Body memory and kinesthetic body feedback. The impact of light vs. strong movement qualities on affect and cognition

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Abstract
What influence does body memory from two different movement qualities have on affect and cognition? This article relates the phenomenological theory of body memory, movement observation theory from dance, and psychological conceptual and empirical work on body feedback. Body feedback means afferent feedback from the body’s peripheral movements to the higher cortical functions, such as the systematic effects of the adoption of certain gestures or postures on the memory for life events (e.g., Riskind, 1984). Meaning of movements is stored in the body in relation to our learning history -- ontogenetic as well as phylogenetic. For such incidences of body memory, phenomenology has recently put forth a theoretical framework (Fuchs, 2012). On the basis of this framework, we hypothesize that specific movement qualities will have a differential impact on affect and cognition. In accordance with our hypotheses, results suggest that strong movements are related to more fighting affect and more negative memory recall, whereas light movements are more closely related to a non-movement
control condition, to more indulgent affect and more positive memory recall. Results are discussed with respect to the phenomenological framework.

Keywords: body memory, phenomenology, movement quality, Laban Movement Analysis, (kinesthetic / dynamic) body feedback.

Introduction
Psychology has recently shown within the domain of embodied cognitive science that the body and its movement have direct implications for affect, attitudes, cognition and action (Niedenthal et al., 2005). Proprioceptive and kinesthetic body feedback from postures and gestures is a central mechanism that can significantly influence feeling and thinking. Actions as simple as arm flexion and extension (i.e., approach and avoidance motor-behavior; Cacioppo et al., 1993; Neumann and Strack, 2000) can have direct effects on affect, attitudes, and learning: the perception of that had no former meaning to participants -- in this case arbitrary Chinese symbols -- can be significantly impacted by movements toward or away from one's own body. In this case, flexion causes more positive and extension more negative evaluations of the target symbols. The authors explain this effect in terms of our learning history: during all of our life we learn to take in or pull toward ourselves positive things: good food, lovely people, useful information, etc., whereas we push away bad things. This can cause ontogenetic as well
as phylogenetic predispositions that are mnemonically stored in the body, as an important part of body memory.

Body memory has been recently taken up in a new theoretical framework from phenomenology (Fuchs, 2012) that we will first introduce and later derive our hypotheses from. Body memory -- conceptually related to implicit memory (Schacter, 1987; 1996; Polanyi, 1967) -- contains all past bodily experiences that imprint on the present situation highlighting the how (quality) rather than the what (content) of the experience. It is a situated and embodied phenomenon, which is constitutive of our subjective uniqueness, of who we are as persons. Body memory is constrained by embodiment: It is anatomically tied to the shape and possibilities of our bodies, and to their embeddedness in the environment. As persons, we are always embedded in a natural, cultural, and intersubjective life-world. Accordingly, body memory has structural and universal components, culturally mediated, and strictly individual ones.

In dance and enactment body memory is particularly important. When a small child imitates Michael Jackson, she uses a mix of explicit and implicit memory --- declarative memory, body memory, and mapping -- in order to perform well. The lightness and suddenness in the quality of the turns, the flow and the lightness of the gait, all are represented in one Gestalt, and only as such can it be enacted. Laban Movement Analysis (LMA; Laban, 1980) provides a theory-based tool to look at quality of movement in a quantifying manner and thus make it suited for research. We
used LMA here in order to derive our hypotheses from a theory system, and in the context of the manipulation check as an observational method (correct application of light versus strong movement quality as the independent variable). Laban and Laban derived theories (e.g., Kestenberg, 1995) provide a very differentiated view on movement elements and on basic dimensions of movement yielding them particularly helpful for embodiment research. Body memory and body feedback research can profit from integrating this dance-derived methodologies into its conceptualizing.

The body feedback hypotheses (Facial Feedback Hypothesis; FFH; Laird, 1984, Postural Feedback Hypothesis, Riskind and Gotay (1982), and Vocal Feedback Hypothesis, Hatfield et al. (1994) have offered a number of different tests related to memory. Riskind (1984) found that an upright posture vs. a slumped posture boosted either pleasant or unpleasant memories, Foerster and Strack (1996) found that nodding or shaking one’s head influenced the memory for positive vs. negative words, and Dijkstra et al. (2007) demonstrated that body position affected the recall of autobiographical memories. They described the memories to be “easier to access if the body position is similar to the one in the original experience” (Dijkstra et al., 2007: 146), that is, state-dependent memory would be specified into a posture congruent memory, facilitating the reconstruction of autobiographical memories. According to Bietti (2013), these findings suggest that the body posture in which the experience was
acquired is contained in the multimodal memory trace of the experience stored in the brain, and provides evidence concerning the multidimensional nature of memory traces.

In phenomenology re-afferent body feedback is related to kinesthesia, conceptualized as the primary sense modality by Husserl (1952), Merleau-Ponty (1966), and Sheets-Johnstone (2012). In dance, kinesthesia is the primary sense modality carrying the professional work (Laban, 1980). In psychology, empirical work on body feedback has much remained in the static realm up to now. Where it has used movement is has explicitly focused on functions of shape changes, such as the nodding and head shaking in the experiments of Wells and Petty (1980) and Förster and Strack (1996), and not on the impact of movement quality. With the move from static to dynamic movement interventions, movement quality – as the second primary dimension of movement, again the how instead of the what -- needs to be taken additionally into account. Investigating this factor, Koch (2011) found that movement quality has a comparable impact to shape changes on diverse dependent variables such as affect and attitudes -- the impact on cognition remaining to be tested.
Body memory is assumed to be a mediating mechanism of re-afferent body feedback. In bringing the three introduced research traditions together, new insights can emerge.

The phenomenology of body memory

Body memory embraces the totality of our subjective, perceptual, and behavioral dispositions, as they are mediated by the body. Different from the expression “memory of the body”, the concept of “body memory” precisely indicates the non-representative nature of this memory. Rather than making explicitly present to us a past experience, or a specific event in our life history, body memory is responsible for the constant enacting of our sedimented past experience. As such, this memory is “intrinsic to the body, to its own ways of remembering: how we remember in and by and through the body” (Casey, 2000: 147). More precisely, body memory allows us to become acquainted with perceptual and experiential patterns, and to acquire familiarity with our bodily capacities, and it plays a role in the process of typological meaning-formation (Bergson, 2007; Casey, 2000; Fuchs, 2000; 2008a; b; 2012; Summa, 2011; 2012). Moreover, it is responsible for the development of an individual style of perceiving and moving, and generally of experiencing the world. As such, it is the condition for the bodily “I can” (Husserl, 1952).
Recent phenomenological research has distinguished several forms of body memory. These descriptive differentiations are fruitful for the debate on memory in phenomenology, cognitive sciences, and psychotherapy (cf. Koch et al., 2012). In what follows, we will briefly discuss Fuchs’s (2012) typological description of six forms of body memory, which has guided the empirical study we will present in the second section of this paper. ii

1) Habitual or procedural memory refers to the habitualization of the sensorimotor capacities of the lived body. It allows us to acquire sensorimotor skills and attitudes, to become acquainted with perceptual and movement patterns, and to develop an individual style of interaction with the world. Examples are playing an instrument, biking, or driving a car. It is worthwhile stressing that such perceptual and kinesthetic habitual memory at the same time opens up and limits our experiential possibilities, and this is why it gives shape to an individual style of experiencing. Habits, moreover, are contextually enacted, and may be partially modified in the context of their enactment.

2) Situational memory extends into the spatio-temporal situation in which we bodily participate. As such, it entails the involuntary emergence of images and sensible impressions related, for instance, to the atmosphere of certain lived situations, which are mostly affectively and emotionally charged. Situational body memory grounds both the feeling of familiarity with certain situations and the feeling of alienness with others, thus allowing us to “get involved in”, to “be touched from”, or to “feel threatened in”
specific situations. Re-experiencing some features of a situation or contexts makes us assume certain bodily attitudes in a pre-reflective and spontaneous way. This particularly shows that there is a contextuality of body memory, which implicitly informs our behavior in accordance to specific contexts without us being explicitly aware thereof.

3) *Intercorporeal memory* is related to the most basic, pre-thematic, and bodily contact with other subjects. Intercorporeality is the primal form of mutual bodily understanding, which happens in interaction (see Merleau-Ponty, 1964). Intercorporeal memory, accordingly, is what enables the formation of dyadic and more generally intersubjective patterns of interaction. The features of intercorporeal memory become particularly visible in those developmental-psychological studies showing how motor, emotional, and social skills in early childhood are jointly formed and integrated through affective-interactive schemas: The child incorporates, as it were, repeated and prototypic experiences with significant others, leading to what Stern (1985) calls “schemes of being with”. These patterns are integrated in what Stern has termed *implicit relational knowing*: a form of intersubjective and operative knowledge, which, from early childhood, impinges on the formation of relational styles and individual personality. Accordingly, such patterns of interaction are comparable to acquired skills that are activated in concrete contexts and situations. They form what Fuchs calls
“embodied personality structures” (Fuchs, 2006; 2012) and are of particular relevance for both psychopathology and psychotherapy.

4) **Incorporative memory** is mostly based on the phenomenon of bodily imitation or identification, and implies the reshaping of one’s own primary bodily schemas of expression and behavior in social contexts. Thus, incorporative memory enables the development of specific bodily attitudes and the assumption of embodied social roles. Developmentally, this form of memory emerges later than intercorporeal memory. It is based in particular on the “interiorization” of the gaze of the other: the child’s behavior is increasingly oriented towards the values and rules of his or her specific social environment, primarily the family context. On the basis of incorporative memory, children implicitly assume bodily attitude that make them conform to specific roles. Progressively, incorporative memory becomes the carrier of what Bourdieu (1980) calls **habitus** thus becoming a form of collective memory. The latter entails the set of socially learned dispositions, skills, styles, trends, way of acting, and all bodily social conventions that mostly go without saying.

5) **Pain memory** refers to the impact that painful experiences still have on our present and which manifests itself, for instance, in the unreflected and spontaneous caution that we have in handling knives, if we once got injured. The French neurologist Claparède (1911) describes an amnesic patient, who could not store any new information because of her brain injury. Each day, he had to introduce himself to her
anew. She had no explicit recollection of previous meetings and was not able to recognize him. One day he covered a tack in his hand when greeting her. Slightly hurt, the patient quickly withdrew her hand. The next day she refused to greet him, although she could not explain why. Explicitly, she could still not recognize her physician. Yet the experience of pain remained imprinted in her body memory. In these cases, the implicit memory of pain is bodily inscribed and has an impact on our behavior, dispositions and ways or interacting with others. The memory of pain may also find expression in psychosomatic illnesses. Many patients with somatoform pain disorders, for instance, have suffered severe pain or violence in their childhood, and the memory of such experiences may be reactivated even after long periods of latency (Fuchs, 2012).

6) *Traumatic memory* refers to the impact traumatic experiences have on the present. Traumatic memories may emerge as displaced or as bodily symptoms, without any explicit awareness of the connection between the past and the present experience. The traumatic event in many cases withdraws from explicit representation; it may not be integrated into a meaningful context and a coherent self-image. Under the extreme stress of trauma, thoughts and imaginations can dissociate from bodily sensations and emotions (Eberhard-Kaechele, 2012; Markowitsch, 2009; Van der Hart et al., 2006; Van der Kolk and Van der Hart, 1995). Later on, traumatic memories can be reactivated by specific stimuli, which are known as triggers, reactivating stimuli, or conditioned stimuli (Van der Hart et al., 2006: 41 ff.) These include sensory and bodily experiences,
time-related stimuli (e.g., anniversaries), daily life events, events during therapy sessions, emotions, physiological conditions (e.g., hyperarousal), stimuli recalling intimidation by perpetrators, and current traumatization. Thus, traumatic memory illustrates an important characteristic of body memory in general: Current bodily experiences (postures, movements, situational features) are always prone to revive the memories, cognitions and affects related to similar former experiences. Thus, body memory may also open the door to declarative or biographical memory, as is famously described in the “madeleine episode” of Proust’s “In search of lost time” (1934).

Empirical test of body memory
In a recent study, Koch (2012) empirically tested Fuchs’s typology using expert interviews of movers versus lay persons. The content analysis of the interviews yielded a first validation of the typology of body memory of Fuchs (2012). This study continues to test the usefulness of body memory theory for psychological research. Experimental evidence for body memory mechanisms comes from the field of body feedback research, yet replications and specifications are needed.

Within body feedback research, effects of dynamic movement qualities need to be investigated in their own right. Casasanto and Dijkstra (2010) showed that more positive autobiographical memories resulted, when moving marbles upward, and more negative memories resulted, when moving them downward. While their experiment
showed the relation of memory recall and directional movement, the relation of memory recall and movement qualities remained unclear. We thus extended body feedback research to movement qualities (Koch, 2011). Complementary to the shape of the movement (e.g., the slumped or the upright posture, or the up or downward movement direction), qualities of movement deliniate the dynamic spatio-temporal patterns of tension changes in the movement (e.g., intensifying, accelerating, decelerating, rhythmic patterns; Kestenberg, 1995; Laban, 1980). In order to test the effect of movement qualities on memory, we designed this experiment and tested the two movement qualities of light vs. strong movement against each other and a control group. Light vs. strong were chosen from a set of four basic dimensions of movement qualities as described by Laban and Lawrence (1947), each set falling into an indulgent and a fighting movement quality side. Laban and Lawrence (1947) describe a spatial dimension (with direct vs. indirect movement), a gravity dimension (with light vs. strong movement), a temporal dimension (with quick vs. sustained movement), and a flow dimension (with bound vs. free movement; for a more detailed descriptions see Laban and Lawrence, 1947). We selected light vs. strong in our investigations of the effects of movement qualities on memory, because it is related to the vertical movement dimension which is one of the best researched dimension in body feedback research so far (note that most experiments mentioned in this paper used the vertical movement dimension).
Effects of strong vs. light movement on affect and memory valence

In this study, 91 participants moved for three minutes in either a strong manner, a light manner or they did not move, but did a meditation exercise (control group) for the same amount of time. We measured affect and valence of memory elicited by the movement assuming that light movement would elicit more indulgent affect and more positive memories, and that strong movement would elicit more fighting affect and more negative memories. Memory valence is the positive or negative evaluation of the specific memories retrieved (see methods), and is a phenomenological aspect of implicit as well as explicit remembering.

Method

Sample and Design

Initially ninety-four participants, 72 female and 22 male, all Caucasian students with mostly a psychology major, or another humanities major, participated in the study for course credit or a chocolate bar. Three participants were excluded because they did not use the appropriate movement quality as judged in the manipulation check. The remaining 91 participants, 70 women and 21 men, had a mean age of 23.1, SD=4.1 (range 19-50). One-factorial between-subject-design with the independent variable of movement quality (strong vs. light) and the dependent variables of affect and valence of
evoked memories (scale from 1 very unpleasant to 4 very pleasant). Mood was used as a control variable.

Procedure and Instruments
Participants moved (in small groups of 2-4 persons; in 30 trials) either in a strong or a light movement quality for three minutes following an instruction of one minute that did not use the words of strong or light but described “please move as if moving heavy objects, pulling them or pushing them”, “please move as if floating or drifting”, with a balanced amount of more negative and more positively connoted description between conditions. The control group merely imagined the movements hearing the same instructions in order to control whether the effects could have occurred as a result of the instructions alone or was a true body feedback effect. Before and after the movement, mood was measured with the MDBF (Steyer et al., 1997), a common German mood questionnaire with 24 items on 5-point Likert-scales. Immediately following the movement, affect was measured with the Brief KMP Affect Questionnaire (Koch and Müller, 2007; 12 items on bipolar 9-point scales; sample items: tense versus relaxed; open versus closed, indulgent versus fighting). Then, memories were assessed in a two-step procedure. First, participants were asked to generate as many memories as they had during and after the movement. Then, they were asked to rate the valence of each generated memory and item on a 4-point-scale according to how pleasant or unpleasant
they had been for them (from “- -“ to “++”). Then, participants were asked to complete the MDBF another time. After being asked for their demographic data they were debriefed, and finally received their course credit or chocolate bar. The entire procedure took 10 to 15 minutes.

Manipulation Check
Videos were all rated by an expert movement analyst on use of strong and light movement quality. This female trained rater was blind to the experimental conditions. On the basis of these ratings, three participants were excluded from further analyses.

Results
In accordance with the hypotheses, participants in the light movement condition reported more positive memories than participants in the strong movement condition $F(10,91)=2.150$, $p=.023$, $\eta^2=.11$. Means and standard deviations are provided in Table 1, Figure 2 graphically depicts the effects on valence of memories after the movement.

--- Insert Table 1 about here ---

Participants in the light condition typically reported memories such as: “a summer day”, “beach, sun, sea, …”, “a walk along the river”, “hovering on clouts”, “birds” etc.,
whereas participants in the strong condition reported rather: “moving out”, “military service; surmounting barriers”, “heavy workout”, “physical labour in the field”, “carrying heavy water bottles upstairs to my apartment”, etc.

Participants further reported more positive affect after light than after strong movements $F(2,91)=4.633$, $p=.012$, $\eta^2=.01$. Means and standard deviations are provided in Table 1, Figure 3 graphically shows the effects on affect after the movement.

Mood was used as control variable. There were no baseline differences in mood (MDBF-sub scales positive vs. negative mood $F(2,88)=1.278$; $p=.284$; $\eta^2=.03$, alertness vs. tiredness $F(2,88)=0.397$; $p=.674$; $\eta^2=.01$; and relaxation vs. tension $F(2,88)=0.893$; $p=.413$; $\eta^2=.020$), and no significant mood change from pretest to posttest, suggesting that the observed changes in affect can be attributed to the experimental manipulation.

Discussion
Based on body memory theory (Fuchs, 2012), embodied cognition approaches (Niedenthal et al., 2005; Niedenthal, 2007), and movement analysis (Kestenberg, 1995; Laban, 1980) we assumed that movement of either a strong or a light quality would elicit differential affect and memory. Results suggest that movements of opposing qualities evoked differential affect and memories of life events as predicted by theories of body memory and movement analysis: light movement caused more indulgent affect than strong movement and participants had more positive memories after light movement. The control group that only imagined the movement showed no differences on both instructional variants (light and strong) pointing to the specific function of the body and its movement in remembering. The study showed that the effects were neither dependent on instruction nor on population as had been criticized in a former study (Suitner et al., 2012). It is suggested that the effect is due to body memories via body feedback. Body feedback presumably transports situated individual as well as more invariant memory cues mediated by phylogenetic and ontogenetic learning.

In a former study (Kasper, 2009), similar results had been obtained not only from dynamic strong vs. light movement, but also when participants held an open hand position (palms toward the ceiling, hands resting on the knees in a sitting position on a chair) vs. making a fist in the same sitting position. Interestingly, results for these merely static postures were not as pronounced as for the ones where dynamic movement was employed, showing the stronger impact of dynamic movement on affect and
memory. In a similar vein, Koch (2011) found that dynamic body feedback from approach and avoidance movements had partly stronger effects than from body feedback of the same statically held force application of pressing on a table from above or below (Cacioppo et al., 1993). The present study thus extends former findings on the influence of body posture on affect and memory, to a more dynamic realm taking into account movement qualities.

Limitations of the study include the sample size, particularly regarding the fact that the experiment was conducted in small groups. One could rightfully argue that in that case the groups should be the unit of analysis which would reduce the sample size to a minimum of n=30. A replication of the experiment as a single subject test would thus be warranted.

The operationalization of the light versus strong movement in form of a free improvisation could also be changed into a more controlled manipulation where one could measure the amount of force executed, etc. The context of the research, however, was related to testing parameters of dance and thus the present operationalization was better suited than a more controlled operationalization.

A second control condition could have also helped to better clarify the impact of energy expense: strong movements are more effortful than light movements; it might be that affective quality is correlated with energy expense rather than strong movement per se. A further control study involving an effortful non-movement condition, where e.g.
participants would do an exercise in mathematical or logical reasoning without the aid of pen and paper, or calculator, could help to control the impact of energy expense.

Theoretical limitations include that the effects of the empirical study may be explained in other ways than based on body memory theory, e.g., by mere physiological feedback. However, it would then remain largely unclear why systematic memory effects occur. Next to the nomothetic patterns, idiosyncratic memory pattern and relations to life history, context, and body history should be of interest in future work.

Conclusions
Phenomenology and psychological embodiment research converge in considering body memory as a dynamic phenomenon, which essentially mediates our pre-reflective self-awareness, and contributes to shape our interaction with the world and with others. As we have seen, phenomenology particularly emphasizes the non-propositional and non-representational character of body memory. Body memories are not represented. Instead, they implicitly sediment as moments of our life-history, they well up and are enacted in specific contexts and situations. In such a way, they tacitly inform our present experience. We usually become aware of the role of such memories in moments of hesitation, fatigue, or when we need to adapt to new and unexpected circumstances. The results of the empirical study presented in this paper substantiate the previously discussed phenomenological-descriptive insights and the mediating mechanism of body
memory. In agreement with the phenomenological theory, such results underline how body memory is characterized by the inner co-belonging of past and present experience. Phenomenological theory thus provides a theoretical and descriptive background that can inspire further empirical research, focusing, for instance, on the situatedness of memory, its world-relatedness, and its dynamics.

In sum, the findings suggest that carrying out specific movements correlates with what we recall and how we feel. They provide evidence for the importance of dynamic body feedback and its potential cognitive and affective implication. In our study, we have shown that the quality of movement is an important feature of such body feedback, stemming from and affecting affect and memory. In future work, bodies in motion need to be more in the focus of empirical research on body feedback and body memory. Suitner et al. (2012) and Koch (2011) have shown implications of movement qualities on attitude formation towards neutral objects or social targets. The way and shape in which we move are key components of our everyday life with numerous effects on cognition, memory, and emotion (Glenberg, 1997; Koch, 2011). Movement, in fact, seems to provide an important part of the mind’s grounding (Barsalou, 2008).

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References


Table 1.

Means (SD) of memory valence, posttest affect (KMP-affect scale) and affect differences (MDBF posttest minus pretest) of the n=91 participants

<table>
<thead>
<tr>
<th></th>
<th>Memory valence of free retrieval</th>
<th>Positive Affect(^b) (Sum)</th>
<th>Difference</th>
<th>Relaxation(^d)</th>
<th>Alertness(^e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Movement</td>
<td>3.23 (0.65)</td>
<td>37.90 (10.78)</td>
<td>0.45 (2.42)</td>
<td>1.12 (2.01)</td>
<td>0.71 (2.75)</td>
</tr>
<tr>
<td>Strong Movement</td>
<td>2.80 (0.52)</td>
<td>49.90 (11.77)</td>
<td>-0.84 (2.83)</td>
<td>-1.25 (2.72)</td>
<td>0.16 (2.41)</td>
</tr>
<tr>
<td>Control Group</td>
<td>3.16 (0.42)</td>
<td>41.96 (10.77)</td>
<td>-0.57 (3.10)</td>
<td>0.25 (2.40)</td>
<td>0.00 (1.81)</td>
</tr>
</tbody>
</table>

Note. \(^a\)Means on bipolar scale from 1 (=very unpleasant) to 4 (=very pleasant);
\(^b\)Measured with KMP-affect-scale (Koch and Müller, 2007); higher values indicate more negative affect;
\(^c\),\(^d\),\(^e\)subscales of MDBF (Steyer et al., 1997): \(^b\)Positive vs negative mood, \(^c\)relaxation/tranquility vs tension/nervosity, \(^d\)alertness vs tiredness; higher values indicate more positive mood, relaxation and alertness.
Figure 1: Assumed mediation of body feedback by body memory; body feedback is the impression function that expressive and motor elements have on affect and cognition; its effects on affect and cognition have been investigated in social psychology since the 1970s (e.g., Laird, 1984).

Figure 2: Movement of light quality evoked more positive memories ($p=.023$)

Note. Dependent variable = valence of memories (high values = positive memories).
Figure 3: Movement of light quality evoked more indulgent affect (p=.012)

Note. Dependent variable = affect sum values (range: 13-91; high values = negative affect)
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This typological and descriptive classification does not exclude possible overlapping and intersections among the different forms of body memories.