Moving the mind: embodied emotion concepts and their consequences

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Chapter 3

Remembering the Self versus Knowing the World: Emotional Consequences of Episodic and Semantic Fear Representations

Involvement of the self may be a defining difference between episodic memory, holding personal experiences, and semantic memory, holding general, conceptual knowledge. In the present study we test how the retrieval of episodic and semantic emotion knowledge affects bodily, subjective and implicit measures of emotion. Participants retrieved personal fear memories or generated fear words. Consistent with embodiment perspectives we found that both semantic and episodic memory representations of fear resulted in stronger bodily activation than neutral inductions. Nevertheless, the strength of emotion activation differed between conditions; episodic memory activation evoked stronger bodily activity, stronger subjective reports of fear and stronger implicit fear activation than semantic memory activation. In addition, analyses showed that bodily and subjective components of emotion were differentially correlated within the semantic and episodic condition. These findings are discussed in terms of the influence of self-relevance on embodied reactions during emotion knowledge activation.

This chapter is based on: Oosterwijk, Rotteveel & Fischer (submitted)

Most people know from experience that recalling emotional memories can evoke emotional states. Whenever you remember a fearful event, your bodily state may change, and you may feel fearful again. In the present paper we examined whether emotional states can also be evoked when people think about emotion from a more distant perspective, for example when generating words that describe a fearful event. When people retrieve a personal memory emotion knowledge will be activated that revolves around personal experiences (i.e., episodic memory). When people think of emotions more generally, the activated knowledge does not involve the self, but involves conceptual information about emotional situations, states, actions and feelings (i.e., semantic memory). Although the association between episodic retrieval and emotion elicitation is well-known (Bodenhausen, Kramer, & Süsser, 1994; Phillippot, Schaefer & Herbette, 2003), less is known about the relation between semantic retrieval and emotion elicitation, even though it has been proposed that retrieving semantic knowledge about emotion has emotional consequences (Niedenthal, 2007). Moreover, a direct comparison between the potential of episodic and semantic emotion representations to elicit emotional reactions has never been made. The aim of the present study is to test whether these two forms of emotion activation differ in this respect.

According to Tulving (1993) episodic and semantic memory can be seen as two functionally different systems, even though episodic memory is an extension of semantic memory. Episodic memory consists of experiences unique to the individual that are bound to time and place. Semantic memory, in contrast, holds general, conceptual knowledge about the world and is context-free. Semantic and episodic memory cannot be strictly separated. Indeed, you need concepts to talk about your own experiences (Barrett & Fossum, 2001; Robinson and Clore, 2002). Vice versa, episodic memory is linked with semantic memory, because conceptual knowledge is based on personal experience (Conway, 1990; Barsalou, Niedenthal,

Barbey & Ruppert, 2003). Still, we think it is important to experimentally distinguish between these systems, because Wheeler, Stuss and Tulving (1997) propose one major defining difference between episodic and semantic memory; involvement of the self. According to these authors episodic memory is by definition associated with a subjective sense of self (i.e., 'autonoetic awareness') and will therefore involve conscious re-experiencing (see also Wilson, 2002). Semantic memory, in contrast, holds knowledge about the world. Retrieval from this system will be from the perspective of an observer, not a participant. Translated to the realm of emotion, this could lead to the prediction that the retrieval of episodic emotional memories results in a re-experience of the original emotional state, whereas the retrieval of semantic emotion knowledge does not, because it has no direct connection with the self.

Nonetheless, current embodiment perspectives (Barsalou, 2008; Niedenthal, 2007) would argue that semantic memory activation may also evoke emotional states, because knowledge is grounded in experience. Modality-specific states that normally occur during interactions with objects (such as actions, perceptions and introspections) become part of the conceptual representation of those objects and may be re-enacted (i.e., simulated) when knowledge about these objects is activated (Barsalou, 1999). Since knowledge is used in many different cognitive processes, including memory, language understanding and thinking, simulation may play a fundamental role in both episodic *and* semantic memory retrieval. Indeed, this may also be the case for processes in which emotion knowledge is used, because embodiment accounts of emotion processing argue that the same systems that underlie emotional states also underlie emotion knowledge (Niedenthal, 2007; see also Glenberg, Webster, Mouilso, Havas & Lindeman, 2009). Based on these assumptions it can be predicted that concordant emotional reactions, for example bodily states, can occur both during the retrieval of episodic emotional memories *and* during the retrieval of semantic emotion knowledge. An open question is to what extent these simulations differ as a result of the activation of different

knowledge representations as a function of involvement of the self. Simulations may differ, for example, in terms of strength, or in terms of the extension to different components of emotion (i.e., bodily states, subjective feelings).

Previous experiments have never directly compared the emotional consequences of activating semantic knowledge versus personal emotional memories, although embodiment effects have been demonstrated during conceptual emotion processing (Niedenthal, Winkielman, Mondillon & Vermeulen, 2009; Oosterwijk, Rotteveel, Fischer & Hess, 2009; Oosterwijk, Topper, Rotteveel & Fischer, 2010). Making this comparison is important, however, in order to examine the role of self-relevance in knowledge representations and simulation. It has been proposed that embodiment effects are stronger for knowledge that is self-relevant, rendering stronger simulated states (e.g., Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005; Niedenthal, Roman & Dalle, 2002). This notion fits nicely with the suggestion by Wheeler and colleagues (1997) that episodic memory, because of its association with the self, is by definition associated with subjective feelings or 'mentally travelling back in time'. 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. Following these assumptions we propose that, even though simulation may occur during both episodic and semantic retrieval, the strength of re-enactment may differ, especially in terms of subjective experience. In other words, the most prominent difference between the activation of semantic and episodic emotion representations may lie in the extent to which emotional states result in consciously accessible feelings.

We designed the present study to investigate both the differences and similarities between semantic and episodic representations of fear. Participants were asked to retrieve either a personal fear memory (episodic induction) or to generate as many fear related words as possible (semantic induction). We measured emotional reactions at a physiological, subjective and implicit level. During memory

induction we measured electrodermal activity as an indication of arousal (Dawson, Schell & Filion, 2000). This provided us with the possibility to examine differences in bodily states when different fear representations were activated (see for a similar approach Oosterwijk et al., 2010). In addition, we asked participants to report on the extent to which they experienced fear during the memory inductions. Finally, because we are interested in a possible differentiation between semantic and episodic emotion activation in terms of emotional reactions that may not be consciously felt, we incorporated an implicit fear task. Self-report questions concerning emotional experiences may only tap emotional reactions that are explicitly labeled as such. Nonetheless, emotional reactions can also occur without accompanying subjective experiences (Winkielman & Berridge, 2004; Lambie & Marcel, 2002) and may thus be only measured with an implicit task. Accordingly we incorporated an implicit fear task a proposed by Rotteveel, den Daas, Wagenmakers and Zeelenberg (in preparation), that may serve as an indicator for the presence of an emotional state.

We test three hypotheses in the present study. First, we hypothesize in line with embodiment theory that both episodic and semantic fear representations are accompanied by an increase in arousal, as measured by electrodermal activity, compared to activating neutral representations. Second, although we hypothesize that both episodic and semantic fear activation can result in physiological responding, we expect that emotion activation is stronger when fear representations are self-relevant. Accordingly, episodic representations should result in stronger subjectively reported fear, physiological arousal, and implicit fear activation, than semantic representations of fear. And third, because we measure subjective fear, bodily activity and implicit fear in one experiment we can directly examine the correlations among these various dependent variables. We assume that bodily activity and *implicitly* measured fear indicate the strength of an *emotional state*, irrespective of whether this state is consciously experienced (Lambie & Marcel,

2002). Therefore, we hypothesize that bodily activity and implicit fear are positively correlated in both the episodic and semantic condition. We further hypothesize that correlations between bodily activity and *subjective* fear should be more pronounced in the episodic memory condition, since memory activation will be self-relevant and hence the emotional state will be more accessible to consciousness (Wheeler et al., 1997).

Method

Participants and design

Sixty-two female psychology students from the University of Amsterdam (average age 20 years) participated for course credit. Four participants were excluded because of system error; which left a total of 58 participants. Participants gave informed consent and explicit permission for analysis of the collected audio material.

The main factor in the present experiment was varied between participants and consisted of the episodic or semantic memory induction. Participants were randomly assigned to one of two inductions. The first part of the study was organized following a 2 (*induction*: episodic versus semantic; between subjects) x 2 (*emotion*: neutral versus fear; within subjects) mixed design. For the second part of the study (i.e., implicit emotion task) only the between factor *induction* (episodic versus semantic) was relevant for analyses.

Manipulations

Concerning the fear induction, we asked participants to recall either a personal experience (episodic memory), or to generate words about a fearful situation (semantic memory). We specifically instructed participants to talk about fear in an interpersonal context because we aimed to increase the similarities of recalled experiences across participants. All instructions were presented on the computer screen. Participants were first asked to think for one minute about their

response before they were asked to start talking for four minutes. A clock on the computer screen indicated the remaining time. Participants were encouraged to keep talking for the complete duration of the tasks.

Episodic manipulation. In the episodic memory induction participants were asked to retrieve a neutral memory and subsequently a personal fear memory. First, participants were presented with the neutral task that instructed them to describe the journey that they took that day to get from home to university. The instruction suggested that they described means of transport, what they saw during the trip and which buildings and streets they passed. Second, participants were presented with the fear memory induction. In this, we emphasized that participants should not retrieve a traumatic memory, but that we were interested in a fear memory that participants had shared with others before. Participants were instructed to talk about a personal fear memory concerning interpersonal contact, focusing on what they saw, felt and what they did in that situation. Participants shared, for example, experiences with fights, physical attacks and other threatening situations.

Semantic manipulation. In the semantic memory induction participants were asked to generate words about a neutral semantic category and subsequently to generate words about fear (see also Oosterwijk et al., 2009). First, in the neutral task, participants were instructed to generate as many kitchen attributes as possible. They were instructed to think about what the attributes look like, what you can use them for, and how they work. Second, participants were presented with the semantic fear induction that instructed them to generate words that were associated with fear in an interpersonal context. As in the episodic condition, participants were instructed to think about what a person can see, feel and do in a fearful situation. Participants generated words such as 'robbery', 'dark', 'attack', 'rape', 'knife', 'scream' and 'flee'.

Dependent measures

Electrodermal activity. Electrodermal activity was measured using an input device with a sine shaped excitation voltage of 1 Vpp at 50Hz, derived from the mains frequency. The input device connected to two 20 mm by 16 mm Ag/AgCl electrodes that were attached to the medial phalanges of the third and fourth fingers of the non-preferred hand. A signal-conditioning amplifier converted the signal into a linear output range of 0 uS to100 uS (measured as a voltage range of -10 to +10 Volt). The analogue output was digitized at 250 samples per second by a 16-bit AD-converter (Keithley Instruments KPCI-3107). Skin conductance responses (SCR) were calculated during the first minute of the memory induction tasks, since all participants, across all conditions, were talking during that period. During this one-minute period an algorithm searched for spontaneous skin conductance responses by identifying changes in the signal with a minimum amplitude of 0.1 uS together with a minimum trough-to-peak length of 100 ms as a valid response. Mean SCR amplitude was calculated by taking the average of all valid responses.

Implicit emotion task. The implicit emotion task is partially adapted from a task introduced by Zeelenberg, Wagenmakers and Rotteveel (2006). The adapted task presented facial stimuli to avoid any overlap between the linguistic nature of the memory induction and the implicit emotion task. The task presented a neutral target face subliminally, after which participants were asked to identify this face among two answer alternatives. Since the target face was always different than the faces presented as answer alternatives, we specifically tested the presence of a bias towards choosing fear stimuli. All faces (562 x 762 pixels) were selected from the Karolinka Directed Emotional Faces set (Lundqvist, Flykt, & Öhman, 1998). Importantly, the 10 neutral targets displayed different models than the answer alternatives. The answer alternatives always presented the same model with two different facial expressions from four categories (fearful, angry, happy and neutral). The answer alternatives consisted of six different sets: fearful-angry, fearful-happy,

fearful-neutral, happy-angry, happy-neutral and angry-neutral. The left-right positions of the unique faces within these different answer sets were fully counterbalanced.

The implicit emotion task was introduced to participants as a task that would examine whether it was possible to 'intuitively' identify subliminally presented faces. The task was presented using the stimulus presentation software 'Presentation' and consisted of 120 trials. Every trial started with a fixation stimulus ('+') presented for 500 ms. Subsequently, the target was flashed for 13 ms, and masked for 1000 ms. Following a short interval of 200 ms, the two answer alternatives were shown. Participants were instructed to choose between these alternatives using the 'a' and the 'l' key on the keyboard. When participants had chosen one of two alternatives a 2000 ms inter-trial-interval was presented, after which the task continued with the next trial.

Exit interview. The exit interview consisted of demographic questions and several questions concerning the experiment. First of all, participants were asked to retrospectively report on the extent to which they experienced fear during the fear memory induction. Participants reported their subjective feelings of fear on a scale from 0 (*'not al all'*) to 6 (*'very strong'*). We decided to ask for retrospective fear ratings because we did not want to make participants' emotional state salient before the implicit emotion task. In addition, the exit interview consisted of several questions about the goal of the experiment. In this, we asked participants about their suspicions concerning the implicit emotion task[1].

Procedure

All participants were tested by a female experimenter. Participants were seated in a separate room and asked to sign the audio-permission form and informed consent. While seated they were connected to the electrodes and provided with a headset. The experimenter explained the audio recordings, and emphasized that she could not hear the participants in the experimenter room. When the

experimenter had left, the memory tasks were presented. After the memory tasks were finished and the experimenter had removed the electrodes, the implicit emotion task was presented. The experiment was completed with the exit interview. Participants were debriefed and thanked for their participation and received their credit. In addition, they received a chocolate bar (Isen, Daubman & Nowicki, 1987) to neutralize possible mood effects elicited by the fear induction.

Results

Subjective fear

A retrospective question tapped subjective feelings of fear when participants talked about semantic or episodic fear representations. As expected, participants reported more fear following the episodic induction compared to the semantic induction, $F(1, 57) = 4.87$, $p < .05$, $\eta_p^2 = .08$. Means are shown in Table 1.

Electrodermal activity

A repeated measures analysis with emotion (control versus fear) as within factor and induction (episodic versus semantic) as between factor was performed on the mean skin conductance response while participants were talking. This analysis demonstrated the expected main effect of emotion, $F(1, 56) = 4.86$, $p < .05$, $\eta_p^2 = .08$. Participants showed stronger mean SCR while talking about fear ($M = .55$; $SD = .33$) compared to talking about a neutral subject ($M = .47$; $SD = .33$). Furthermore, a significant main effect of induction, $F(1, 56) = 4.42$, $p < .05$, $\eta_p^2 = .07$, indicated that, overall, mean SCR during the episodic induction ($M = .60$; $SE = .06$) was higher than mean SCR during the semantic induction ($M = .44$; $SE = .05$). There was no interaction between emotion and memory induction.

Table 1. Mean SCR and subjective fear during the episodic and semantic induction while thinking and talking about neutral subjects and fear. Standard deviations are in parentheses.

	SCR (in uS)		Subjective fear
Induction	Controle	Fear	
Episodic	.57 (.41)	.63 (.35)	2.67 (1.9)
Semantic	.39 (.23)	.48 (.31)	1.65 (1.6)
Total	.47 (.33)	.55 (.33)	2.12 (1.8)

Implicit emotion task

For clarity, and because we are specifically interested in fear, we will not present the data concerning the sets that did not involve fear faces. The implicit emotion task tested whether participants demonstrated a bias towards choosing fear faces. A bias was present when a certain face was chosen significantly more often than 50%. First, one-sample t-tests (test-value 50%) examined whether participants showed a bias for fearful faces (mean percentages are presented in Table 2). Overall, we found a bias towards fear faces (59%), $t(57) = 4.85$, $p < .001$, when fear and angry faces were combined. When fear faces were combined with happy faces, fear faces were chosen significantly less often (45%), $t(57) = 2.35$, $p < .05$, indicating a bias towards happy faces. When fear faces were combined with neutral faces, the percentage of chosen fear faces (46%) did not differ significantly from 50%, $t(57) = 1.79$, $p = .08$, indicating that fear and neutral faces were chosen equally often.

When we examined the percentages of chosen fear faces within the different memory inductions (see Table 2), we found a bias towards fear faces after both the episodic (63%), $t(26) = 5.08$, $p < .001$, and the semantic induction (56%), $t(30) = 2.20$, $p < .05$, when fear and angry faces were presented together. Thus, when choosing between angry and fearful faces, participants in both conditions demonstrated a bias

towards fear faces. To test whether fear faces were chosen more often after the episodic induction compared to the semantic induction we performed a face (fear-angry, fear-happy, fear-neutral) x induction (episodic versus semantic) repeated measures analysis. As expected, this analysis showed a main effect of induction, $F(1, 56) = 7.87$, $p < .01$, $\eta_p^2 = .12$, indicating a higher percentage of fear faces chosen after episodic induction (54%) compared to after semantic induction (47%). In addition, this analysis demonstrated a main effect of face, $F(2, 55) = 17.76$, $p < .001$, $\eta_p^2 = .24$. Simple effects revealed again that fear faces were chosen significantly ($p < .001$) more often when combined with angry faces (59%), than when combined with happy (45%) or neutral faces (46%).

Table 2. Mean percentage that a fear face is chosen while combined with an angry, happy or neutral face. Standard deviations are in parentheses. ** differs significantly from test value 50 ($p < .05$); *** differs significantly from test value 50 ($p < .01$)

	Fear face chosen (mean %) combined with:		
Induction	Angry	Happy	Neutral
Episodic	63.1*** (13.5)	47.7 (15.2)	51.5 (15.1)
Semantic	55.7** (14.5)	43.3** (15.2)	41.2*** (17.5)
Total	59.2*** (14.2)	45.3** (15.2)	46.0 (17.1)

Correlations

We found the expected correlation between the number of chosen fear faces (within the combination fear-angry) and the mean skin conductance response during talking about fear in both conditions ($r = .29$, $p < .05$). In other words, the stronger the physiological reactions while talking about fear, the more participants demonstrated a bias towards fear faces. When these correlations were examined separately within each memory condition, the strength of the correlations was

comparable, although lack of power restricted significance levels (episodic: r = .20, p = .16; semantic: r = .28, p = .07, one-tailed). We found no correlation between subjectively reported fear and the number of chosen fear faces.

In addition, we examined correlations between the physiological reactions and the subjective experience of fear reported by the participants in both conditions. We found a significant correlation between these two dependent measures (r = .27, p < .05). As expected, this pattern was different when we examined the episodic and semantic inductions separately. In the episodic condition the correlation between reported fear when talking about a fearful episode and the mean SCR measured during talking was significant (r = .33, p = .05, one-tailed). Within the semantic induction, however, this correlation was absent (r = .09, p = .32, one-tailed).

Discussion

The present study demonstrated that both semantic and episodic memory representations of fear resulted in stronger bodily activation than neutral inductions. When participants talked about fear, whether it was a personal fear memory, or the generation of words associated with fear, electrodermal activity was stronger than when participants talked about a neutral memory, or generated neutral words.

The present study also demonstrated interesting differences between episodic and semantic memory inductions. Episodic memory activation evoked stronger electrodermal activity overall, stronger subjective reports of fear and a stronger bias towards fear faces compared to the semantic memory induction. In addition, in the episodic condition the strength of electrodermal activity during the fear induction was positively correlated with subjectively reported fear. This correlation was absent in the semantic condition. In both conditions, the bias towards fear faces was positively correlated with electrodermal activity during memory retrieval.

The present findings concerning electrodermal activity support embodiment accounts (Barsalou, 2008; Niedenthal, 2007) by showing that not only episodic memories, but also semantic representations of fear can result in fear-related bodily

activity. Furthermore, our results indicate that episodic memory representations lead to stronger bodily reactions (i.e., arousal) than semantic representations. Thus, even though semantic fear representations result in embodied reactions, these reactions are weaker compared to when personal fear memories are activated. These results emphasize the importance of self-relevance in facilitating embodiment effects (Niedenthal et al., 2005a) and support the idea that retrieval from episodic memory leads to a re-experience of the past event in terms of bodily reactions (Wheeler, Stuss & Tulving, 1997). Re-enactment of bodily states may be associated with episodic memory in general, since we found that the difference in bodily activity between the episodic and semantic induction was independent of emotional or neutral content. This finding could suggest that any memory that implies the self is accompanied by simulations (Wilson, 2002), and that the mental activity associated with these simulations is accompanied by an increased state of arousal (Barrett & Bliss-Moreau, 2009).

Wheeler and colleagues (1997) propose that retrieval from episodic memory is prone to be accompanied by subjective feelings, or 'autonoetic awareness'. This occurrence of self-awareness is supported by our finding that more fear was reported after episodic compared to semantic fear activation. The positive correlation between subjective fear and bodily activity in the episodic condition (but not in the semantic condition) suggests that bodily states and subjective experiences are connected during episodic retrieval to form a multi-component re-experience of the past event. As such, episodic retrieval may result in an *emotional experience*, in which the self-focus implied by the memory activation enhanced conscious experience of bodily activity (Lambie & Marcel, 2002). Bodily activation during semantic retrieval, in contrast, could be seen as an indication of an *emotional state* (Lambie & Marcel, 2002), caused by automatic simulation processes that do not (necessarily) lead to conscious experience (Barsalou et al., 2003a, see for similar findings Oosterwijk et al., 2010).

Finally, we will address the findings from the implicit fear task. We found a significant bias for fear faces after recalling a personal fear memory, and after generating fear words. It is important to note, however, that the relative strength of the bias in the semantic condition remains unclear, because we do not have a no-fear baseline comparison. Nonetheless, the bias for fear faces was significantly stronger after episodic compared to semantic retrieval. Following the notion that the bias task can serve as an implicit emotion measure (Rotteveel et al., in preparation), this finding indicates, in line with our subjective and physiological findings, that the retrieval of personal fear memories is accompanied by stronger emotion activation than semantic retrieval. Interestingly, the bias for fear faces was positively related to bodily activity across conditions, but not to subjectively reported fear. This suggests that the implicit emotion task presented in the present study taps into emotion processes that have not reached consciousness (see Winkielman & Berridge, 2004; Lambie & Marcel, 2002).

The subjective, bodily and implicit measures taken in the present study suggest that activating personal emotion memories can result in a 'full-blown' emotional experience (Barsalou et al., 2003a; Lambie & Marcel, 2002), whereas different components of emotion remain disconnected when general, semantic emotion knowledge is accessed. Involvement of the self may be the factor that either integrates different emotion components, or facilitates subjective or introspective simulation (Barsalou, 1999), when retrieving episodic memories.