly identical conditions. Upon arrival, participants were guided to isolated tables that were

separated by screens. The study allegedly consisted of several unrelated tasks and was self-paced. A morally positive state was induced for all participants, by writing about a recent autobiographical event where they had done something moral. Then, during a product test, half the participants cleaned their hands with a hand sanitizer (cleaning condition), while the other half performed a neutral task (control condition). Next, while starting the last computer program, the experimenter handed the solicitation for study volunteers (the measure for prosocial behavior) to the participant. Finally, participants answered some questions about the experiment, provided demographic data, and were thanked and compensated for participating.

4.5.2 Results and Discussion

The time for which a participant agreed to volunteer was calculated as the sum of minutes of all studies for which the participant signed up. A *t*-test on the time for which participants volunteered with cleaning condition as the independent variable was calculated and did not yield a significant difference, $t(234) = 0.33$, $p = .74$, $d = 0.043$, 95% CI [-0.213, 0.299]. Participants in the cleaning condition agreed to participate for about as much time ($M = 26.03$ min, $SD = 24.76$ min) as participants in the control condition ($M = 27.11$ min, $SD = 25.42$ min).

Discarding the information of how much time participants volunteered and analyzing just how many participants in each group volunteered at all (thus, analyzing like Zhong & Liljenquist, 2006), does not yield significant effects either, $\chi^2 = 0.52$, $p = .42$. 79% of the participants in the control condition and 83% of the participants in the cleaning condition volunteered. Thus, Experiment 1 does not provide evidence for the presence of an embodied cleansing effect after a morally positive manipulation.

No obvious faults in the experimental setups could be detected that might account for this absence of embodied cleansing. Informal analysis of the autobiographical priming texts showed that participants adhered to the instructions. Moreover, in the cleaning manipulation, participants did indeed sample the product and clean their hands.

The available evidence from an experiment with a total of 235 participants suggests no difference in prosocial behavior between participants who cleaned their hands after recalling a morally positive experience and those who did not clean their hands after recalling a morally positive experience. Therefore, in contrast to what was predicted by the clean slate hypothesis, I did not find a reduction of the moral licensing effect by embodied cleansing. Nor did I find support for the moral purity explanation, which predicts that cleaning should always increase one's standing,

leading to less prosocial behavior, even when one's state was already positive.

However, as argued in Chapter 3.3 and Chapter 4.2, one possible explanation for the null-result might be that both mechanisms influence behavior, are of similar magnitude, and therefore cancel each other. Note, however, that the moral licensing effect is one of few domains where both accounts make opposing predictions.

To test whether embodied cleansing produces a larger effect in a domain where both accounts make the same predictions, I conducted a similar experiment for a morally negative (instead of positive) initial manipulation. Here, both the clean slate hypothesis and the moral purity hypothesis make the same prediction, namely embodied cleansing should reduce prosocial behavior.

4.6 Experiment 2: Washing Away Moral Guilt

Experiment 2 largely mirrors Experiment 1. While Experiment 1 investigated embodied cleansing of moral compensation in a morally positive context, Experiment 2 did the same in a morally negative context. Recall that feeling morally negative about oneself (as a consequence of being reminded of a previous transgression) should generally increase prosocial behavior. Thus, either by wiping the slate clean of one's previous transgression (clean slate explanation) or by increasing one's morally pure state by cleaning (moral purity explanation), cleaning should increase one's moral standing; and this increase should lead to less prosocial behavior than non-cleaning. Importantly, both explanations concur in this hypothesis. Therefore, if either or both explanations of embodied cleansing act at the same time, embodied cleansing should reduce prosocial behavior in the present experimental set-up. And indeed, Zhong and Liljenquist (2006; as well as Reuven et al., 2013; H. Xu et al., 2014) already found reduced prosocial behavior after cleaning one's hands after a negative moral state had been induced compared to not cleaning. Accordingly, Experiment 2 has two functions: replicate (not exactly but rather closely) Zhong and Liljenquist (2006, Exp. 4) and test the size of the embodied cleansing effect after negative moral manipulation with the current experimental material.

4.6.1 Method

4.6.1.1 Participants and Design

241 people (145 women, 96 men) aged between 17 and 47 years, with a mean age of 23.6 years (SD = 3.8 years) participated. Participants were invited via flyers, via e-mail, or in person. They were compensated with chocolate or with €7 for a multi-experiment session. Data collection took place in five data collection batches. Each participant was randomly assigned to one of two conditions (cleaning vs. control) of a between-participants design.

4.6.1.2 Materials

The materials and procedure were almost identical to Experiment 1. Specifically, the product test and the dependent measure were identical. The only major difference was that this time the autobiographic priming task was intended to make people feel immoral. Participants were asked to write about an immoral action for which they felt guilty. Accordingly, in the instructions for the autobiographical recall a few crucial words were changed compared to the instructions of Experiment 1: words that indicated the valence of the topic and words that referred to examples of suitable topics. Other than that, the instructions for the autobiographical recall were similar to that in Experiment 1.

4.6.1.3 Procedure

Students participated in small groups of up to six people. Upon arrival, they were guided to isolated tables. Participants were further separated from each other by screens between the tables. The study allegedly consisted of several unrelated tasks. First, a morally negative state was induced in all participants by writing about a recent autobiographical event where they had done something immoral. Then, completing a product test, half the participants cleaned their hands with hand sanitizer (cleaning condition), while the other half performed a neutral task (control condition). Next, while starting the last computer program, the experimenter handed the solicitation for study volunteers to the participants, which constituted the measure for prosocial behavior (for details see Chapter 4.5.1.2). Finally, participants filled in some questionnaires, provided demographic data, and were thanked and compensated for participating.

4.6.2 Results and Discussion

A t-test on the time for which participants volunteered was calculated with cleaning condition as the independent variable. The test did not yield a significant difference, $t(240) = 1.75$, $p = .081$, $d = 0.226$, 95% CI [-0.028, 0.480]. Participants in the cleaning condition agreed to participate for about as much time (M = 26.79 min, SD = 26.43 min) as participants in the control condition (M = 21.11 min, SD = 23.38 min); if anything, participants in the cleaning condition volunteered rather more time than participants in the control condition, which runs counter to the hypothesis that washing away guilt reduces prosocial behavior.

Discarding the information of how much time participants volunteered and analyzing just how many participants in each group volunteered at all (thus, analyzing like Zhong & Liljenquist, 2006), does not yield significant effects either, $\chi^2 = 0.15$, $p = .69$. 77% of the participants in the control condition and 75% of the participants in the cleaning condition volunteered. Thus, Experiment 2 does not provide evidence for the presence of an embodied cleansing effect after a morally negative

manipulation.

Experiment 2 suggests no difference in prosocial behavior between participants who cleaned their hands and participants who did not clean their hands after recalling their immorally behavior. This is surprising as both explanations of embodied cleansing would predict the effect, and indeed it has been observed before. Zhong and Liljenquist (2006; see also Reuven et al., 2013; H. Xu et al., 2014) found after an immoral recall task participants who cleaned their hands to be less likely to volunteer for unpaid experiments than participants who did not clean their hands. Moreover, the true effect size in the present Experiment was in all probability (greater than 99.9%) less than half the effect size reported by Zhong and Liljenquist (2006). Thus, the present lack of an embodied cleansing effect is unlikely to be the result of mere statistical fluctuations. The results are therefore in line with other non-replications of guilt reduction through cleaning (Cougle et al., 2011; Fayard et al., 2009; Gaméz et al., 2011).

4.7 Analysis on Moral Compensation

The two embodied cleansing studies do not show any significant effects. This means, I cannot find reliable differences between cleaning oneself and doing something neutral after either a positive or a negative moral state has been induced.

There are two possible reasons for this result. Either embodied cleansing "does not replicate", as has been suggested by previously published non-replications; or the problem lies in the basic effect of moral compensation (or its experimental setup as I used it in the present studies). Note that cleaning should lead to less prosocial behavior only if non-cleaning under the same circumstances leads to more prosocial behavior. Thus, both embodied cleansing explanations only predict effects if a negative moral state has been induced that increases prosocial behavior compared to a control condition without immoral manipulation. Unfortunately, no morally neutral control condition was present in Experiments 1 and 2, nor in any of the published non-replications—probably because successful embodied cleansing experiments did not report such conditions either. Yet only a neutral control condition would have permitted a test whether the basic moral compensation effect obtained. And only the presence of a moral compensation effect combined with the absence of a moral cleansing effect would enable a conclusion about the non-replicability of embodied cleansing effects.

In the present context, some information on this can be gained by analyzing the two experiments together. As already mentioned, the present studies were extremely similar. The manipulations were largely identical and even the data collection batches of the two experiments were interspersed. Crucially in the present context, the experiments used the same measure for prosocial behavior, which

means that we can actually compare the amount of prosocial behavior across experiments in a meaningful way. Thus, we can compare the amount of prosocial behavior after a positive moral manipulation (which should result in moral licensing) with the amount of prosocial behavior after a negative moral manipulation (which should result in moral compensation). Comparing the control conditions, that is, the conditions without cleansing, in both experiments should show the moral compensation pattern—more prosocial behavior after a morally negative than a morally positive manipulation.[3]

A *t*-test on the time for which participants volunteered was calculated with valence of the initial manipulation (immoral recall vs. moral recall) as the independent variable. The test did not yield a significant difference, $t(228) = 1.85$, $p = .066$, $d = 0.245$, 95% CI [-0.016, 0.505]. Participants in the moral recall condition agreed to participate for about as much time ($M = 27.11$ min, $SD = 25.42$ min) as participants in the immoral recall condition ($M = 21.11$ min, $SD = 23.38$ min). If anything, participants in the moral recall condition volunteered rather more time than participants in the immoral recall condition, which is at variance with the moral compensation effect.

Analyzing the proportion of participants who volunteered at all, does not yield any significant differences either, $\chi^2 = 0.13$, $p = .72$. 77% of the participants in the morally negative condition and 79% of the participants in the morally positive condition volunteered some of their time. Thus, participants who should feel guilty do not volunteer more than participants who should feel morally positive.

In short, I do not find moral compensation. And without moral compensation, as already discussed, neither embodied cleansing explanation predicts any influence of cleaning on prosocial behavior. Therefore, the present experiments do not allow conclusions about the replicability of embodied cleansing.

4.8 Chapter Discussion

In the present experiments, I tested whether moral licensing (Experiment 1) and moral compensation (Experiment 2) can be ameliorated by embodied cleansing. The results showed no effect of cleaning in either context. However, even the moral compensation effect failed to appear: prosocial behavior does not significantly differ between participants reminded of their previous moral behavior and participants reminded of their previous immoral behavior. In other words, people who should have felt licensed to slacken in their good deeds were just as likely to volunteer helping other students as participants who should feel an urge to make up for their

[3]Note that the embodied cleansing cells are left out of the analysis altogether.

previous selfish behavior.

Without a moral compensation effect, cleaning one's hands should not affect prosocial behavior. Therefore, the present lack of an embodied cleansing effect does not argue against its replicability. Rather, the present data are mute about embodied cleansing as the necessary precondition turned out to be not fulfilled. Instead, they question the stability of the moral compensation effect.

Regarding the lack of a moral compensation effect, I see possible methodological and theoretical reasons. One possible reason is a fault in the experimental materials; that is, either the autobiographical priming did not manipulate the moral standing as intended, or the measure for prosocial behavior did not measure prosocial behavior as intended. To me, although possible of course, neither seems likely, as I took care to choose conventional manipulations that seemed valid and reliable. For the manipulation of participants' (im)moral state, I used autobiographical priming, a popular and efficacious manipulation in general (e.g., Brewer, Doughtie, & Lubin, 1980; Martin, 1990; Westermann, Spies, Stahl, & Hesse, 1996); importantly, it has often been successfully used in moral compensation effects (e.g., de Hooge, Zeelenberg, & Breugelmans, 2007; Jordan et al., 2011; Ketelaar & Au, 2003; Mulder & Aquino, 2013; McGraw, 1987). Moreover, I tried to model the instructions as closely as possible on these studies. As a measure of prosocial behavior I also used a very common operationalization: asking for uncompensated experiment participation (e.g., Converse, Risen, & Carter, 2012; Greitemeyer, 2009; Meier, Moeller, et al., 2012; Schnall et al., 2010; Twenge et al., 2007; Zemack-Rugar, Bettman, & Fitzsimons, 2007). In sum, it does not seem likely to me that faults in the material can account for the absence of the moral compensation effect.

On a theoretical level, the dynamics of moral behavior are still imperfectly understood. While some moderators have been found for when (im)moral behavior tends to elicit consistent and when compensating behavior (Conway & Peetz, 2012; Cornelissen et al., 2013; Joosten et al., 2013; Susewind & Hoelzl, 2014), unknown moderators might still be at work. Indeed, the idea of moral consistency, especially concerning immoral behavior, is rather new; no such effect was, to the best of my knowledge, published when I started collecting data on cleaning after immoral recall. In the present studies, I tried to ensure that compensation would occur, see Chapter 4.1. Specifically, moral compensation effects have often been shown (e.g., Carlsmith & Gross, 1969; Darlington & Macker, 1966; Jordan et al., 2011; Sachdeva et al., 2009); and the present experimental material tried to elicit moral compensation by modeling the experimental material closely upon previous material and particularly by taking known moderators into account by framing the material so as to elicit compensation instead of consistency (e.g., asking about recent instead of distant memories, Conway & Peetz, 2012, and focusing on consequences instead of reasons, Cornelissen et al., 2013). As my goal was to examine embodied cleansing, I banked on the moral compensation being a stable basic effect that could then be

moderated—unfortunately, this proved overoptimistic. The plea for hidden moderators might be considered an easy way out (Cesario, 2014), but with my present state of knowledge, it seems the most likely explanation to me. Previous (im)moral behavior has been shown to influence later prosocial behavior, but the direction of this influence, whether leading people to be consistent or compensating, seems to depend on various factors, some of which seem not clear, yet.

Nevertheless, the research in the present chapter can make a modest contribution to the knowledge on embodied cleansing. Namely, it suggests a way to reconcile the findings on embodied cleansing (Florack et al., 2014; Lee & Schwarz, 2010b; Kaspar, 2013; Reuven et al., 2013; H. Xu, Begue, & Bushman, 2012; H. Xu et al., 2014; Zhong & Liljenquist, 2006) with the non-replications (Cougle et al., 2011; Earp et al., 2014; Fayard et al., 2009; Gaméz et al., 2011). Apart from power issues that might hide an effect, either moral compensation or embodied cleansing might not have worked. All published non-replications (i.e., Cougle et al., 2011; Earp et al., 2014; Fayard et al., 2009; Gaméz et al., 2011) have interpreted their data as a failure to find embodied cleansing. Specifically, they all assume embodied cleansing did not alter the state but the immoral manipulation did affect prosocial behavior in the intended way—though none had an appropriate control condition or manipulation check. But in the light of the present experiments, this implicit reliance on the moral compensation effect seems unwarranted. In the published non-replications, like in my experiments, the autobiographical priming might not have elicited an increase in prosocial behavior in the first place. And if there is no urge to behave prosocially, none can be removed by cleaning one's hands.

On a very general level, the present data also illustrate intricacies in interpreting non-replications of moderation effects. Here, embodied cleansing should moderate moral compensation. The non-replication of this effect might lead one to doubt the stability of the more exotic embodied cleansing effect, especially as the basic to be moderated effect, compensation for previous transgressions, has been around since the 1960s (e.g., Carlsmith & Gross, 1969; Freedman et al., 1967). Still, non-replications of an effect that should moderate another effect need to provide evidence for the presence of this latter effect, if they want to draw conclusions about the lack of replicability of the former effect. The present data help illustrating this point. While at first they seemed to be a non-replication of embodied cleansing, additional analyses revealed that the problem lies in the supposedly more basic effect of moral compensation.

Additionally, the present data show that moral compensation is less a matter of course than is generally assumed in the embodied cleansing literature (see also Blanken, van de Ven, Zeelenberg, & Meijers, 2014). Getting to grips with the dynamics of moral behavior is an important goal in itself, but it should be separated from research on moderators on moral compensation that presuppose a stable ba-

sic effect. Therefore, the next Chapter concerns embodied cleansing experiments in another domain where the to be moderated effect proved more stable.

Chapter 5

Mechanisms in Embodied Cleansing

In addition to being a morally good person, being smart and successful is another key goal for most people. Therefore, information about intellectual aptitude is highly self-relevant, especially for students—influencing not only their self-estimated aptitude for a specific task but also their self-esteem. Thus, a negative self-valuation that results from performance feedback may be be unpleasant. However, it was found that such feelings can be ameliorated by embodied cleansing (Kaspar, 2012). The work in the present chapter builds on this finding, extends it to positive performance, and manipulates different aspects of the cleansing in order to tap into its psychological mechanisms.

Being inherently a social species, humans tend to look to others when evaluating themselves. According to social comparison theory (Festinger, 1954), they compare themselves with others (especially similar others) in order to find out how they score on various dimensions. Especially, people have an urge to evaluate their abilities. Such comparisons happen automatically and influence people's self-esteem, even when they are only casually exposed to another person (Morse & Gergen, 1970; see also Gilbert, Giesler, & Morris, 1995). By comparing themselves with their social surroundings, they maintain a sense of who they are, which attitudes they have, which preferences, peculiarities, strengths, and weaknesses.

Social comparisons are especially important as means for self-assessment where performance cannot be objectively measured (Van Yperen & Leander, 2014). However, if performance can be objectively evaluated, absolute feedback as well as social comparison information plays an important role (Klein, 1997). Success or failure, whether in comparison to an objective standard or to other people, influences participants' mood (Nummenmaa & Niemi, 2004), optimism about their performance in a similar task (Greenwald & Farnham, 2000), and self-esteem (Bongers, Dijksterhuis, & Spears, 2009; Crocker, Sommers, & Luhtanen, 2002; Greenberg & Pyszczynski, 1985; Heatherton & Polivy, 1991; Ybarra, 1999). For example, participants who are unable to solve a logic puzzle or receive bad grades on an exam experience a drop

in performance-related self-esteem (Heatherton & Polivy, 1991).

In the experiments in the present chapter, I use participants' performance in bogus academic achievement tests to manipulate their self-esteem. A sense of success or failure is provided in three ways: (a) by the difficulty of the test items and, additionally, (b) by a comparison with a fictitious sample of other students or (c) by a comparison with a very much more or very much less successful student in the room. With this setup, I hoped to influence participants' academic self-esteem and performance estimates. This was likely to be a powerful manipulation as most participants were first-year students in psychology—a field of study where the entrance standards are notoriously high. Moreover, these students had not yet received any feedback about their academic achievements and were therefore expected to be especially anxious for a comparison with their peers.

To measure self-esteem, I used changes in participants' signature sizes, because it is an unobtrusive and fast measure of self-esteem. Supporting its validity, signature size correlates with status. Men sign larger than women, professors larger than participants with less prestigious jobs, and tenured professors larger than untenured professors (Aiken & Zweigenhaft, 1978; Zweigenhaft, 1970; Zweigenhaft & Marlowe, 1973). Additionally, signature size correlates with explicit measures of self-esteem (Zweigenhaft, 1977). Importantly, influencing participants' self-esteem by false feedback in an alleged intelligence test influences their signature size accordingly (Zweigenhaft & Marlowe, 1973). Similarly, signature size changes as a result of subliminal evaluative conditioning compared to non-affective conditioning (Rawal, Harmer, Park, O'Sullivan, & Williams, 2014).

5.1 Aim of the Experiments

The aim in the present experiments was to examine the operating conditions of embodied cleansing. Which aspects of the comparatively complex action of hand washing are necessary and sufficient for producing embodied cleansing? Cleansing consists of five aspects that might play a role for its embodied consequences: (a) the motor action (rubbing one's hands) and (b) the concurrent sensory feedback typical for cleaning (e.g., scent and wetness sensation), in combination with (c) a cognitive activation of the cleaning concept, (d) the awareness of performing an act of cleaning that is (e) additionally referring to one's own body. Up to now, only the third aspect, the activation of the cleaning concept, has been examined. In several experiments, participants in control conditions evaluated cleaning products without using them, thus ensuring an activation of the cleaning concept (Florack et al., 2014; Lee & Schwarz, 2010b; A. J. Xu et al., 2012). But embodied cleansing effects only appeared when the product was used in addition to being evaluated. Thus, activating the cleaning concept without any of the other mentioned aspects of

cleaning seems not sufficient for embodied cleansing. In the present experiments, I therefore examine the other four aspects of cleaning.

On a more mechanism-oriented level, embodied cleansing could be influenced by different underlying processes (see Chapter 2 and Chapter 3.3). First, embodied cleansing could work through *sensorimotor simulation*. A sensation of feeling clean could probably be simulated, like other sensations, but it seems far-fetched to postulate that this simulation should automatically be employed in all effects that have been shown to be influenced by embodied cleansing. For example, it seems unlikely that cleanness simulations should be employed when making gambling decisions or deciding which pen to choose. Therefore, it seems unlikely that sensorimotor simulation is the main underlying mechanism in embodied cleansing.

Second, embodied cleansing could employ *modal priming*, as there is evidence for an association between cleanness and morality (see Chapter 3). However, as detailed in Chapters 3.2.4–3.3, embodied cleansing influences judgment and behavior in a broad variety of domains, from gambling to product selection, many of which are not associated to cleanliness. Therefore, it seems unlikely that modal priming is the main underlying mechanism in these effects of embodied cleansing.

Third, the diverse clean slate effects could result from *direct state induction*. Indeed, a broad array of unrelated effects was described as the signature characteristic of direct state induction. If, however, clean slate effects were purely a result of direct state induction, the clean slate mindset would have to follow invariably from cleansing, unmediated by cognitive inferences (see Chapter 2.1). As this seems unlikely, I shall also take the role of conscious inferences into account by examining the role of the awareness of the cleansing (aspect d).

In short, the present chapter tests the operating conditions of embodied cleansing in order to shed light on its underlying mechanisms.

5.2 Overview of the Experiments

As a basic effect for examining embodied cleansing, I used changes in performance-related self-esteem and their consequences. This seemed to enable a strong basic effect on which to build more subtle embodied cleansing manipulations. First, as already pointed out, performance is both highly relevant and at the same time comparatively undetermined for the present participant population, providing ideal conditions for a manipulation that matters and that is convincing. Second, changes in performance-related self-esteem can be measured very unobtrusively. Even guarded participants do not recognize the request to sign a form about participating in an experiment as a measure. Therefore, participants' intentionally influencing

the measure for self-esteem can ruled out, which is especially important for the discussion of the role of conscious inferences in embodied cleansing, see Chapter 6.1.2.

Using signature size as main measure for self-esteem and performance feedback as independent variable, the present experiments rely on the impact of the performance feedback on self-esteem. That is, I assume that positive performance feedback, either by receiving objective feedback or by social comparison, should increase self-esteem as well as optimism about future performance. Conversely, negative performance feedback, again no matter how it was induced, should in general decrease self-esteem and optimism about future performance.

The influence of performance feedback on self-esteem should nevertheless, as explained above, be influenced by physical cleansing. The present experiments vary different aspects of the cleaning task to identify its essential components. Specifically, Experiment 3 compares the motor aspect of cleaning oneself, the rubbing of one's hands, with cleaning one's hands (comprising all aspects of cleaning). Experiment 4 examines whether the act of deliberately cleaning is responsible for embodied cleansing independent of the object that is cleaned. In fact, Experiment 4 compares wiping the slate clean with wiping oneself clean. Finally, Experiment 5 tests the role of conscious inferences in embodied cleansing—whether an awareness of cleaning oneself is necessary or, conversely, "unconscious cleansing" works.

5.3 Experiment 3: Cleaning vs. Rubbing One's Hands

Experiment 3 had three main aims. First, I tried to establish an experimental paradigm that could be reliably used for embodied cleansing. For that, I built on Kaspar's (2012) finding that physical cleansing can alleviate the consequences of a negative performance feedback. I changed and extended the paradigm to address two more aims: I added both positive performance feedback conditions and control conditions to address the previously stated research objectives about the aspects responsible for embodied cleansing.

Specifically, Experiment 3 addresses the motoric aspect of cleaning one's hands: Is the typical hand rubbing motion employed in cleaning one's hands instrumental in producing embodied cleansing? For that, I used a cleaning condition (i.e., all five aspects of cleaning are present, including hand rubbing motion), a hand motion condition (i.e., only hand rubbing motion is present), and a neutral control condition (i.e., no cleaning aspect is present). If the motor component is sufficient, both motion conditions should result in embodied cleansing and therefore differ from the neutral control condition. If, on the other hand, motion is not sufficient, only the cleaning condition should result in embodied cleansing, while the hand-motion

only condition should not differ from the control condition.

Participants in the "hand motion only" condition had to use hand lotion instead of an antiseptic wipe, which resembles cleaning. Specifically, using hand lotion belongs to the same broad semantic category of body care and should therefore activate similar general knowledge structures as wiping one's hands. Additionally, presumably using hand lotion is about equally engaging as using a hand wipe. More importantly, the motor action in using both products is similar: Using a wipe and using hand lotion both involve a repeated motion of rubbing one's hands. Therefore, if the motor action is the vital factor in embodied cleansing, then using hand lotion should yield similar effect as cleaning.

In addition to varying aspects of the cleansing action, I made one other major extension: I added valence of the performance feedback as another factor to the experimental design. This means half the participants experienced success, while the other half experienced failure in an alleged aptitude test, which was assumed to increase or decrease their performance-related self-esteem respectively. This expansion of the design is useful to dissociate the failure to find embodied cleansing from the absence of an effect of the performance manipulation (see Chapter 4.8). Moreover, it is useful to ensure that embodied cleansing indeed attenuates previous states instead of generally enhancing participants' states.

I hypothesized that any increase or decrease in self-esteem as a consequence of the performance task would be unabated in the control condition. In contrast, any remnants of the previous performance manipulation should be obliterated in the embodied cleansing condition. Concerning the hand motion condition, I expected neither the motor action nor the broader concept of body care to be instrumental in embodied cleansing. Therefore, I did not expect the motion condition to resemble the cleaning condition. Instead I expected the motion condition to yield comparable results with the control condition. If anything, in line with the metaphor of "rubbing something in", using lotion could even amplify a current state, and thereby lead to opposite results from embodied cleansing.

5.3.1 Methods

The experimental procedure consisted of three main parts. Participants performed an aptitude test that was rigged to be easy or difficult and for which they got according performance feedback. Then, during a product test, participants used either a hand cleaning product, or a completely unrelated product (head phones), or hand lotion. Afterwards, as an implicit measure for changes in their self-esteem, changes in participants' signature size were assessed.

5.3.1.1 Participants and Design

164 first-year psychology undergraduates participated in exchange for partial course credit. Due to an error in a computer program, no demographic data were collected for four participants. Of the rest, 33 participants were male, 127 female. Their age ranged from 18 to 36 years, with a mean of 20.6 (SD = 2.8) years.

Sample size in this experiment, as well as the following experiments, was determined by extraneous circumstances, specifically by the number of students who participated in a specific course in a given year. Therefore, adequate power estimates and sample-size adjustments were not possible.

Participants were randomly assigned to one cell of a 2 (performance: success vs. failure) x 3 (product: cleaning vs. control vs. lotion) between participants design. One participant chose not to provide a second signature, and was therefore excluded from the analysis.

5.3.1.2 Performance Manipulation

All students participated in groups of two, with one participant randomly assigned to the success condition and the other participant to the failure condition. First, the experimenter handed each participant a paper-questionnaire and asked them to read the first page, the instructions how to perform the task including a sample item with its correct solution[1]. The first page was identical for both participants, and participants were led to believe that they completed the same questionnaire. They were informed that they had 5 minutes to solve nine out of twelve remote associates task (RAT) items.

Actually measuring creativity (Mednick, 1962), the RAT was introduced as a measure for cognitive acquirements that constitute important qualifications for students' success in academia (loosely modeled after Brown & Gallagher, 1992 and Dutton & Brown, 1997; see also McFarlin & Blascovich, 1984, for the efficacy of the RAT as a performance manipulation). Their achievement level would be measured by how long it took participants to correctly solve nine out of the 12 items. The experimenter gave the signal to turn the page and start the task as soon as both participants had indicated that they understood their task. For participants in the success condition, most of the items were easy[2]. For participants in the failure condition, four of the twelve items had no correct solution, and three were very difficult, which prevented these participants from completing the task during the allotted time.

[1]Complete stimulus material can be found in the electronic Appendix.

[2]The items had been pretested for plausible solutions and difficulty

If participants indicated that they had solved the task, the experimenter noted the time, looked at the solutions and provided feedback. The kind of feedback differed between the success and failure condition. For participants in the success condition, the experimenter said in a somewhat hushed but audible voice that the participant had been quick and had done very well, that, in fact, all solutions were correct. The experimenter then informed the successful participant that he/she would have to wait until the other participant had finished task as well. The experimenter then turned to the participant in the failure condition and informed him/her about how much time was left.

If participants in the failure condition indicated that they had solved the task, the experimenter also noted the time, but provided negative feedback on incorrect and unsolvable items and then asked the participant to try again. Eventually, after the time for the task was over, the experimenter asked whether the participant had finished, and after receiving the inevitable negative answer, indicated in a disappointed voice, that they had to proceed to the next task and took the material away.

To sum up, the performance manipulation consisted of two added components to ensure a strong manipulation. First, the experienced success or failure during the task was manipulated by having either predominantly easy or predominantly difficult or unsolvable RAT items, which should provide a sense of success or failure while participants were at work. Second, the success or failure of the other participant provided a standard against which one's own performance should be automatically evaluated. The feeling of succeeding or failing should therefore be strengthened by a comparison of one's own results with those of the other participant.

5.3.1.3 Procedure

Participants were greeted and led to the lab in dyads. They were seated in close proximity but largely screened from each other's sight. First, participants signed an informed consent form. This signature constituted the baseline for measuring the change in signature size. Then participants engaged in unrelated tasks for approximately 20 minutes.

Then the performance manipulation followed. As detailed in the previous section, participants experienced either success or failure in a performance task in order to increase or decrease their performance-related self-esteem respectively.

For the cleansing manipulation, participants were then asked to complete a product test. All participants were handed a product evaluation questionnaire. Participants in the hand lotion and the cleaning condition additionally received a package of the product they were to sample with instructions on using it. Partici-

pants in the neutral control condition were asked to try on headphones and listen to a sample sound (22 seconds of street café noises, e.g., indistinct voices, clutter of cutlery, and motor vehicles). Participants sampled the product or listened to the sound and then answered six questions on the product questionnaire. The purpose of the questionnaire was to maintain the cover story; participants' answers were not analyzed.

On the last page of the questionnaire, participants were asked to indicate whether they would permit their data of the product evaluation to be passed on (no potential recipient for the data was specified). By asking participants to date and sign their consent or refusal, this question provided a rational for asking participants for another signature. The size of this signature (relative to the signature they provided at the start of the experiment) constituted the dependent measure.

The experimental session continued with questionnaires and other tasks, during which the participants also provided demographic information. None of these tasks will be discussed any further. At the end of the session, participants were thanked and asked to provide their e-mail-address for debriefing. Elaborate debriefing was sent to all participants after data collection had ended.

5.3.2 Results

Changes in participants' signature sizes were determined as follows: For all signatures, the smallest rectangle was drawn that comprised the signature completely. Then, the length and width of this rectangle were measured (to a precision of 1 mm) and multiplied, resulting in the area of the space used for the signature. This was done for both pre- and post-manipulation signatures. By subtracting the pre-manipulation area from the post-manipulation area, I obtained a measure for the change in signature size, with greater values denoting larger signature increases. More specifically, positive values indicate an increase in signature size while negative values indicate a decrease in signature size.

In general, success in a performance task should lead to an increase in self-esteem, while failure in a performance task should lead to a decrease in self-esteem. This should affect signature size accordingly. Namely, participants who experienced unmitigated success should exhibit an increase in signature size; conversely, participants who experienced unmitigated failure should exhibit a decrease in signature size. However, this should not hold for participants who clean their hands. Participants who wash away their success should have smaller signature sizes than participants who do not wash away their success. Conversely, participants who wash away their failure should have larger signature sizes than participants who do not wash away their failure. For the lotion conditions, I did not expect an attenu-

ation of the previous state. As mentioned, in line with the "rubbing in" metaphor, possibly the opposite could happen: Participants who rub in their success could rather exhibit an increase in signature size compared to participants who experience no modification of their success. Conversely, participants who rub in their failure could rather exhibit a decrease in signature size compared to participants who experience no modification of their failure.

After calculating the change in signature size for each participant, the sizes were entered into a 2 (performance: success vs. failure) x 3 (product used: cleaning vs. neutral vs. hand lotion) between-participants ANOVA. Neither main effect was significant (performance: $F(1,157) < 1$, $p > .66$; product: $F(2,157) = 1.19$, $p > .30$). However, as predicted, the two-way interaction approached significance, $F(2,157) = 3.00$, $p = .053$, $\eta_p^2 = .037$, 95% CI [.000, .102]. As can be seen in Figure 5.1, the effects of the different products reverse for the positive performance condition compared to the negative performance condition.

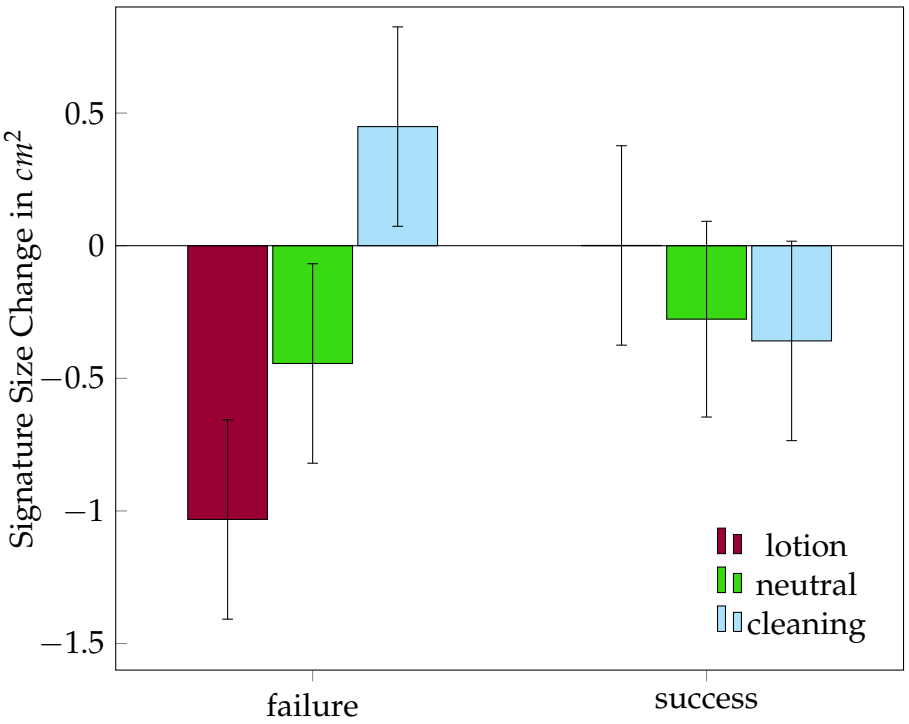

Figure 5.1: Mean change in signature size as a function of cleaning condition and performance condition. Error bars depict +/- 1 SEM.

To further examine the interaction between performance and cleaning condition, I calculated one-way ANOVAs for both performance conditions separately. For the success condition, the analysis clearly failed to reach significance $F(2,79) = .30$,

p = .74. For the failure condition, however, the different products yielded significantly different signature sizes, $F(2,78) = 3.38$, p = .038, η_p^2 = .080, 95% CI [.000, .196]. Participants' signature size change when cleaning after failure (M = 0.45, SD = 1.44) was more positive compared to both the neutral condition (M = -0.44, SD = 1.74), $t(50) = 2.06$, p = .045, d = 0.56, 95% CI [0.01, 1.10], and to the hand lotion condition (M = -1.03, SD = 2.87), $t(52) = 2.40$, p = .020, d = 0.62, 95% CI [0.10, 1.12]. The latter two conditions did not significantly differ from each other, $t(52) = 0.91$, p = .37.

5.3.3 Discussion

Self-esteem (measured by change in signature size) is influenced by one's performance in combination with bodily manipulations that are metaphorically associated with changing the influence of previous experiences. More specifically, after failure at a performance task, cleaning significantly increases threatened self-esteem compared to a neutral action. At the same time, rubbing hand lotion into one's hands has a different, descriptively opposite effect, namely rather decreasing self-esteem after failure even further compared to a neutral control condition (although the simple contrast was inconclusive). This pattern does not hold for participants who experienced success at a performance task before cleaning, rubbing in hand lotion, or performing a neutral action. Rather, descriptively the opposite occurs, namely a decrease in self-esteem after washing and an increase after rubbing in lotion compared to a neutral control condition. Yet these differences were far from significant.

The first conclusion to be drawn from Experiment 3 is that embodied cleansing worked—it lessened the influence of the previous experience. Specifically, embodied cleansing yielded opposite effects for positive and negative performance manipulations. Thus, cleansing did not always increase participants' subjective standing, but indeed yielded effects that differed according to the previously induced state. This finding accords well with H. Xu et al. (2012), who found a similar pattern for luck. After bad luck, washing increases risk taking compared to not washing; yet after good luck, washing decreases risk taking compared to not washing. The present study is the first to demonstrate this opposing pattern in the performance domain. This lends further support to the *clean slate* explanation for embodied cleansing, proposed by Lee and Schwarz (2011). According to this explanation, cleaning one's hands should attenuate the influence of any preceding state—undesirable or desirable.

The second conclusion from Experiment 3 concerns the difference between the two hand motion conditions: The results for hand rubbing with cleaning clearly differ from the results for hand rubbing without cleaning (the hand lotion conditions). This lends support to the hypothesis that a typical cleaning motion is in itself not sufficient to wipe the slate clean. On the other hand, actual cleansing, which consists

of all five aspects mentioned in Chapter 5.1 (sensory and motor features as well as concept activation and self-referential intentional cleaning action), is sufficient for significantly alleviating the influence of previous manipulations. If using lotion has an effect in itself, it seems to be rather in the opposite direction of embodied cleansing. However, the evidence for this idea is far from conclusive, and I will not pursue this question any further.

In sum, Experiment 3 lends clear support for the hypothesis that performing a motion typically associated with cleaning one's hands does not yield embodied cleansing, unless combined with the other aspects involved in cleansing. I had a washing condition, a motion-only condition, and a condition that involved none of the five cleaning aspects. The next experiment examines another cleaning aspect: whether the cleaning concerns oneself or something else.

5.4 Experiment 4: Cleaning Oneself vs. Wiping a Slate Clean

Experiment 4 had two main aims. First, I wanted to examine the influence of embodied cleansing after positive performance again. While the interaction in Experiment 3 indicated a difference between the negative and positive performance conditions, the simple effects for the positive conditions were not significant. Therefore, by changing the manipulation in a way that was intended to make success more salient, I hoped to shed further light on the influence of embodied cleansing on the consequences of success.

Second, by using a different control condition to compare with the "real" cleansing condition, I wanted to examine another candidate factor for producing embodied cleansing effects: whether or not the cleansing refers to the self. As I assumed that physical cleaning would not produce embodied cleansing if it is not self-referential, the control condition consisted in cleaning something other than oneself, here an object. Cleaning an object comprises both the notion of cleaning (and therefore also concept activation) and a cleaning motion—albeit not exactly the same motion as in cleaning one's hands. At the same time, it does not entail the notion of cleaning oneself. I assume that this notion would be necessary, and therefore, cleaning an object should not yield embodied cleansing, i.e., should not lessen one's current state of having succeeded or failed.

More specifically, participants were asked to test a board marker on a transparent plastic board and wipe the board clean again afterwards. Thus, participants' actions in this control condition were close to literally wiping the slate clean. The control condition is, therefore, probably as likely to activate the clean slate metaphor as the cleaning condition, and by that additionally tests whether an activation of the clean

slate metaphor produces the clean slate effect.

As already mentioned, some of the previously published cleansing studies had a control condition with cleaning concept activation (Florack et al., 2014; Lee & Schwarz, 2010b; A. J. Xu et al., 2012). This already shows that mere concept activation is not sufficient to produce embodied cleansing. The present manipulation extends previous concept activation conditions. Instead of only looking at a cleaning product, participants do actively clean something in the present control condition. Thus, the self-cleaning and the object-cleaning conditions are similar in agency and to some degree in the motoric action. The main difference is the reference object of the cleaning: oneself or an object.

5.4.1 Method

5.4.1.1 Participants and Design

82 first-year psychology undergraduates—72 women, nine men, and one person who did not provide demographic information—participated in exchange for partial course credit. Their age ranged from 18 to 42 years (M_{age} = 21.2 years, SD = 3.4 years). Participants were randomly assigned to one cell of a 2 (performance: success vs. failure) x 2 (target of cleaning: self vs. object) between participants design[3]. Two participants did not provide a second signature and were therefore excluded from the analysis.

5.4.1.2 Procedure

After participants were greeted and seated at separate semi-cubicles, they provided informed consent. Their signature on the consent form was used, as in Experiment 3, as the baseline for measuring changes in self-worth.

Then participants performed the bogus intelligence test and received either positive or negative feedback. As in Experiment 3, the success and failure performance manipulations entailed both differently difficult RAT test items and different feedback material. However, instead of feedback by contrast to the performance of another student in the room, participants received a table and graph allegedly indicating how last year's student sample had performed[4]. The success group received predominantly easy items (determined by a pretest), a generous evaluation of which answers were considered correct, and a table and histogram indicating that

[3]20 additional participants were assigned to a condition unrelated to the present hypothesis and will not be mentioned any further.

[4]The material can be found in the electronic Appendix.

last year's student population had performed rather moderately. This should induce a notion of having succeeded at the task. The failure group received predominantly difficult and unsolvable items as well as a table and histogram indicating that last year's student population had performed rather well. As only seven items had a correct solution at all, this guaranteed that all participants received below average feedback. Note that by having participants' feedback depend partly on their actual achievement, I sacrificed the chance of having equally strong manipulations for all participants for an increase in subjective plausibility of the feedback.

Next, participants completed the cleaning manipulation. As in Experiment 3, participants performed a product test that included cleaning their hands. Participants in the hands cleaning condition were asked to evaluate antiseptic hand wipes. For that, they were to take one wipe, clean their hands with it, and fill out a short questionnaire on a clipboard about their opinion concerning the wipes. Participants in the object cleaning condition were asked to evaluate a board marker. For that, they were given a board marker, a single wipe (the same that were used in the hand cleaning condition), and a transparent plastic clipboard containing the questionnaire. Participants were asked to try out the marker on the back of the clipboard, as the surface allegedly was a good substitute for a whiteboard. Then they were to wipe the clipboard clean and fill out the questionnaire about the board marker. All participants complied with these instructions.

For all participants, the final page of the questionnaire asked them to provide a second signature under the guise of permitting or prohibiting their product test data being passed on. The difference between this signature size and the one at the start of the experiment constituted the dependent variable.

Then a number of questionnaires and other tasks succeeded. At the end of the experimental session, participants were thanked and asked to provide their e-mail-address for debriefing, which they received after data collection was complete.

5.4.2 Results

As in Experiment 3, the change in participants' signature size constituted the dependent measure, and this change was calculated exactly as in Experiment 3. The change in signature size values were entered into a 2 (performance: success vs. failure) x 2 (self-reference: cleaning oneself vs. cleaning an object) between-participants ANOVA. While the main effect for the performance manipulation was not significant, $F(1,79) = 0.51$, $p = .47$, the main effect for self-reference reached significance, $F(1,79) = 5.99$, $p = .017$, $\eta_p^2 = .073$, 95% CI [.002, .202], indicating that self-referential cleaning lead to smaller signature sizes than cleaning an object. More importantly, the predicted interaction also emerged, $F(1,79) = 5.43$, $p = .022$, $\eta_p^2 =$

.067, 95% CI [.001, .193].

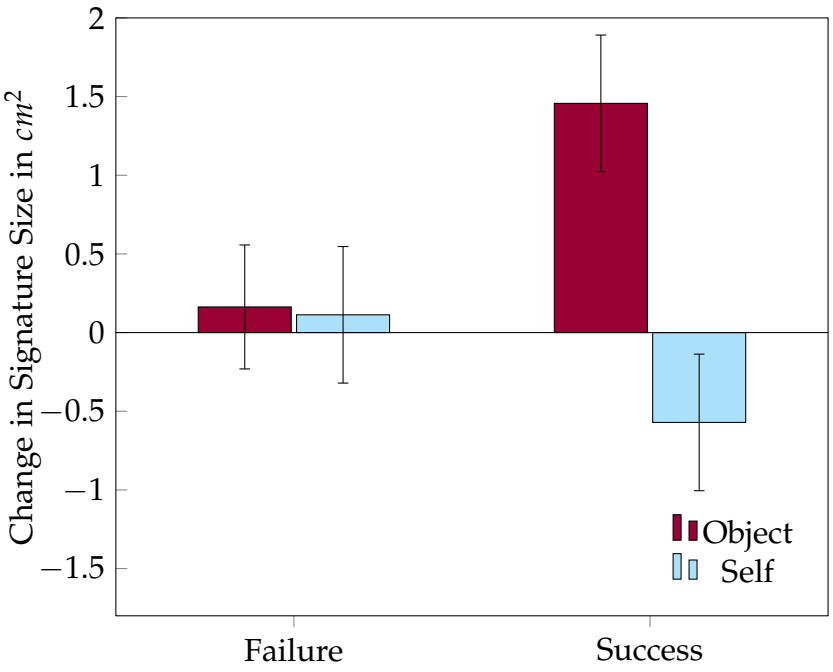

Figure 5.2: Mean change in signature size as a function of cleaning condition (cleaning an object vs. cleaning oneself) and performance condition. Error bars depict +/- 1 SEM.

When cleaning an object, participants who had experienced success showed larger increases in signature sizes (M = 1.46, SD = 2.20) than participants who had experienced failure (M = 0.16, SD = 1.54), $t(40) = 2.24$, $p = .031$, $d = 0.69$, 95% CI [0.06, 1.32], indicating that the performance manipulation still significantly influenced participants' self-esteem. On the other hand, participants who cleaned themselves did not differ in their signature sizes, $t(36) = 1.10$, $p = .28$, depending on whether they had experienced failure (M = 0.11, SD = 1.81) or success (M = -0.57, SD = 2.02) in a previous task, see Figure 5.2.

When conversely comparing self-referential cleaning with object cleaning, there is no difference for signature size change after failure, $t(40) < 0.1$, $p > .90$. However, after success, participants who cleaned an object had more positive signature size increases than participants who cleaned themselves, $t(36) = 2.96$, $p = .005$, $d = 0.96$, 95% CI [0.28, 1.63]. These results accord with the hypothesis that cleaning something else does not remove the traces of past experiences while cleaning oneself does—in this experiment, however, mainly after success and not so much after failure.

5.4.3 Discussion

Participants who cleaned an object showed more increase in signature size after experiencing success than after experiencing failure. However, participants who cleaned themselves did not differ in their signature sizes depending on their performance experience. Thus, while embodied cleansing removes the impact of previous performance on self-esteem, cleaning something else is not efficacious in removing the traces of the past. Therefore, self-reference is an essential factor in embodied cleansing. When cleaning without self-reference, past performance looms larger than when cleaning oneself.

Concerning the aspects of cleansing explained in Chapter 5.1, Experiment 4 held intentional cleaning constant and varied self-reference of the cleaning[5]. By showing a difference between cleaning oneself and an object, the present experiment provides evidence that self-reference is essential for embodied cleansing.

While embodied cleansing in Experiment 3 had a stronger effect on failure than on success, the pattern reverses in the present experiment. Here, the significant interaction is mainly driven by the difference in the success condition, while the signature size change after failure is negligible. This difference is probably due to differences in the manipulation of success and failure in the two experiments, rather than to differences in the influence of embodied cleansing on success and failure in the two experiments. Thus, in Experiment 4 the success manipulation was probably stronger and thus yielded stronger changes in self-esteem, whereas in Experiment 3 the failure manipulation was probably stronger and therefore yielded stronger changes in self-esteem. While in Experiment 3 the successful participants only noticed that they were faster than the other student, in Experiment 4 successful participants saw statistics showing that they were distinctly better than many of their peers. Conversely, the failure manipulation was probably more salient in Experiment 3 than in Experiment 4, because public failures can be more devastating to self-evaluations than private failures (e.g., Stotland & Zander, 1958; see also Brown & Gallagher, 1992). And in Experiment 3 the experimenter and in some measure the other participant were aware of the poor performance of the participant in the failure condition while in Experiment 4 the information on their performance was only seen by the participants themselves.

Taking the two experiments together, the evidence for embodied cleansing affecting positive as well as negative states improves. The clean slate explanation predicts that all previously induced states can be attenuated by cleaning one's hands. While information for negative and neutral states is sizable, this is only the second instance

[5]As the motor action and sensations were not perfectly identical either, those two aspects will be controlled in Experiment 5.

of a desirable state being affected by washing one's hands. Experiment 5 will try to gain additional support for the influence of embodied cleansing on success.

5.5 Experiment 5: Intentional vs. Unwitting Cleansing

Experiments 3 and 4 show that cleaning (but not lotioning) oneself (but not an object) attenuates the influence of one's previous performance. These results, while showing the boundary conditions of embodied cleansing, do not directly examine the proposed mechanism, namely direct state induction. To recap, direct state induction seems plausible because of the broad range of effects unrelated to morality and cleanliness. However, for embodied cleansing to be a process-pure instance of direct state induction, it has to follow directly from the cleansing manipulation without being mediated by cognitive processes.

Experiment 5 tests this strong feature of direct state induction by holding the actual cleansing constant and varying cognitive inferences associated with it. This was done by having participants use an ambiguous cleansing product that was either said to be hand sanitizer or hand lotion. If embodied cleansing is purely driven by direct state induction, it should not matter whether the hand sanitizer is used under the guise of using a hand lotion, it should still produce embodied cleansing, as direct state induction works even when participants are not aware of the state or action that is meant to induce a specific state. If, on the other hand, inferential processes play an essential part in embodied cleansing, cleaning oneself without knowing it should not yield embodied cleansing.

Concerning its experimental procedure, Experiment 5 is somewhat similar to Experiment 4; specifically, it provides performance feedback in a similar manner, although using a different task. However, the main dependent variable differs. In this experiment, I used change in optimism about one's performance as a main dependent variable. Previous performance influences estimates of future performance in a similar task (e.g., Greenwald & Farnham, 2000; see also Kaspar, 2012), and should therefore be a reliable measure of how much previous success or failure still influences participants.

Additionally, I employed the signature size measure used in Experiments 3 and 4. However, the initial signature was collected at the start of the experimental session and different experiments followed in between the first signature and the present experiment. Although not manipulating participants' self-esteem, these experiments differed in length and difficulty, and could therefore influence signature size independently of the present experiment. Therefore, results concerning signature size should be interpreted with caution.

5.5.1 Methods

5.5.1.1 Participants and Design

126 participants were recruited (95 women and 31 men). Their age ranged from 17 to 52 years (M_{age} = 21.8 years, SD = 5.2 years). Participants were either compensated with partial course credit or by receiving €7 for a multi-experiment session that lasted about an hour. Participants were randomly assigned to one cell of a 2 (performance: success vs. failure) x 2 (product label: cleaning vs. hand lotion) between participants design.

5.5.1.2 Procedure

The general experimental procedure was similar to the previous experiments. After participants were greeted and seated at separate semi-cubicles, they provided informed consent. Then participants performed one of two unrelated experiments that took ca. 15 min or 35 min respectively.

The next task was an alleged aptitude test which consisted of items of Raven's Advanced Progressive Matrices (Raven, Raven, Court, & Bulheller, 2008). Developed as a non-verbal intelligence test, participants see a figure where the lower right corner is missing. Additionally participants see eight options for solutions and are asked to indicate the right solution—the one that completes the figure. For that, participants first received instructions and a sample item. Having indicated that they understood the task, participants performed three test items with a time limit of 50 seconds for each item. Immediately after submitting an item, participants received feedback on whether or not they had solved it correctly.

After they had completed all three test items, participants indicated their agreement to statements about generally feeling optimistic at the moment, and about feeling optimistic about their performance in the upcoming task. Answers were given on a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely well*)[6]. Then, participants answered the same questions about pessimism instead of optimism. The answers for optimism and pessimism were averaged into an optimism (M = 3.35, α = .81) and pessimism (M = 2.66, α = .81) score respectively.

Next, participants completed 12 new matrices, again with a maximum time of 50 s per item. Eight items were identical for all participants; additionally participants in the success condition received four comparatively easy items and participants in the failure condition received the four most difficult items in the test. Again participants received instant feedback. However, the feedback did not always accord with actual performance. Specifically, for some items in the success condition,

[6]For the original German wording of the questions and scale see the electronic Appendix.

participants received success feedback not only if their answers were correct but also if their answers were similar to the correct answer. And participants in the failure condition received failure feedback on six difficult items, even if they had given the correct answer. After completing all twelve matrices, participants received cumulative feedback, which consisted of the number of items for which they had received success feedback and statistics about the alleged percentage of previous participants who had scored worse, the same, and better. The comparison data were presented in numbers and in a histogram. And like in the previous experiment, the comparison data were fictitious and meant to enforce that participants' own performance was relatively better (success condition) or worse (failure condition) than their peers'.

The next task comprised the cleaning manipulation. Like in Experiments 1–4, participants completed a product test that contained the cleaning manipulation. This time, all participants received the same product, a white emulsion in a small transparent flask—the product was a mixture of sanitizer, dye, water, and a thickening matter. The instructions stated up front which kind of product would be tested: either a new hand sanitizer (cleaning label condition) or a new hand lotion (non-cleaning label condition). All participants were asked to use a small amount and disperse it evenly on their hands until it was completely absorbed. As in the previous experiments, participants were then asked to fill out a questionnaire about the product, which enforced the alleged product identity once more. For all participants, the final page of the questionnaire asked them to provide a second signature.

Next, participants were informed that they were about to perform another bout of the intelligence task. Using the same questions about optimism and pessimism as in the beginning of the experiment, participants once more indicated their optimism in general and about the ensuing task. The difference between optimism after the manipulation and optimism previous to the manipulation constituted the dependent measure.

Then a number of questionnaires and other tasks succeeded. At the end of the experimental session, participants were thanked and either debriefed directly or asked to provide their e-mail address for debriefing, which was sent to them after that round of data collection had ceased.

5.5.2 Results

One participant was excluded for scoring more than three standard deviations from the group mean in the performance manipulation. For the other participants, the change in optimism was computed by subtracting the pre-manipulation optimism

from the post-manipulation optimism.

The change in optimism was then entered into a 2 (performance: success vs. failure) x 2 (product label: cleaning vs. non-cleaning) between participants ANOVA. No main effect for the cleaning (i.e., product label) condition emerged, $F(1,121) < 0.1$, $p > .70$, but a significant main effect for the performance condition emerged, $F(1,121) = 26.57$, $p < .001$, $\eta_p^2 = .180$, 95% CI [.072, .297], indicating that participants in the success condition showed larger increases in optimism than participants in the failure condition, see Figure 5.3.

Importantly, the predicted two-way interaction also approached significance, $F(1,121) = 3.67$, $p = .058$, $\eta_p^2 = .029$, 95% CI [.000, .109]. While participants who used a non-cleaning product showed an increase in optimism after success, $t(28) = 3.56$, $p = .001$, $d = 0.66$, 95% CI [0.25, 1.06], and a decrease in optimism after failure, $t(31) = 2.85$, $p = .008$, $d = 0.50$, 95% CI [0.13, 0.87], these effects were attenuated after using a cleaning product (success: $t(30) = 1.76$, $p = .090$, $d = 0.32$, 95% CI [-0.05, 0.67]; failure: $t(32) = 2.03$, $p = .051$, $d = 0.35$, 95% CI [-0.00, 0.70]).

The change in signature size, as an additional dependent variable, did not yield any significant results, all Fs$(1,121) < 1$, ps $> .30$.

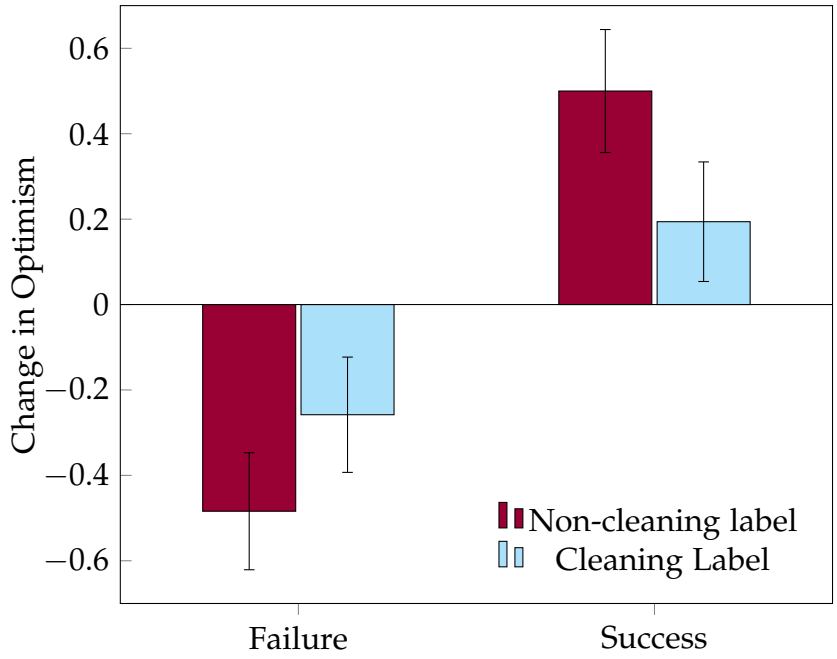

Figure 5.3: Mean change in optimism as a function of cleaning condition and performance condition. Error bars depict +/- 1 SEM.

5.5.3 Discussion

The present results support the role of cognitive inferences in embodied cleansing. While all experiential components (e.g., texture, smell, movement) were held constant, the notion of whether or not participants were knowingly cleaning their hands influenced how much their previous performance influenced their present optimism. Specifically, participants who did not think they cleaned their hands were strongly influenced by their previous experience of success or failure, while participants who thought they cleaned their hands where less strongly influenced by their previous performance. Thus, embodied cleansing is not purely driven by direct state induction—or, indeed, by another of the three automatic embodiment effects described in Chapter 2—but seems to rely in some measure on cognitive inferences.

This result confirms what probably most people would have predicted, namely that humans do not have a "cleanness sense" that tells them, independently of what they see or know, how clean they are. Still, from the point of view of testing underlying mechanisms, finding out whether cognitive inferences are essential to embodied cleansing is important. Direct state induction has to be independent of cognitive inferences. Consequently, as this is not the case in embodied cleansing, embodied cleansing cannot be driven purely by direct state induction, but relies to some degree on cognitive inferences. That is, in contrast to body posture, for example, sensorimotor feedback from cleaning oneself does not of itself create the embodied effect. The knowledge of cleaning oneself has to be present as well.

Contrary to Experiments 3 and 4, the signature size change as a measure of implicit self-esteem did not yield any effects. This might be due to the fact that, for logistic reasons, the tasks that followed the first signature differed between participants. Every participant performed one of two unrelated tasks that, however, differed in their length, and thus probably in how tiring they were. This might have influenced participants' level of arousal or energy which possibly might influence their signature size independently of self-esteem. Note that change in optimism, the main dependent variable in this experiment, is not affected by this methodological flaw, as both the pre- and the post-measure were collected after the unrelated task had been performed.

5.6 Chapter Discussion

Two main results have been established in the present chapter. The first one is an extension of the scope of the clean-slate effect. And the second one is a refinement of instrumental factors and underlying mechanisms contributing to embodied cleans-

ing.

First, cleaning one's hands attenuates not only consequences of failure but also of success. Even though this was clearly predicted by the clean slate hypothesis (Lee & Schwarz, 2011), it is, to the best of my knowledge, only the second demonstration where "the positive version" of an effect proves soluble in addition to the negative one (the first one being luck; see A. J. Xu et al., 2012). Moreover, it is a more rigorous test for the clean slate effect. Luck in gambling situation waxes and wanes and has in general no particular relevance to the self-concept. Intelligence and cognitive abilities in general, on the other hand, are an integral part of many students' self-concept. Therefore, while getting rid of negative feedback might be particularly self-serving, holding on to positive feedback is also self-serving. To reiterate, the clean slate notion predicts attenuation of all kind of influences by embodied cleansing. However, up to now, mainly states that one presumably wants to get rid of have been washed away. Some states, namely the ownership states in Lee and Schwarz (2010b) and Florack et al. (2014), might be considered as rather neutral, and the positive luck in A. J. Xu et al. (2012) might even be mildly positive. But none is as positive and as important to a positive self-view as a surpassing academic self-concept for first year undergraduates. Therefore, while generally negative or neutral states have been washed away, here we find for the first time a distinctly important and positive state, which presumably participants would want to keep, is affected by embodied cleansing in a like manner and apparently to a comparable degree as its negative counterpart.

In Chapter 5.1, p. 50, I split the act of hand washing into five components. Cleaning involves (a) a distinct motor action with (b) corresponding sensory feedback, (c) concept activation, and (d) the conviction of cleaning (e) one's own body. Concept activation had already been shown to be not the driving factor for producing embodied cleansing (e.g., Lee & Schwarz, 2010b). Here, Experiments 3 and 5 ruled out that cleaning movements are instrumental in embodied cleansing; and 5 additionally showed that even a combination of the cleaning movement with the corresponding sensory input does not produce embodied cleansing unless accompanied by an awareness of cleaning. Experiment 4 additionally showed that the cleaning has to refer to oneself to result in embodied cleansing. Therefore, deliberately cleaning one's own body is necessary for embodied cleansing.

I was not able to examine all five aspects independently of each other. An activation of the cleaning concept necessarily follows from the conviction of cleaning—making these two aspects non-independent. Still, previous experiments show that concept activation itself is not the crucial aspect in the conviction of cleaning oneself (Florack et al., 2014; Lee & Schwarz, 2010b; A. J. Xu et al., 2012). Moreover, I have only tested the conviction of cleaning one's own body when participants were actually cleansing their own body; thus actual sensorimotor cleaning states (aspects a and b) were also present. Therefore, I cannot say whether either or both are

necessary for embodied cleansing. However, as Experiment 5 shows, those aspects are not sufficient for embodied cleansing. From that, I conclude that—even though other aspects may be necessary—the last two aspects, conviction of cleaning and self-reference of this cleaning conviction, are instrumental in embodied cleansing.

Additionally, the experiments in the present chapter highlight the role of conscious inferences in embodied cleansing. Unwittingly cleaning oneself does not result in embodied cleansing. Therefore, embodied cleansing is not purely driven by *direct state induction*, nor even by a combination of direct state induction with the other two automatic embodiment mechanisms. Instead, embodied cleansing seems to be caused by a combination of conscious inferences and direct state induction.

Chapter 6

General Discussion

6.1 Appraisal of Embodied Cleansing Results

In the present thesis, I presented two lines of experiments on embodied cleansing. Having first established two possibly different embodied cleansing mechanisms, I tried to pit the two against each other in the first line of experiments. However, no significant influence of embodied cleansing could be found, neither when the two explanations were expected to counteract each other, nor when they were expected to strengthen each other. Moreover, the analyses confirmed that any effect is in all likelihood small at best. However, an additional analysis comparing the positive and negative moral manipulation uncovered that not even an influence of the moral manipulation on prosocial behavior emerged. This precluded any possibility of embodied cleansing to occur. Thus, no conclusions regarding embodied cleansing could be drawn from Chapter 4.

The second line of research tested mechanisms in embodied cleansing. Embodied cleansing influenced consequences of success and failure in a performance test. Specifically, estimates of future performance (Experiment 5) and self-esteem (Experiments 3–4) were less influenced by previous success or failure after participants had cleaned their hands than after they had performed a control action. The control actions were similar to physical cleansing in several respects, thus allowing for conclusions about which aspects of physical cleaning are instrumental in producing embodied cleansing. Rather than sensomotoric feedback, an intentional and self-referential cleaning action seems to be decisive for embodied cleansing (for a discussion of underlying mechanisms see Chapter 6.1.2).

6.1.1 The Stability of Embodied Cleansing

Comparing Chapter 4 with Chapter 5, the chapters on cleaning after moral vs. performance manipulations, suggests a more definitive interpretation for the null-result

in Chapter 4. Chapter 5 finds a reliable embodied cleansing effect, that is a significantly reduced influence of previous experiences for participants who cleaned their hands. Yet the experimental material for the cleansing manipulation was virtually identical to the material used in Chapter 4. Therefore, the different results are not due to the operationalization (e.g., the used product, cover story, or instructions) of the cleansing manipulation. Nor could they be due to cultural differences or any other factor regarding the participant population as these factors should have influenced both lines of experiments alike.

A theoretical explanation, namely that cleansing simply does not influence changes in one's moral state while influencing changes in one's performance state, is possible, yet not plausible as it contradicts both proposed theoretical accounts of embodied cleansing. If there is a difference in how much embodied cleansing influences effects in different content domains, this influence should be strongest—not weakest—in the domain of morality. The moral purity explanation only postulates effects in the moral domain and the clean slate explanation postulates a domain general effect. Therefore, to the extent that either explanation holds, washing one's hands after feeling morally negative should increase one's subjective moral standing. And it should certainly influence morality if it influences performance.

Thus my conclusion on the null-effect in Chapter 4 is not altered from what it was in Chapter 4, but it is rather strengthened. The moral and immoral manipulation did not affect the used measure for prosocial behavior in the expected way, see Chapter 4.7. Additionally, the results from Chapter 5 suggest that embodied cleansing works, given the initial manipulation influences the dependent measure in the predicted way. All in all therefore, I interpret my results as rather speaking for the stability of embodied cleansing than against it.

6.1.2 Underlying Mechanisms of Embodied Cleansing

Cleaning one's hands is a multi-faceted act and could plausibly be influenced by different embodiment mechanisms. As discussed in Chapter 5.1, sensorimotor simulation seems unlikely to be involved in embodied cleansing and will therefore not be discussed further. However, as described in detail in Chapter 3, to me there seem to be two qualitatively different kinds of embodied cleansing effects, one content-specific and characterized by an association between immorality and uncleanness—the moral purity explanation—and the other one broad in its consequences and described by the metaphor of wiping the slate clean. As suggested in Chapter 3.3, these two forms of embodied cleansing might be caused (exclusively or at least predominantly) by two different embodiment mechanisms: *moral purity* effects might be caused by *modal priming*, while *clean slate* effects might be caused by

direct state induction.

As none of the present experiments examined *moral purity* directly, my analysis of moral purity effects does not change from what it was in Chapter 3.3. To recap, for some of the experiments recounted in Chapter 3—for example, semantic priming of the cleanliness concept by immorality words (Yan et al., 2011)—the moral purity explanation, and modal priming as its cognitive mechanism, seems most plausible.

Concerning the clean slate explanation, and direct state induction as the underlying mechanism, Chapter 5 adds some new insights. The results of Experiments 3–5 strengthen the clean slate explanation by showing that an elevated achievement-related self-esteem—a distinctly positive and self-serving state—can be attenuated by embodied cleansing. This result broadens the scope of embodied cleansing effects further, and broadness of consequences is a feature not explained by any mechanism but direct state induction. Therefore, by strengthening the clean slate explanation, the results also strengthen direct state induction as a mechanism.

However, as Experiment 4 shows, clean slate effects also depend on conscious inferences. Using hand sanitizer without knowing that one's hands are getting cleaned results in physical but not in embodied cleansing. However, knowledge of the nature of the embodied action is not necessary for direct state induction—or indeed for any other automatic embodiment mechanism. Therefore, conscious inferences contribute to embodied cleansing.

Yet, it is extremely unlikely that conscious inferences could yield embodied cleansing without automatic embodiment mechanisms. For conscious inferences to be the sole driving mechanism, two conditions would have to hold: an awareness of the embodied action (cleansing) would have to be necessary for the effect; additionally, an awareness of the association between cleaning and its consequences (i.e., a reduced influence of the previous manipulation) would also have to be necessary for the effect. In other words, people have to be aware that they clean their hands and additionally that this cleaning reduces the influence of their previous performance on the following task. Thus, if conscious inferences were the sole driving mechanism, no embodied cleansing effect could occur for participants who are not aware of this association.

However, participants were not aware that cleaning their hands should influence how much their previous performance continues to affect them. Indeed, when asked about their best guess of the study's purpose before debriefing, none of the participants in Experiments 3–5 mentioned a hypothesis even remotely connected to embodied cleansing. In Experiments 3–4, even the awareness that the previous manipulation influences the dependent measure was presumably lacking. All interviewed participants expressed surprise when we told them their signatures were purposefully elicited as signature sizes should vary according to their performance.

In fact, many participants reacted by apologizing, saying that they had signed just as they always did.

In sum, while being aware of the action of cleaning oneself seems necessary for embodied cleansing, being aware of the clean slate effect is not necessary and was not given in Experiments 3–5. Accordingly, conscious inferences cannot have been the sole driving mechanism. Thus, both direct state induction and conscious inferences seem to operate in embodied cleansing.

6.1.3 Cultural Functions of Cleansing

Cleansing seems to lie at an interesting juncture between more purely experience-based embodiment effects—like the connection of social and physical warmth (Williams & Bargh, 2008)—and rather more symbolic embodiment effects—like many gestures, for example, the hostile middle finger (Chandler & Schwarz, 2009). It seems that washing is sometimes more symbolic, while at other times it is purely "physical". Its being both makes it an interesting object for study.

Cleaning's physical nature is obviously culturally and historically universal. Every human being, during all times, removed physical dirt by washing and felt the difference it made. Though notions of hygiene vary greatly[1] , every culture observes some kind of cleaning standards; and at least hands (though not bodies), seem to have been washed through the ages and cultures (Ashenburg, 2010). Moreover, hygiene is simply necessary for survival—a culture without hygiene would become extinct.

Not only physical cleaning is culturally universal, even symbolic cleansing is. Though again practices vary greatly, the broad classes of cleansing occasions are similar. Cleaning thus seems to be a "natural symbol" (Twigg, 2000; Douglas, 1966): though imbued with different specific meanings by different cultural practices, its prevalence suggests that washing is natural "raw material" for creating a symbolic action.

I argue there are two broad classes of symbolic cleansing occasions. First, people observe purification rituals in connection with religious practices. All religions seem to observe cleansing rituals when dealing with the sacred. Importantly, cleansing in these rituals always restores or affirms order. While dirt is "matter out of place" (Douglas, 1966), cleansing remedies this lack of order. Thus, cleansing in this symbolic meaning has a clear valence—it improves (the situation). This pancultural use of symbolic cleansing in handling different levels of spiritual purity fits well with

[1]Indeed, what is considered clean, healthy, and normal by one group, may be termed excessive and self-indulgent or, conversely, uncivilized and dirty by another (Twigg, 2000).

the notion of embodied cleansing as moral purification.

Second, washing is central to many rites of passage (Van Gennep, 1960)—of transition from one phase of life or social state to another. In this context, washing can serve to separate people from their previous community or life, but it can also be a means of introducing them into their new life (Van Gennep, 1960). For example, brides and grooms in many cultures ritually wash off their single state before marrying, and people in most cultures wash their dead to prepare them for their last journey (Ashenburg, 2010). Cleaning as a sign of passage, of separation form the old and incorporation into something new, accords well with the clean slate explanation of embodied cleansing: one's life up to date is closed to a large degree, something new begins and the old does not matter anymore. Accordingly, studies have shown that, for example, one's previous choices do not constrain one's evaluations anymore (Lee & Schwarz, 2010b), nor does one's previous performance determine one's optimism (Kaspar, 2012).

In sum, the two classes of embodied cleansing effects accord well with two classes of cultural cleaning rituals. While *moral purity* effects accord with religious purification practices, *clean slate* effects accord with washing as rites of passage. To be sure, separate anthropological rituals do not guarantee separate underlying psychological processes, but they highlight the difference in symbolic meaning that can suggest the possibility of psychologically different effects.

6.1.4 Further Questions About Embodied Cleansing

The present results shed some light on the processes underlying embodied cleansing, at least in clean slate effects. The difference between moral purity and clean slate effects seems plausible both as different experimental effects and as driven by different psychological processes. However, empirical proof has only ever been gathered for the two classes separately. To show that they indeed differ, experiments should directly compare moral purity and clean slate effects. For that, some of the tests proposed in Chapter 2.6 could be used on both effects in parallel.

Additionally, a test of the five aspects of physical cleansing proposed in Chapter 5.1 might yield interesting results when applied to moral purity effects. As already mentioned, if the mechanisms differ, differing operating conditions are also plausible. And indeed there is some evidence that cleanliness priming might produce moral purity effects (e.g., Helzer & Pizarro, 2011; H. Xu et al., 2014) while it does not produce clean slate effects (e.g., A. J. Xu et al., 2012). Similar differences might emerge for other factors as well. Especially testing whether conscious inferences are essential for moral purity effects seems interesting to me. On the face of it, there is no reason why there should be a difference; however, Cohen and Leung (2009) men-

tion an experiment where the cleaning motion (rubbing one's hands for warmth) seems to affect moral judgments in a similar manner as embodied cleansing does. This being the case, the sensomotoric components might also produce moral purity effects, independently of all other aspects detailed in Chapter 5.1—therefore, also independently of cognitive inferences.

Another interesting open question concerns the state that is induced by embodied cleansing. My results accord well with the clean slate notion—remnants of the past are removed by cleaning. But it is unclear how exactly information processing is altered. With other effects, some concept is activated, leading to increased accessibility and usage in subsequent tasks. Here, everything seems to be deactivated: Everything that mattered before is gone, is less important at least. This accords with an altered motivational state or mindset. However, it is less clear what this mindset might look like. To me, it might be an increased openness for new experiences. However, preliminary tests of this idea have been inconclusive. To my knowledge, no data exist that would support an alteration in this or any other mindset or motivational state.

6.2 Embodiment Mechanisms

In this thesis, I have proposed mechanisms of how the human body, its morphology, states, and actions, can influence human cognition and behavior. However, the present framework is not the only framework for classifying embodiment effects.

6.2.1 Comparison to Different Frameworks

The distinction most similar to my mechanism framework is Cohen and Leung's model for cultural embodiment effects (2009). This model describes two types of cultural embodiment mechanisms—evolutionarily pre-wired connections (resembling *direct state induction*) and totem connections (resembling *modal priming*). Pre-wired connections follow a two-staged course: first, bodily configurations automatically trigger basic affective and cognitive states, but they do not completely determine those states, as the link is underspecified (see IJzerman & Cohen, 2011). Second, these configurations prime more complex ideas and representations. Totem connections, on the other hand, directly prime complex representations by bodily configurations.

The greatest similarity between *pre-wired embodiment* and *direct state induction* is that both are seen as stable and universal. Similarly, *totem embodiments* and *modal priming* both heavily rely on learning. However, *direct state induction* is a more narrow category than *pre-wired embodiment*, while *modal priming* is more comprehensive than *totem embodiment* and can include non-arbitrary associations. Moreover, my

conceptualization is more comprehensive, encompassing non-social effects as well, and, most importantly, including sensorimotor simulation effects. By focusing on the mechanisms, moreover, my framework is naturally more explicit concerning cognitive processes in embodiment.

Other research programs are also related to my mechanism approach. A particularly vibrant research area examines the origins of embodiment. The question revolves around how embodiment came about, what led to the development of effects that we can now observe (e.g., Bargh, Schwader, Hailey, Dyer, & Boothby, 2012; Casasanto, 2014; Williams, Huang, & Bargh, 2009). Various sources for associations between bodily and mental states have been suggested: Some effects can be derived from features of the human body or the physical world (Lakoff & Johnson, 1980; Myachykov, Scheepers, Fischer, & Kessler, 2014). For example, larger numbers are rather associated with higher than lower positions in vertical space (Ito & Hatta, 2004). This association can be explained by our constantly experiencing gravitation, which naturally leads smaller numbers of objects forming lower piles and greater numbers of objects forming higher piles. Presumably early learning and constant reinforcement promote or constrain these ecological associations in human minds (Myachykov et al., 2014).

For other associations, people may have hard-wired—or at least pre-wired—predispositions, without there being any obvious necessity for the specific association. For example, people might have a predisposition to associate some bodily poses with specific mental states (Cohen & Leung, 2009), or there might be a hard-wired association between social and physical warmth (e.g., IJzerman et al., 2012; Inagaki & Eisenberger, 2013). Both ecological and prewired associations should yield culturally universal effects and be non-arbitrary (Bargh et al., 2012).

Still other effects rely on learned associations that are more or less arbitrary. And these associations can vary between cultures. For example, the direction of the mental time-line (i.e., the past is on the left and the future on the right side vs. the other way around) varies with a culture's writing direction (Tversky, Kugelmass, & Winter, 1991; Ouellet, Santiago, Funes, & Lupiánez, 2010). Moreover, some effects seem to be specific to the language especially the specific linguistic metaphors used in a society. For example, associations of time flow with the back to front axis reliably vary with metaphoric associations (e.g., Boroditsky, 2000, 2001; Boroditsky & Gaby, 2010; see also Casasanto, 2014). To explain how the learning of metaphoric associations occurs, *scaffolding* and *neural re-use* have been suggested as the operating principle (Anderson, Richardson, & Chemero, 2012; Williams et al., 2009). New concepts are formed using the structure of old ones—particularly abstract concepts using concrete ones, for example, time using distance. The structure of the already familiar concept pervades in the new concept (Williams et al., 2009).

While certainly intriguing, the question of the origin of embodiment effects is only weakly related to their underlying mechanisms. In general, there is no one-to-one mapping of developmental course and operating mechanism. However, origin constrains mechanisms in some instances. For example, completely arbitrary associations, cultural or linguistic ones, can only be accounted for with modal priming (as detailed in Chapter 2.6.2). Yet all three mechanisms can support ecological connections between the body and mind. Therefore, knowing the origin of an embodiment effect generally does not reveal its underlying mechanism.

In other cases, distinguishing embodiment effects according to their origin requires distinctions that do not matter for their underlying mechanisms. For example, whether a modal priming effect was established by early physical experiences or correlations in linguistic experiences does not influence the operation of modal priming. Thus, though the two approaches share some similarities and can inform each other to some degree, origins and mechanisms of embodiment are not equivalent.

6.2.2 Appraisal of the Present Framework

Embodiment research has put forth a plethora of different effects that, at the face of it, seem very heterogeneous. Moreover, with several psychological sub-disciplines studying embodiment effects, the literature seems to drift apart somewhat. For example, cognitive psychology hardly mentions social findings, while social publications tend to ignore developmental findings. For that reason, integrative theories are especially important to foster coherence. Integrative frameworks are particularly useful if, as I believe to be the case with embodiment, the underlying processes are very similar, even if the methods and results might look different. Thus, cross-fertilization could be facilitated by a common framework and common terms.

A classification of embodiment effects depending on semantic category, on the other hand, seems less suitable when causal mechanisms are of interest. Effects within the same subject domain may be caused by different mechanisms. For example, approach–avoidance effects can have different mechanisms, either directly inducing a motivational orientation (Koch et al., 2008; Neumann & Strack, 2000) or being (in)compatible with a sensorimotor simulation (Duckworth, Bargh, Garcia, & Chaiken, 2002). Conversely, the same mechanisms can account for effects in different sub-disciplines. For example, sensorimotor simulation can be found in motivational (approach–avoidance, e.g., M. Chen & Bargh, 1999), cognitive (object affordances, e.g., Tucker & Ellis, 1998), developmental (problem solving, e.g., Boncoddo, Dixon, & Kelley, 2010; see also Kontra et al., 2012), and social psychology (preference judgments, e.g. Shen & Sengupta, 2012). Thus, even when classes of effects look very different, the underlying mechanisms might be similar. Therefore, dividing

along effects instead of mechanisms impedes the advancement of knowledge.

In sum, my current approach of examining cognitive mechanisms seems suitable for investigating embodiment. A closer understanding of the mechanisms underlying embodiment will advance and hopefully unify the field. Moreover, with the distinction of mechanisms and the emphasis on empirical tests for the proposed mechanisms, I hope the present framework might be a valuable contribution to that.

On a more critical note, one might argue that having three different embodiment mechanisms is not very parsimonious. Indeed, on a different level of analysis, the mechanisms might not be very different after all. At least two different "one mechanism explanations" for embodiment are conceivable. First, one could argue that, at the bottom of it, everything might be parsimoniously explained by simulation as the one embodiment mechanism. State induction might result from particularly strong simulations, and modal priming is superfluous as simulation can influence the accessibility of concepts. Second, alternatively all embodiment effects could be explained by priming in a multi-modal storage. What looks like simulation could be just the partial activation of a behavioral schema that is associated with a concept. And state induction could result from a complete activation of behavioral schemas.

However true this may be, at the level of analysis that I have chosen, the properties of the mechanisms differ considerably, and this difference can account for observed differences in embodiment effects. For example, priming cannot explain how embodiment influences fluency effects (e.g., why eating popcorn prevents the false-fame effect Topolinski & Strack, 2010; see also Topolinski, Lindner, & Freudenberg, 2014). Similarly, simulation cannot explain why unscrambling sentences about religion should increase the accessibility of cleaning related words (Preston & Ritter, 2012). Therefore, the greater complexity results in an increase of explanatory power. Whether this increase is worth the price of less parsimony is a matter of opinion. Future theories and experiments have to show which level of analysis proves most fruitful for advancing our understanding of embodiment.

In my description of mechanisms, and especially of tests, I have relied on current knowledge concerning moderators and operating conditions for embodiment effects. As this knowledge advances, so can an account of how to tease apart the workings of different mechanisms. For example, individual differences in size of embodiment effects are presently hardly incorporated into the framework. Similarly, the role of interoception seems to be a potent factor in embodiment (Füstös, Gramann, Herbert, & Pollatos, 2013; Herbert & Pollatos, 2012; Pollatos & Schandry, 2008); but its underlying mechanism does not seem clear yet. Another particularly useful factor for empirically distinguishing the different mechanisms might be conditions for contrast effects. Up to now, most published embodiment effects show an assimilative pattern. However, distinct predictions can be derived when contrast effects should occur: In sensorimotor simulation, specific differences in timing should

be important (Reed & McGoldrick, 2007), while in modal priming differences in the target of evaluation (or other factors known to determine assimilation or contrast effects in priming) might play a greater role. Moreover, in direct state induction, contrast effects should never occur in the induced state, unless influenced by additionally working inferential processes.

Thus, I do not see my present description of embodiment mechanisms as final by any means. For me, the present framework represents an interim summary to explain mechanisms for how the body might influence the mind. I hope it will be tested and refined in the future.

6.3 Thoughts About Embodiment

Embodiment theories agree in giving a prominent role to the body in mental processes. Information is processed in a modal way, and representations contain or even consist of modal elements. Different embodiment theories agree thus far. However, not surprisingly, at a slightly more detailed level differences emerge. For one thing, different approaches stress different aspects, for example, the role of simulation (Barsalou, 1999), of metaphors for abstract concepts (Lakoff & Johnson, 1980), or of situatedness (Clark & Chalmers, 1998). However, differences even exist in fundamental aspects of how the mental representation system works—even whether there are central representations at all (Glenberg et al., 2013).

6.3.1 Radicalism of Embodiment

Accepting embodiment as an important part of human cognition leaves much room for differences in what this embodied cognition might look like. Embodiment theories differ in the scope, the radicalism of the body's (and the environment's) role in information storage and processing: from being just another source of input for amodal information processing to a radically different form of cognition (Barsalou, 2010; Kiverstein, 2012; Machery, 2007; M. Wilson, 2002).

Probably the "mildest" form of embodiment uses essentially amodal theories to explain cognition. This form of embodiment generally stresses its situatedness and reliance on bodily states; cognition takes place while interacting with the world, receiving sensory input and acting at the same time as thinking, and having to take changes in the world and time constraints into account (M. Wilson, 2002). Still however, cognition works in the brain using abstract concepts which happen to include modal elements. Thus, the body is still merely an input-output device for traditional cognition. The only new aspect is that the role of this input-output device is strengthened and gets more attention. For example, input from bodily actions or sensations influences the accessibility of concepts, but concept accessibility in an

associative network is still considered the mechanism of cognition (Lee & Schwarz, 2014b).

On the other end of the spectrum are notions of embodiment that completely discard amodal cognitive processes and amodal representations (Chemero, 2013; Clark, 1999; Prinz, 2009). Those theories try to explain how all higher processes are completely grounded in sensorimotor actions or reenactment processes. On an enactment view, sensation, conceptual processes, and action cannot be meaningfully separated. Sensations and conception are thought to be caused by actions and cannot work independently (Prinz, 2009). In their most radical form, embodiment theories dispense with internal representations altogether (Chemero, 2013).

The embodiment mechanisms discussed in Chapter 2 fall on different points of this continuum. First, *modal priming* fits my description of the amodal end of the embodiment continuum. The associations include bodily states but the information processing itself is thought to work along amodal lines. Second, *sensorimotor simulation* proposes a new form of information processing, which, however, is not very different from mental imagery and interacts with other forms of information processing. Therefore, I would rather place it somewhere in the middle, less amodal than modal priming, but certainly far from radical embodiment notions. Third, *direct state induction* is the most embodied mechanism. Here, the bodily state actually forms part of the representation of an emotion, non-affective feeling, or mindset. However, as it is described here, directly induced states are still amenable to purely cognitive manipulations. Therefore, though differing on the amodal–embodied continuum, all proposed embodiment mechanisms tend to be far from the radically embodied end of the spectrum.

6.3.2 Models With Both Embodied and Disembodied Processing

There has been another way of approaching the question of how much of cognition is embodied. Several models employ both modal and amodal mechanisms (e.g., Barsalou, Santos, Simmons, & Wilson, 2008). If both embodied and amodal cognition take place, the question changes—from whether to when information processing is embodied (Pecher, Boot, & Van Dantzig, 2011). Under which conditions and to what extent do humans use embodied compared to amodal processes?

A few theories take this approach. Andrews, Vigliocco, and Vinson (2009) postulate two forms of meaning representation: abstract relations between words and sensorimotor representations. Instead of separate processes, the two are thought to form a common network, with abstract word associations being rather quicker and, therefore, dominating in tasks for which a full representation is not necessary (for a similar idea, see also Louwerse, 2007). Barsalou et al. (2008) suggest two

similar processes and a similar time course of their activation. Here, however, the representation of meaning is largely restricted to the simulation system.

There is also some empirical support for the idea of dissociable embodied and amodal processes. One factor that influences whether embodied or amodal associative processes dominate is the nature of the task. Participants use their facial muscles when judging the semantic content of emotional words but not when performing a syntactic task (indicating if the word was printed in upper-case or lower-case letters) (Niedenthal et al., 2009). Moreover, evidence for simulation in a property verification task no longer obtains when the task can be solved by judging associatedness instead of having to process meaning (Solomon & Barsalou, 2004).

In addition to the nature of the task, mode of stimulus presentation (pictures vs. written words) influences the usage of linguistic compared to embodied processes (Louwerse & Jeuniaux, 2010). Moreover, the two processes seem to differ in their time course. While linguistic processes seem to dominate for short reaction times, embodied processes seem to contribute with longer reaction times (Louwerse & Connell, 2011; see also Simmons, Hamann, Harenski, Hu, & Barsalou, 2008). To sum up, there is some evidence for the above proposed idea that a fast, amodal, associative mechanism and a slower, richer simulation mechanism might concurrently or alternatively operate, depending on the nature of the task and stimulus presentation.

My proposed mechanisms of embodiment might be developed into a rudimentary model employing both embodied and amodal processes. In the present work, I only sketched some of their possible interactions and did not try to establish operating conditions for each—which, of course, would have to be carefully established when trying to make this delineation of possible mechanisms into a theory of human cognition. However, even in their present rudimentary form, the embodiment mechanisms I proposed—and especially how they interact with amodal processes—differ from the theories sketched above. The most obvious difference lies in the depth of amodal processing. While the mentioned theories suggest amodal processing at a very basic, fast, associative, and rather shallow level (Louwerse & Connell, 2011; Niedenthal et al., 2005), the amodal processes I have discussed in Chapter 2 are rather slow and propositional. Thus, while all models ascribe differing depth of processing to their amodal and embodied processes, higher-order amodal processing is presently not integrated in models featuring both embodied and disembodied cognition.

6.3.3 Embodiment or Amodal Meta-Theories

Ultimately, the question whether cognition is embodied and to what extent cannot be conclusively decided. Neither embodiment nor amodal information processing are specific enough to be falsifiable—not even in their radical form. That is, neither

radical embodiment (everything as constituted of embodied experience) nor the strong notion of amodal information processing (the body not influencing cognition at all apart from gaining sensations and acting as an output device) will be or can be falsified. Specific theories, both embodied and amodal, if they are clearly specified and make empirical predictions, can be disconfirmed, of course. But in their generic forms, both amodal processing models and embodiment are flexible enough to accommodate every new finding (Machery, 2007). Indeed, both notions are so abstract and general that they are not so much theories but rather meta-theories. Nor are they useless for all that.

Meta-theories, even had they no other advantages, are helpful in highlighting meta-theoretic assumptions in competing models, and thus in laying them open to question. Even if they are not falsifiable, an awareness of the assumptions that tacitly form the basis of more detailed and testable theories can lead to refinements in these theories, as well as in developing and testing alternatives. As discussed in the introduction (Chapter 1.1, pp. 2), the generally prevailing computational model of social cognition rests heavily on the computer metaphor. In fact, most of psychology is taking the computer metaphor and the information processing approach for granted. This can go so far as not to see that it is a metaphor and that alternative metaphors for describing human cognition are possible (see Chapter 1). Here, embodiment can be useful. Embodiment can act as a counterbalance for amodal information processing models, challenging, refining, or spurring it on. In short, as for any branch of scientific research, a pluralistic stance for the study of human cognition promotes progress. And the embodied cognition approach poses a substantial challenge for the amodal cognition approach, which will be ultimately useful for our understanding of cognition.

Embodied cognition has brought us a priori predictions and thus has sparked intriguing lines of research that amodal theories, in all probability, would not have stimulated. This, in addition to its heuristic plausibility, and integrative power, seem to me the greatest assets of an embodied approach to the human mind. Nevertheless, we need more refined theories, especially theories that make specific, falsifiable predictions. By suggesting and testing the role of different mechanisms, the present thesis hopes to contribute shaping discourse and stimulating experiments for the development of said embodiment theories.

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Appendix A

Zusammenfassung

Ein schwerer Rucksack lässt Hügel steiler wirken (Proffitt et al., 2003). Kaum wahrgenommene Gerüche beeinflussen Ordentlichkeit (Holland, Hendriks, & Aarts, 2005). Kaubewegungen beeinflussen, als wie vertraut man vorher gesehene Namen bewertet (Topolinski, 2012). Die vorliegende Arbeit beschäftigt sich mit derartigen Auswirkungen von körperlichen Zuständen, Sinneswahrnehmungen und Handlungen auf psychische Zustände und Vorgänge, die als *Embodiment* bezeichnet werden.

In der vorliegenden Arbeit wird zuerst Embodiment im Vergleich zur Computermetapher des Informationsverarbeitungsansatzes definiert und Betrachtungen zu Metaphern für die menschliche Psyche im Allgemeinen aufgestellt. Danach werden verschiedene psychologische Mechanismen für Embodiment-Phänomene aufgezeigt. Kapitel 2 führt alle Embodiment-Phänomene auf drei verschiedene grundlegende psychische Mechanismen zurück, die alleine oder in Kombination alle Embodiment-Phänomene erklären können. Da die Untersuchung zugrundeliegender Mechanismen bisher eher wenig verbreitet ist, werden außerdem empirische Testverfahren dargestellt, mit deren Hilfe zwischen verschiedenen Mechanismen für spezifische Phänomene unterschieden werden kann. Während die Inhalte dieser Arbeit also Embodiment-Phänomene sind, ist die Herangehensweise—die Untersuchung kognitiver Prozesse—in der Social Cognition Perspektive verwurzelt.

Der empirische Teil der Arbeit untersucht einen spezifischen Embodiment-Effekt genauer, nämlich den Einfluss körperlicher Reinigung auf psychische Prozesse, die *verkörperte Reinigung*. In Kapitel 4 wird untersucht, inwiefern sich Hilfsbereitschaft nach eigenem moralischen oder unmoralischen Verhalten durch physikalische Reinigung ändert—inwiefern man sich also von einem moralisch positiven oder moralisch negativem Gefühl reinwaschen kann (zwei Experimente mit insgesamt 476 Teilnehmern). In Kapitel 5 wird untersucht, wie sich durch physikalische Reinigung die Änderungen in Optimismus und Selbstwert reduzieren, die durch Erfolg oder Misserfolg in einem vorangehenden Leistungstest hervorgerufen worden waren (drei Experimente mit insgesamt 372 Teilnehmern). Die Grundidee bei

verkörperter Reinigung ist also, dass physikalische Reinigung nicht nur physische sondern auch psychische Rückstände entfernt. Das heißt, dass der Einfluss vorheriger Erfahrungen durch Händewaschen reduziert werden sollte.

In dieser Arbeit sollen die psychologischen Prozesse untersucht werden, die den Einfluss von Reinigung auf die Psyche vermitteln könnten. Ausgehend von bereits bekannten Auswirkungen körperlicher Reinigung auf verschiedene psychische Prozesse, werden zwei mögliche Erklärungen für das Phänomen der verkörperten Reinigung kontrastiert und über deren zugrundeliegende Prozesse spekuliert (Kapitel 3). Kapitel 4 vergleicht die Effekte verkörperter Reinigung, wenn die beiden Erklärungen konvergierende Vorhersagen machen (nach moralisch negativen Erinnerungen) und wenn die beiden Erklärungen divergierende Vorhersagen machen (nach moralisch positiven Erinnerungen). Kapitel 5 untersucht dann eine der beiden Erklärungen genauer. Dafür werden verschiedene Aspekte der Reinigungshandlung variiert um die notwendigen und hinreichenden Kriterien für verkörperte Reinigung und damit auch die beteiligten psychischen Prozesse zu untersuchen.

Die Ergebnisse des Einflusses verkörperter Reinigung in Kapitel 4 sind nicht interpretierbar, weil der vorausgesetzte Einfluss positiver und negativer moralischer Erinnerungen auf prosoziales Verhalten nicht nachweisbar war. Mit geändertem Grundparadigma ließ sich dann in Kapitel 5 ein stabiler Effekt verkörperter Reinigung nachweisen. Eine Variation verschiedener Faktoren der Reinigung ergab, dass eine intentionale oder zumindest wissentliche Reinigung essentiell ist und dass sich diese Reinigung auf den eigenen Körper (und nicht auf einen Gegenstand) bezieht damit physische Reinigung zu psychischer Reinigung führt. Damit spielen sowohl inferentielle als auch automatisch Prozesse eine Rolle bei Effekten verkörperter Reinigung.

Zum Abschluss der Arbeit werden die Erkenntnisse und Limitierungen der aktuellen Arbeit diskutiert und die beiden möglichen Reinigungserklärungen in einen anthropologischen Kontext gestellt. Anschließend wird der hier verfolgte Ansatz mit anderen Arten von Embodiment-Erklärungen verglichen.