UNIVERSITY OF AMSTERDAM

UvA-DARE (Digital Academic Repository)

Moving the mind: embodied emotion concepts and their consequences

Oosterwijk, S.

Publication date
2011

Link to publication

Citation for published version (APA):
Oosterwijk, S. (2011). *Moving the mind: embodied emotion concepts and their consequences*. [Thesis, fully internal, Universiteit van Amsterdam].

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: https://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, P.O. Box 19185, 1000 GD Amsterdam, The Netherlands. You will be contacted as soon as possible.

UvA-DARE is a service provided by the library of the University of Amsterdam (https://dare.uva.nl)

Download date:09 11月 2026

Chapter 6

General Discussion

'Take as much care with words expressing your sentiments, as you will crafting your doctoral dissertation' (Marisha Pessl, 2006, pp. 390).

In the present dissertation we aimed to increase insight in the fundamental issue of how people create emotional meaning when they read, think or talk about emotional events or states. In order to understand the evolvement of emotional meaning in these processes, we have to start with a theoretical account of how emotion concepts are represented.

Emotion concepts hold knowledge about emotional situations, reactions, states and experiences (Niedenthal, 2008). According to amodal views on conceptual representation concepts are represented by abstract symbols that re-describe perceptual, bodily and experiential states (Fodor, 1975; Pylyshyn, 1984; Phillippot & Schaefer, 2001; Teasdale, 1999). In this view, emotion concepts are symbolic representations that are disconnected from what we feel and do when we are experiencing an emotion. Yet, emotions are associated with a great variety of states, including bodily states such as facial and postural expressions, changes in sympathetic nervous system activity and approach and avoidance tendencies (Ekman, 2007; De Gelder, 2006; Chen & Bargh, 1999; Rotteveel & Phaf, 2004; Levenson, 2003; Mauss, Levenson, McCarter, Wilhelm & Gross, 2005). If these states are central to the experience of emotion, and thus represent what emotions *are,* it seems inevitable to incorporate these states into a model of how emotion concepts are represented.

Embodiment perspectives propose that the same neural and bodily mechanisms activated during emotional experiences also underlie emotion concepts (Barsalou, 1999; Niedenthal, 2007; Niedenthal, Barsalou, Ric, & Krauth-Gruber, 2005; Gallese & Lakoff, 2005; Glenberg, Webster, Mouilso, Havas & Lindeman, 2009). During emotional experiences or interactions with emotional stimuli, perceptual (e.g., vision, audition, smell), motor (e.g., actions, expressions), interoceptive (e.g., arousal) and introspective (e.g., feeling angry or sad) states are 'captured' and stored to represent knowledge about emotions (Barsalou, 1999; Niedenthal, 2007). When emotion concepts are activated, meaning arises by simulating these states in the

brain and body. From these theoretical assumptions, it can be predicted that re-enactment of bodily states, for instance as indicated by facial muscle activity or sympathetic nervous system activity, accompanies conceptual tasks in which emotion knowledge is utilized. The presence of such embodiment effects is examined in this dissertation.

We focused on one central question: Do bodily states occur when people think about emotion, remember emotional events or process emotion language? Evidence for the occurrence of bodily states in these tasks would support the core assumption of embodiment perspectives that simulations of emotional states ground emotion concepts (Niedenthal, 2007; Niedenthal, et al., 2005a). Moreover, evidence for embodiment effects during these tasks would imply that embodiment effects occur beyond 'real' interactions. In contrast to research that examines embodiment effects in interpersonal contexts, where it may be directly relevant to 'catch' other people's emotions (Bastiaansen, Thouix & Keysers, 2009; Hawk, Van Kleef & Fischer, in revision), the conceptual tasks in the present dissertation do not present 'real world' emotional stimuli, but activate emotion knowledge offline (Wilson, 2002; Niedenthal, Barsalou, Winkielman, Grauth-Gruber, & Ric, 2005b). Hereby, the present findings forward new insights into the processes that underlie the retrieval of emotion knowledge from someone's own mind or the symbolic representation of emotion through language.

Embodied processes in emotion: Language, thinking and remembering

We will start with an overview of the experimental findings and address how the experimental chapters support and extend embodiment theories. In this overview we will organize the discussion according to content. As such, some parts of the results presented in Chapter 3 and Chapter 4 will be discussed in the following paragraph, whereas other results forwarded by these chapters will be presented in separate sections. Following the overview of the experimental findings

we will briefly touch on the possible limitations concerning an embodied view on emotion concepts and address the broader implications.

Bodily states

The present dissertation clearly demonstrates that our body responds spontaneously when we think about emotion. **Chapter 2** assessed spontaneous changes in body posture when participants thought about the concepts of pride and disappointment. Both pride and disappointment are associated with changes in posture; pride is associated with an upright, expanded posture (Tracy & Robins, 2004; Stepper & Strack, 1993) and disappointment is associated with a slumped posture (Riskind, 1984). Following embodiment views, we predicted that the activation of knowledge about these emotions should result in the spontaneous activation of congruent bodily expressions (Barsalou, 1999; Niedenthal, 2007; Niedenthal et al., 2005a). As expected, the results of this study demonstrated a decrease in posture height during the generation of disappointment words, whereas this decrease was absent during the generation of pride words. The finding that the body posture associated with disappointment is adopted when people think about this emotion, suggests that bodily states can be spontaneous and overtly re-enacted when accessing emotion concepts.

In addition to bodily expressions that can be seen on the 'outside', such as changes in body posture, the present dissertation also incorporated the measurement of 'internal' bodily states. Until now experiments examining the embodiment of emotion concepts have mainly focused on manipulating or measuring facial expressions (Niedenthal et al., 2009; Foroni & Semin, 2009; Havas, et al., 2007). Nevertheless, internal or interoceptive cues from the body (e.g., endocrine or autonomic reactions) are a basic component of emotional experience (Duncan & Barrett, 2007). Consequently, internal states may be captured and stored during emotional experiences to represent knowledge about those emotions (Niedenthal, 2007; Glenberg et al., 2009; Barsalou, 1999). Following this assumption,

it can be predicted that in addition to simulation of facial expressions, internal states may also be simulated when emotion knowledge is utilized in conceptual emotion tasks. This is indeed what we found. **Chapter 3** demonstrated that both episodic fear activation (i.e., retrieving a personal fear memory) and semantic fear activation (i.e., generating fear words) resulted in sympathetic nervous system activity (i.e., arousal); a reaction that is generally associated with fearful experiences. The latter finding that a state of arousal is present when people generate fear words, replicates the findings from Chapter 2 with a non-expressive dependent measure and a different emotion concept.

Both Chapter 2 and Chapter 3 demonstrate that people embody emotional states when they generate emotion words. These results support embodiment perspectives that predict that the use of emotion knowledge in conceptual tasks is accompanied by bodily simulation (Niedenthal, 2007; Glenberg et al., 2009; Niedenthal, et al., 2005a). There is an alternative explanation for these findings, however, that we would like to address. Although the tasks presented in Chapter 2 and 3 are conceptual in nature (Martin & Chao, 2001), and we took great care to instruct our participants to 'just' generate words, some may assume that these tasks worked as direct emotion manipulations, comparable to, for instance the Velten technique (Velten, 1968). If that would be the case the bodily states resulting from the experimental manipulations may not have reflected simulation processes, but 'genuine' emotional reactions resulting from the (mild) subjective experiences of fear and disappointment reported in these studies. Our data does not support this explanation, since we found no correlations between bodily states and subjective experiences when people generated emotion words. Nevertheless, support for bodily simulation during conceptual tasks would be stronger when using a task that would not activate subjective emotional experiences. In **Chapter 4** we report an experiment in which we used a scrambled sentences task, which activates emotion knowledge without the presence of subjective feelings (see also Stapel & Koomen,

2000; Innes-Ker & Niedenthal, 2002; Maringer & Stapel, 2007). We found activity of the sympathetic nervous system (i.e., arousal) and facial muscle activity when people unscrambled fear sentences, without any indication that unscrambling fear sentences resulted in a reportable, subjective state of fear. These findings provide important evidence for spontaneous, multi-component bodily simulations during conceptual emotion tasks (Niedenthal, 2007; Glenberg et al., 2009; Niedenthal et al., 2005a), without the possible objection that these bodily states are 'just' a consequence of the presence of subjective emotional experiences.

The fact that we found bodily reactions in the absence of subjective emotional experience is in accordance with embodiment theory. Conceptual processing will, in most cases, result in automatic simulations that occur outside of consciousness (Barsalou, Niedenthal, Barbey, & Ruppert, 2003). Even though bodily states can be subjectively reflected upon (Duncan & Barrett, 2007), the *simulation* of these states is partial, and may not involve subjective experience (Barsalou, et al., 2003a). Nevertheless, because we found reports of subjective feelings states in the studies presented in Chapter 2 and 3 of the present dissertation, it is important to discuss when bodily and experiential simulation may occur in parallel during conceptual emotion processing, and whether this depends upon contextual factors (Winkielman, Niedenthal & Oberman, 2009). It is to this subject that we will turn next.

The brain, the body and the self

Embodied states can be manifested as patterns of activity in modality specific areas in the brain, as overt bodily reactions or even as subjective experiences that are accessible to consciousness (Bastiaansen, Thioux & Keysers, 2009; Niedenthal, 2007; Barsalou, 1999). On most occasions simulation will be partial, without resulting in full blown subjective experiences or even a measurable bodily state (Barsalou, 1999). For example, reading the word 'kick' leads to neural simulation, but not to an actual kicking movement (Hauk, Johnsrude & Pulvermuller, 2004). On other occasions

simulations may 'rise to the surface', such that conceptual tasks are accompanied by bodily simulations. For example, the body may take on a certain posture, or a heightened state of arousal while reading or thinking about emotions (see Chapter 2, 3 & 4). On yet other occasions conceptual emotion processing may result in subjectively experienced emotion. People may feel anger when they think about a certain emotional event, or become genuinely afraid while reading a story. For instance, in Chapter 2 people reported feelings of disappointment after thinking about this concept.

Some may argue that the presence or absence of subjective experiences is not specifically relevant for embodiment theory, because the occurrence of subjective experiences indicate a 'genuine' emotional response, and not a re-enactment of an emotional state. We disagree with this view, because embodiment accounts predict that introspective experiences (i.e., feeling states) can be simulated during conceptual emotion processing or emotion language understanding (Niedenthal, 2007; Barsalou, 1999; Glenberg et al., 2009; Bastiaansen, Thioux & Keysers, 2009). Because it is assumed that these simulations will occur within the same (neural) systems that are also active during 'genuine' emotional experience (Bastiaansen, Thioux & Keysers, 2009; Niedenthal, 2007; Niedenthal, et al., 2005b), it is quite difficult to differentiate a 'genuine' emotional experience from a re-enactment. Nevertheless, the potential presence of these states during conceptual processing is interesting because it informs us about the power of thought and language. Simply calling these experiences 'actual' emotional responses does not provide us with an explanation about why these experiences occur during conceptual processing in the first place. Embodiment theories, in contrast, provide us with an underlying, testable mechanism that explains these effects.

Embodiment effects are seen as flexible (Winkielman et al, 2009) and dynamic (Barsalou et al., 2003a). Hence, contextual factors and task demands may influence the extent to which embodiment effects are bodily and experientially manifested.

The present dissertation forwards evidence that suggests that self-relevance is a factor that influences the strength of embodiment effects, and more specifically whether the activation of emotion knowledge results in subjective experience (see also Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005; Niedenthal, Roman & Dalle, 2002). We manipulated self-relevance during the activation of conceptual emotion knowledge in **Chapter 3**, by asking people to retrieve information from semantic and episodic memory. Wheeler, Stuss and Tulving (1997) propose that episodic memory, because of its association with the self, is by definition associated with subjective feelings. Semantic memory, in contrast, does not have this close connection with the self, and may therefore be associated to a lesser extent with subjective emotional experiences. Chapter 3 supports this idea. When people retrieved a personal fear memory, we found stronger electrodermal activity, subjective reports of fear, and implicit fear, compared to when people generated fear words. Moreover, correlation analyses demonstrated a positive correlation between subjectively reported fear and bodily activity during episodic retrieval, whereas this correlation was absent when accessing semantic knowledge. This suggests that bodily states and subjective experiences are connected during episodic retrieval to form a multi-component re-experience of the past event. Accordingly, personal emotion memories may activate 'full-blown' emotional experiences (Barsalou et al., 2003a; Lambie & Marcel, 2002), whereas activating semantic emotion knowledge may not (necessarily) lead to consciously experienced states (see also Chapter 4).

In addition to self-relevance, the present dissertation provides us with other clues to the identification of task characteristics that may potentially influence embodiment effects. First, subjective embodiment effects may more readily occur when people actively retrieve information from their minds, compared to when information is presented *to* them. The present dissertation demonstrated bodily simulation and mild activation of subjective states when people actively accessed

emotion concepts through the generation of emotion words (Chapter 2 & 3). In these situations processing may be deeper and more meaningful (Niedenthal et al., 2005b) than when people process words or sentences provided by the experimenter (as in Chapter 4 & 5). Thus, processing conditions that involve an active search for emotion knowledge may result in 'full blown' simulation (Barsalou et al., 2003a), whereas other conditions, in which emotion knowledge is used more implicitly, may 'just' induce bodily simulation without an accompanying subjective experience. Moreover, under minimal processing conditions (see Vermeulen Mermillod, Godefroid, & Corneille, 2009) simulation may only involve activation in modality specific areas in the brain, without this activation 'leaking through' into the body. Although highly speculative, this could suggest that there are inhibitory links between modality specific simulation, the production of actual bodily activity and subjective experiences. The possible presence of these inhibitory links, and the contextual factors that may influence the activation and deactivation of these inhibitions is an interesting and important avenue for further research.

On a similar note, it can be predicted that simulation processes may be prominent in tasks where meaning is not clear, for example when processing ambiguous stimuli. If embodied processes are underlying the formation of meaning (Glenberg et al., 2009; Zwaan & Madden, 2005; Barsalou, 1999), than bodily and possibly subjective simulation may be most relevant in tasks where meaning needs to be constructed online. This hypothesis awaits further research. In addition, it may also be interesting to further pursue the issue of self-involvement concerning the strength and manifestation of embodiment effects (Niedenthal, et al., 2005a ; Niedenthal, Roman & Dalle, 2002). In the present dissertation we differentiated episodic and semantic memory in terms of self-involvement. Nevertheless, even though self-involvement is seen as a defining characteristic of episodic memory (Wheeler et al., 1997), it may also be possible to 'infuse' semantic processes with the self. For example, self-involvement may affect embodied reactions during active

imagery or perspective taking when processing emotion language. Although it has been demonstrated that imagery cannot explain covert embodiment effects, such as those underlying switching costs (Pecher, van Dantzig, & Schifferstein, 2009), it has never been tested whether active imagery can play a role in the extent to which embodiment effects are *subjectively* manifested. Such research may add to our understanding of why some may feel pangs of fear while reading a book, whereas others simulate on a 'lower level' and never have such experiences. Furthermore, since it has been found that the tendency to become absorbed in fiction predicts social abilities, including empathy (Mar, Oatley, Hirsch, dela Paz & Peterson, 2006; Mar & Oatley, 2008), a thorough analysis of when and how people simulate during reading may be important for educational purposes (Glenberg, 2010) and social learning (Zwaan, 2009).

Emotion concepts potentiate emotional reactions

In addition to demonstrating embodiment effects *during* conceptual processing, the present dissertation examined whether the activation of emotion concepts influences *subsequent* emotional responding. This examination provided us with an important new insight concerning the consequences of activating emotion concepts. In **Chapter 4** we demonstrated that processing conceptual fear knowledge enhances bodily reactions to subsequently presented emotional stimuli. We demonstrated stronger electrodermal activity towards fear pictures and a stronger startle modulation effect when participants had unscrambled fear sentences, compared to neutral sentences. These results are consistent with our prediction that embodied emotion concepts can potentiate bodily reactions at a later time. Importantly, a mediation analysis indicated that this potentiation effect may be best understood in terms of the embodied responses that accompany the activation of fear knowledge. The analysis demonstrated that the effect of the scrambled sentences task on electrodermal activity towards fearful pictures was fully mediated by electrodermal activity during the scrambled sentences task. Based on this result

we propose that bodily reactions are potentiated *because* emotion concepts are embodied, and therefore create a state in the individual that influences bodily sensitivity. This finding is consistent with previous suggestions that embodied emotion knowledge can play an important role in how we perceive and respond to the emotional world (Barrett, Lindquist & Gendron, 2007; Barrett & Lindquist, 2008; Niedenthal, 2007).

Embodied emotion concepts may influence emotional responding in a similar way as directly manipulated bodily states. Previous research has, for example, demonstrated that manipulating a certain body posture or facial expression can influence information processing and evaluation (Stepper & Strack, 1993; Strack, Martin & Stepper, 1988). Furthermore, a state of arousal, activated by physical exercise, can influence how people respond to emotional material (Zillmann, Katcher, & Milavsky, 1972). The crucial distinction between these effects and the findings in Chapter 4 is that we did not directly manipulate a bodily state. In contrast, bodily states were a spontaneous consequence of the conceptual task performed by the participants. Although the results from the mediation analysis support the idea that these bodily changes drive the effect of emotion knowledge activation on emotional responding, other interpretations are also possible. For example, the presently found effect could potentially be caused by a change in interpretation or appraisal of the subsequently presented stimuli. Further research, for instance measuring subjective reports, may shed light on this issue. Moreover, it would be relevant to examine whether conceptual emotion knowledge influences other processes, such as for example attention for emotional stimuli, or whether other emotion concepts, such as disgust or joy, have similar effects on subsequent emotional responding.

It is important to note that bodily reactions were potentiated after emotion knowledge was activated in an implicit way. In contrast to previous research that demonstrated startle modulation after emotional imagery (Vrana, 1995; Vrana,

1994), the present manipulation did not instruct emotional imagery, nor made emotional meaning salient (see also Bargh, Chen & Burrows, 1996; Innes-Ker & Niedenthal, 2002). Consequently, our findings indicate that emotion concepts, even when activated linguistically without an active focus on emotional meaning, still have the potential to influence how people respond to the world. This can have important methodological implications. For example, instructions incorporating emotion words, or words referring to bodily states, may influence emotional reactions at a later time, simply because participants activate embodied representations while processing these words. Furthermore, our finding may have implications for the influence of emotion knowledge in natural settings. People encounter many instances of emotion concepts, for instance while reading a newspaper or having a conversation, without necessarily being fully aware of the emotional content. In these situations, especially when embodied reactions occur outside of consciousness, (Barsalou et al., 2003a; Niedenthal, 2005b), the activation of knowledge may still influence sensitivity to emotional events. The time-course and strength of these effects is an important avenue for further research.

Switching costs

Until now, we have not discussed the results of Chapter 5. The reason for this is that this chapter, although highly relevant for embodiment perspectives, differs from the other experimental chapters with respect to the dependent measure. In this chapter we did not measure bodily states directly, but examined simulation with a switching costs paradigm (Pecher, Zeelenberg, & Barsalou, 2003). In a switching costs paradigm people are asked to verify modality specific properties of concepts (e.g., *'an apple is green'* or *'an airplane is loud')*. If these conceptual judgments are associated with simulation in different systems (e.g., the visual system or the auditory system), then switching costs should occur when people switch from one modality to the other.

Chapter 5 explored whether modality switching effects extend beyond the classic sensory-motor domains of vision, audition, touch, smell and taste. So far, switching effects have been demonstrated when verifying perceptual properties (Marques, 2006; Pecher, Zeelenberg, & Barsalou, 2003; Van Dantzig, Pecher, Zeelenberg, & Barsalou, 2008), or general affective properties (Vermeulen, Niedenthal, & Luminet, 2007). The study presented in Chapter 5 opens up a new domain by examining whether switching costs occur when people switch between visual verification and verification of properties associated with internal states. In this study we focused on emotional (e.g., anger, fear, happiness) and 'non-emotional' mental states (e.g., hunger, dizziness, familiarity, thinking), since all these states involve subjective feelings or interoceptive cues from the body (Craig, 2002; 2009). In line with embodiment theory (Barsalou, 1999; Glenberg, et al., 2009; Niedenthal, 2007), we proposed that these internal experiences are simulated when people process sentences that describe mental states from an 'internal perspective' (i.e., describing feelings and internal bodily states). In contrast, when mental states are described from an 'external' perspective (i.e., describing expressions or actions), simulation of visible outside features may be more relevant for understanding. Evidence for such a process would be forwarded by the presence of switching costs when processing these sentences.

As expected, we found that sentences describing internal aspects of mental states were judged faster when primed with sentences with the same focus (internal) than when primed with sentences with a different focus (external). A similar switching effect was present for sentences with an external focus. These findings suggest that focusing attention on internal or external descriptions of mental states is associated with simulations in different neural systems. For example, understanding sentences describing internal states (e.g., arousal, subjective feelings) may be accompanied by simulation in brain areas associated with feeling states and interoception, such as the insula (e.g., Craig, 2002, 2009). Such an hypothesis could

be tested with a follow-up fMRI experiment that examines the active brain areas during internal and external sentence processing. In addition, further research could also examine whether internal sentence processing results in the simulation of internal states on a bodily level (e.g., cardiovascular changes, electrodermal activity) or in the re-enactment of actual subjective feelings. Because we did not perform the necessary measurements to draw such conclusions it is, for now, impossible to say whether processing internal sentences will result in a similar spontaneous activation of internal states as demonstrated, for instance, in Chapter 3 and 4.

Modal versus amodal views

The present dissertation examined the activation of emotion knowledge from an embodiment perspective. Even though the results of the experimental chapters are indeed supportive of embodiment theories, it is important to ask whether embodiment accounts exclusively explain the present findings. Embodiment accounts predict bodily simulation during conceptual tasks ad hoc, and forward a theoretical explanation for the underlying mechanism (Barsalou, 1999; Barsalou et al., 2003a). Still, amodal accounts may also be able to explain the present findings. Amodal accounts assume that concepts are abstract, 'transduced' representations in brain areas separate from areas that are associated with modality specific states (Fodor, 1975; Pylyshyn, 1984; Phillippot & Schaefer, 2001; Teasdale, 1999). This, however, does not necessarily mean that there are no connections between amodal areas and areas that represent and control perceptual, experiential and bodily states. For example, Mahon and Caramazza (2008) propose that activity can spread from amodal areas, where concepts are amodally represented, to modality-specific areas, resulting in bodily, perceptual or motor activity during conceptual tasks. Importantly, Mahon and Caramazza assume that this 'spreading of activation' is not fundamental or causal to conceptual representation, but may only enrich conceptual understanding. In other words, these authors criticize embodied explanations of conceptual processing by assuming that simulation is not fundamental to conceptual

and linguistic processing, but may be better interpreted as a 'by-effect' or an epiphenomenon.

Recently, a transcranial magnetic stimulation (TMS) study performed by Pobric, Jefferies and Lambon Ralph (2010) has shed more light on this issue. This study demonstrated that stimulation of the anterior temporal lobe (ATL; an area indicated in amodal semantic representation) generates a category-general impairment in naming pictures. In other words, when this area is stimulated all conceptual categories are affected. When, in contrast, the inferior parietal lobule (IPL) was stimulated, which is an area associated with handling tools, a specific impairment was generated in naming pictures that represented manipulable objects. These results suggest that concepts reflect both amodal representations (i.e., abstract redescriptions) in the ATL *and* modality specific representations in the respective modality specific areas (e.g., the IPL). As such, concepts are not represented in modality specific areas alone (i.e., the strong embodiment hypothesis) nor only as amodal, abstract representations (i.e., the amodal hypothesis). In contrast, both ways of representation contribute to conceptual understanding.

With these results in mind, we do not think that the effects found in the present dissertation are 'by-effects' that do not tell us anything about the nature of emotion representation. The findings of Pobric and colleagues (2010) suggest that modality specific simulation is crucial for concepts that involve experiences associated with a particular modality. Following this logic, we assume that emotion concepts, because they are intrinsically linked to perceptual, bodily and experiential states, may be especially dependent upon modality specific representations. For now, much more research is needed to be able to draw strong conclusions about the specific mechanisms that underlie conceptual emotion representations. Nevertheless, even when emotion concepts reflect a combination of amodal and modality specific representation, it is still of major importance to answer the question under what circumstances modality specific simulations represent

emotional meaning, and how these neural simulations result in spontaneous bodily reactions and subjective experiences to aid understanding.

Broader implications

The main goal of the present dissertation was to find evidence for the embodiment of emotion concepts. Our findings, however, are relevant beyond the question of how emotion knowledge is represented. First of all, the embodiment of emotion concepts may have important consequences for emotion regulation. According to Niedenthal, Roman and Dalle, (2003) emotion language may create a context to regulate emotional responding. Some studies have found support for such a proposal by demonstrating that labeling emotional stimuli in terms of their emotional meaning can decrease emotional reactions (Lieberman, Eisenberger, Crockett, Tom, Pfeifer, & Way, 2007; Tabibnia, Lieberman, & Craske, 2008). These results can be contrasted with the findings of Chapter 4 that demonstrate that the activation of emotion knowledge can enhance bodily reactions. At the moment it is unclear whether these different results can be addressed by one theoretical explanation. For instance, it is possible that a trial-by-trial application of an emotion label will result in decreased emotional reactions (see Lieberman et al., 2007), whereas the general activation of emotion knowledge will increase emotional reactions. In other words, actively labelling a single emotional stimulus in terms of its emotional quality may result in emotion regulation, whereas priming emotion knowledge without directly linking it to the stimulus may increase bodily sensitivity. In addition, it may also be possible that emotion knowledge will have a differential effect on emotional responding depending on whether participants are asked to subjectively judge emotional stimuli (as in the labelling tasks) or when physiological reactions are examined without active introspection or subjective report (as in Chapter 4). This question can be answered by examining whether the activation of fear knowledge leads to emotion regulation when participants are asked to subjectively rate their emotional state. In short, in order to define the

specific conditions under which conceptual emotion knowledge increases or decreases emotional reactions further experimental research is warranted.

Another important avenue for further research concerns the implications of embodied processes for emotional learning. Emotion concepts are important in the transfer of potentially dangerous situations (Niedenthal, 2008). This has been shown experimentally in a study that simply told participants that a neutral stimulus would be paired with a shock (Phelps, Connor, Gatenby, Gore, Grillon & Davis, 2001). The results demonstrated that telling people about the possible emotional consequences of a stimulus resulted in similar brain activity as actually pairing the stimulus with a shock. This effect was replicated in a study that showed that participants responded with a fear reaction (i.e., electrodermal activity) when they learned through observation that a stimulus predicted a shock and when they were verbally told that the stimulus predicted a shock (Olsson & Phelps, 2004). Even though it is quite reasonable to assume that embodied representations may play a role in these effects, the role of simulation in the transfer of knowledge about potentially emotion evoking events has not yet been the subject of experimental investigation.

Finally, the present findings are relevant for how we theoretically view cognition and emotion. More specific, the present dissertation bids the question whether it is necessary to draw a strict line between cognition and emotion when embodied views are taken into account (see also Duncan & Barrett, 2007). The tasks presented in the previous chapters are classically seen as cognitive tasks because they involve memory, conceptual representation and language. Yet, these processes result in states that are similar to those that occur during emotional experiences. As such, a differentiation between 'hot' and 'cold' processing of emotion may not be appropriate (Schaefer, Collette, Philippot, Van der Linden, Laureys, Delfiore, Degueldre, Maquet, Luxen & Salmon, 2003; see also Phillippot & Schaefer, 2001). In addition, bodily states may not be uniquely important to emotions, but may also

underlie cognitive processes such as thinking, memory, and concentration (see Chapter 5). We therefore support a view that does not separate emotion and cognition, but sees them as psychological constructs that are ultimately based on the same underlying systems (Duncan & Barrett, 2007; Barrett, & Bliss-Moreau, 2009).

Conclusion

The experiments presented in this dissertation support, enrich and extend embodiment accounts of emotion concepts. With this we gained more insight into the representation of emotion knowledge, and the crucial role of the body herein. Our bodies form Rosetta's Stones that enable us to understand emotions transferred through abstract symbols written down in letters, books and chat windows. Moreover, since bodily states are a fundamental part of emotion concepts, it seems impossible to separate our thoughts from our body. When thinking about emotion the body may respond *as if* in an actual emotional state. Thus, we can assume that JK Rowling mimicked Harry Potter's emotional and bodily states when she wrote down his adventures. Just as millions of others while reading her books. As such, even though we do not live in a magical world and have never fought Voldemort, we can still physically join Harry '*as he walked through the castle for the last time, out into the grounds and into the forest*'.