PSYCHOLOGON

How Body Influences Memory: The embodied aspects in retrieval of autobiographical memories

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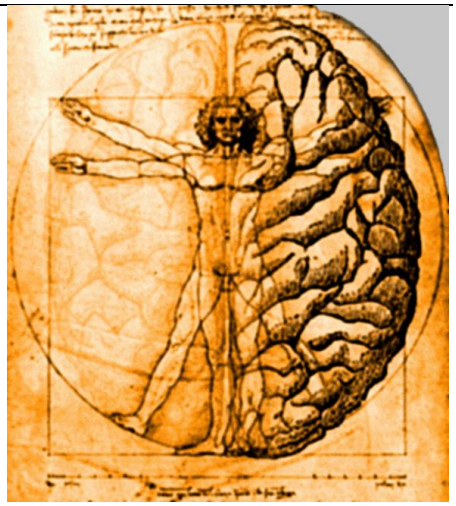

Abstract

How can we recall autobiographical memories? Does our body play any important role in memory retrieval? In this paper I deal with the voluntary retrieval of autobiographical memories within the frame of embodied cognition theories. I summarize the aspects causing the retrieval of autobiographical memories and also consider the circumstances facilitating this retrieval. Although the process of AM retrieval still lies in the field of academic discussion and no comprehensive theory of AM retrieval exists, in this paper I find empirically based evidence of autobiographical memory retrieval of which particular aspects shall come to be highlighted in the way of embodied cognition theories and help us to understand the retrieval processes.

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ISSN: 1805-7160

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1. Introduction

We still cannot find any comprehensive theoretical account how autobiographical memories (henceforth AM) are retrieved (Dijkstra, 2006), and as AM researchers note in general, not much is known about the construction of memories (Conway, 2005). Theories about autobiographical memories try to get deeper insight into the topic from many points of view, considering e.g. basic perceptual systems (Rubin, 2012) on the one hand and the inclusion of "self" on the other (Conway, 2012, 2005). The importance of life-scripts in autobiographical retrieval seems also very influential aspect of remembering (Rubin & Berntsen, 2003; Berntsen & Rubin, 2004). These notions suggest the importance of both schema-oriented, abstract aspects in memory, and also sensory and motoric encoded pathways in retrieval process. This also actively questions the mechanisms, which stand behind such a complex process. Overall, this topic still remains in the field of academic discussion. To help explaining many cognitive phenomena embodied cognition (henceforth EC) theories slowly enter into the autobiographical memory issues. In my opinion,the EC concept seems very promising to highlight AM issues, because it considers situational context of cognitionand as seen below, the situational and embodied cues may be the crucial movers of AMs retrieval. Therefore the focus of experimental research in the AM field starts to be incorporated within the EC framework.

The topic of this paper is the examination of the available current approaches and empirical studies about EC in voluntary AMs retrieval. According to the suggestions of the implicit inclusion of the human body into the cognitive processes I want to study the current statements of voluntary autobiographical memories retrieval within the framework of embodied cognition and deepen the understanding of how the memories are retrieved.

First I will outline the EC theories in relation to AM; (a) EC theories, (b) AM retrieval context and (c) EC through current approaches in AM. Secondly I summarize the available empirical research dealing with AM within the EC approach, to analyse theoretical claims in sections a, b, c, and in my conclusion I will try to interpret the findings.

2. EC in the field of autobiographical memory

Embodied cognition is a broadbackground possibly standing behind cognitive processes.The EC approach we can simply understand as the organism – environment interaction influence on cognition. From its point of view, as many researchers admit, most of cognitive phenomena could be better explained. In the field of philosophy and psychology already a century ago, the philosophers and scientists such as Martin Heidegger, John Dewey, Ludwig Wittgenstein or Lev Vygotsky anticipated the possible importance of the inclusion of the body and situational context into cognition. Even though, for more than fifty years these voices were obscured by another approaches and rediscovered only few years ago.

In the first part of this section I describe the EC concept and its intersections with AM. Then I outline some knowledge about AM retrieval and its research and then I consider the EC response in current AM theories.

2.1 EC theories

Embodied cognition (henceforth EC) is the approach in which cognition (and its subjected processes) is always considered as the situated activity and also is embodied (Anderson, 2003). EC is the opposite of Cartesian and cognitivist attitudes (dualism of mind and body) and its dominant research paradigm, in which the development of Artificial Intelligence (GOFAI) is attempted (i.e. the cognition is not influenced by any body inputs). Cognitive psychology used for a long time this computer metaphor to describe memory and its processes, but the quite novel approach of embodied cognition theories suggest the explicit inclusion of body inputs and situational context in cognition (Varela, 1993, Cowart, 2014). The concept of embodied cognition describes human cognition as always depending on the body experience. It extends the cognitive processes space from separated brain to interaction of the whole body with its environment. In this point of view, cognition is always situated, goal-oriented, time pressured and an active more than a passive process (Wilson, 2002). When encoding information, body experience includes not only body postures, but also actively engages the role of motion and emotion experiences. Does it play any important role when autobiographical memories are retrieved? Or does the retrieval

occur without any necessary connection to the body? In my opinion the embodied cognition perspective can help explain some features of AM retrieval process.The inclusion of Dynamical Systems Theory into cognitive science (Clark, 1999) opens an inspiring point of view on cognitive processes. In the field of social cognition Niedenthal claims, that without EC involvement the central intersubjectivity, empathy, and sympathy cannot be understood functionally (Niedenthal et al., 2005) The theories of extended mind (Sutton, 2006, 2005), and embodied cognition in memory issues (Sutton, 2014) offered explanations of memory in many ways. Some researchers as Conway (2005) consider cognition implicitly as driven by its goals, which is one of EC presumption (see: Wilson, 2002). In general, EC breaks the cognitivist approach and understands the cognitive processes as strongly influenced by particular contexts. But despite this, EC as quite a new conceptstill misses empirical evidence.

2.2 Searching for AM retrieval

The exact mechanism of AM retrieval still remains somewhat unclear. What exactly helps us to recall autobiographical memories? Although the AM retrieval mechanism is probably very complex and demands activity of different brain areas, recent research helps us to highlight this issue among others also by definition of new memory aspects as voluntary and involuntary memories, future memories (see: Berntsen & Jacobsen, 2008) and false memories to help us better describe, what is happening during our autobiographical memory retrieval. Although, the long research tradition in psychology focused mainly on voluntary memories, claiming that most of the memories in our lives we recall in a strictly voluntary way. Involuntary autobiographical memories appear when cues we can meet in everyday life, with no conscious effort, raise recollections of the past. Memory recalled with conscious effort is contradictory the voluntary one. Recent studies have shown the importance of involuntary AMs, and according to Berntsen (2010, 2012), involuntarily retrieved memories create at least the same part of our personal memories as voluntary ones. To understand voluntary recall we also have to better understand involuntary recall, because as seen below, in many ways, those both, within the EC concept, help to highlight the whole retrieval mechanism. As Berntsen and colleagues suggest (Berntsen & Jaobsen, 2008, Berntsen & Hall, 2004), the differences we can find

between voluntary and involuntary memories could be on account of different retrieval processes in a way of "top-down" process (voluntary memories) and "bottom up" process (involuntary memories), which is in a more associative way. The bottom-up based evoking of memories seems to be natural for involuntary AMs recollections. Nonetheless, voluntary access can probably offer us the crucial highlight of AM retrieval, because it is probably a specific human ability (Donald, 2012) and therefore involving higher cognitive functions. To support embodied nature also for voluntary memory retrieval I summarize mostly voluntary retrieval empirical evidence.

Berntsen and Jacobsen (2008) and other researchers (D'Argembeau & Van der Linden, 2006) describe memories from the past and images of the future in the concept of mental time travelling. They add that these two systems seem overlapping in many ways, involving the same memory system, but according to D'Argembeau and Van der Linden (2004), imagining future events is less sensory active than remembering the past. The physically experienced situation seems to be encoded in the body sensory and motor pathways. This could be also explained in the EC account, because there is the specific experience of the organism in the real past event, which physically influenced the history of organism. Contrary to the past issues, as Berntsen & Jacobsen note (2008), the future imaging (retrieving the life events from the future and future thoughts) more depends on semantic knowledge. Her findings are consistent with brain imaging studies (Addis et al., 2007) that show more brain areas activity when future events are imagined than when recalling the past, especially in the memory construction phase. According to this claim Berntsen & Jacobsen (2008) deduce, that future mental time travel demands complex constructive processes to imagine events and therefore, constructive components in the memory retrieval is needed. Donald (2012) supports this with his evolutional perspective, where he finds voluntary memory retrieval (usually of personal experience) as specifically formed by human culture, and particularly, language plays an important role through the developmentof this kind of memory. According to early claims of Lakoff and Johnson (1980), who considered language as a highly embodied activity, the influence of embodiment in the development of autobiographical memory and its retrieval mechanisms is rather obvious. As seen below, recent studies supported this claim.

Top-down and bottom up processes seem to be collaborating in AM retrieval of both, voluntary and involuntary memories. These two processes also probably enhance each other to recall specific event. The EC theories are in general constructivist approaches. The body-based cues (subjected to EC) encouraging AM retrieval suggest that the bottom-up processing occurs, but some constructive issues are included even in such basic cues as body postures and emotion. This claim is underlined by the fact that EC involvement is also apparent in voluntary recall where the activity of right prefrontal cortex (Hall, Gjedde, & Kupers, 2008) is present and it matches the evidence of embodied abstract mind structures in the same parts of brain (Pulvermüller & Garagnani, 2014). The EC concept, therefore, supports both, bottom-up and top down processes during AM retrieval. The evidence of less sensory activity when imagining the future than when remembering past events (D'Argembeau & Van der Linden, 2004) seems also to agree with EC theories. This assumption is supported by findings of previous studies, which suggested that the experience is written in the perceptual and motoric body traces (Damasio, 1999; Glenberg, 1997).

As Dijkstra (2006) summarized, some current theories distinguish between general and specific events in memory, so they understand memory from a hierarchical perspective. According to findings by Burt, Kemp, and Conway (2004) and Conway (2005) we may get a deeper insight into roles of the event components in AM organization. These components are highly rooted in EC framework. From this point of view autobiographical memories are seen more as "specific events". They consist of sensory, perceptual and affective information with some level of reliving experience – e.g. remembering smelling the rose. Therefore, on embodied cognition account, the remembering in this case is only outcome of sensory and motor reconstruction of the past event. The event was once experienced and the experience was encoded into nervous system. When I remember it (smelling rose), incurred connections are reactivated and produce the memory on the low level. However, recent studies show the sensory-motor grounding present also for abstract concepts (Dijkstra, 2014). This suggests that there could be retrieval mechanism consisting of combinations of different cues from different hierarchical levels of memory organization, but all basically embodied. Next I investigate some comprehensive AM theories and their relatedness to EC.

2.3 EC and current approaches in AM

With respect to the computer metaphor denial in his paper, I investigate Rubin's attitude to AM. David Rubin (2012) divides the mind into basic subsystems – senses, language and motor output and according to his findings, "all AM are constructed through the interaction of the basic systems" (Rubin, 2012, pgs. 13) and "autobiographical memories are not constructed from a general, abstract, propositional cognitive structure of homogenized information, but rather from sensory, language, emotion, and other systems, each of which uses fundamentally different structures and processes for fundamentally different kind of information" (Rubin, 2012, pgs. 13-14).This approach seems to be consonant with EC theories framework and support the implicit role of motor and sensory pathways in AM retrieval.

The retrieval mechanism in Rubin's point of view consists of three systems, which can get the information from subsystems together in the right time (Rubin, 2012). Although this claim is still speculative, he admits, that there is a kind of primal information derived from subsystems and creating the AMs along with the others subsystem's information. His "emotion system" fits with the previous findings of Niedenthal (2007), who considered the embodied emotion as one of the specific parts of the AM production. The "frontal search and retrieval system" seem to be more schematized and could be related to the top down processing retrieval. "Event-memory system" issue offers the comparison of its nature to Dijkstra's "temporal cues" definition (2006) considering the role of time in AM retrieval. Rubin (2012) understands event-memory system as system binding together events that occur in the same time. Dijkstra's (2006) temporal cues are considered as event-context body experience with the world and according to her, when one is reliving the memory, the other context components (bound events) always occur. Therefore, these two approaches seem to agree in general.

Rubin's not distinguishing between semantic and episodic memory could be put into coherence with the Berntsen and Hall's (2004) findings of the bottom-up and top down retrieval processes, not only in the case of memory retrieval. To recall

autobiographical memory semantic knowledge (more abstract) as well as the specific detailed event knowledge (motor and sensory nature) is needed and probably both within the EC framework.

To support the embodied nature of AMs retrieval I mention this empirical evidence.

3. The recent empirical evidence

In the past few years the memory hypothesis started to be tested within the EC theories framework, to emphasize the importance of body inclusion into cognitive processes. The results helped not only to support the EC approach, but offered many new answers for the previous theoretical questions. Eelen (2013) mentioned a pronounced research interest within the fields of cognitive and social psychology, but also in consumer behaviour and neuroscience, suggesting the human body having impact on higher order cognition as language, emotion processing, self-regulation and trust. Below I mention relevant examples.

3.1 Body postures and AM

In the field of autobiographical memory the influence of body posture when retrieving a memory was considered. In her recent study (2007), Dijkstra highlighted the effect of congruent body position on autobiographical memory retrieval. The study showed significantly better participant's performance involuntary AM retrieval when stating the congruent body position than the neutral (incongruent) position. Dijkstra showed in her experiment, that people in specific positions (e.g. lying on their back in the kind of dentist chair) were faster at retrieving a memory of seeing the dentist. Also after experiment, free recall task showed better access to memoriesretrieved in congruent position two week after experimental task. This research shows that the basic levels of physical experience, like assuming the body postures when retrieving the particular memory, can significantly facilitate the retrieval of this memory and also increase the effect of retrieval, than in neutral position.

3.2 Motion to emotion

On the borderline of motor and emotional processes Daniel Cassanto's research deepens the knowledge about memory retrieval within the EC concept (2010). His

experiment showed the tendency to implicitly associate positive and negative life experiences with schematic representation of upward and downward motion. His experiments also suggest that e.g. moving marbles upwards could bring people to think of positive thoughts and the valence of memory retrieval can be influenced by the direction of motor action. In general within theories of metaphorical mental representation, this study provides evidence that emotional memories interact with schematized motor actions. This connection seems to be basically embodied.

3.3 Emotion in AM

In her paper *Embodying emotions* Paula Niedenthal (2007) summarizes many studies dealing with the interconnection of embodied cognition and emotion. The importance of embodiment in the field of emotion reliving is demonstrated by the studies of Niedenthal et al. (2001) or Wallbott (1991), suggesting the necessity of feedback from facial mimicry in the ability of a perceiver to process emotional expressions. In the important study regarding AM, Riskind (1984), instructed participants to take different facial expressions and body positions. Then they had to retrieve pleasant or unpleasant AMs.The results, in compliance with EC theories, showed that body position and expressions influenced the latencies of positive and negative AMs retrieval. The erect standing and smiling enhanced the pleasant life experiences retrieval and decreased the negative AMs retrieval. This could be interpreted as clear evidence of body statement influence on AM's retrieval.

3.4 Context of situation - event components in AM

Event aspects are very important in AM retrieval, because the situational cues seem to be crucial triggers to memories recall. This suggests that the perceptual states involving activity, participants, location etc. are reconstructed during memory recall. Dijkstra (2006) provides evidence, that the "activity" component of the event is the crucial one for AMs retrieval, because "activity" is the principal organizing feature in AM (Dijkstra, 2006). She also finds these activities as central to comprehend particular events. Activity is a kind of royal cue to retrieve specific events. But it is necessary to take into account the uniqueness of the event. With simultaneous use of another cue component as "location", "temporal", or "participant" cues, the search for a particular memory seems to be faster. The uniqueness of memory is a significant

factor and more situational cues help to differentiate one event from another. Eelen's study (2013) also supports the claim that embodiment is strictly context-dependent. These findings, again,support an EC account of autobiographical memory: the recallof theevent is the reconstruction of motor, sensory and introspective states of the original event (Conway, 2005; Dijkstra, 2006; Barsalou, Niedenthal, Barbey, & Wilson, 2002).

3.5 Language

Glenberg, (1997), Donald (2012) and other researchers consider language as one of the most active formers of memory. The observation and examining of pre-language phases of human development suggest how important language is in the forming of AM. As noted above, one of the earlier arguments for involvement embodiment into cognitive processes (1980) formulated linguist George Lakoff in early 80'. In his next work (1987, 1999) he explained the language as the embodied phenomenon supporting its motor simulations – he suggested the interaction between language and human motor actions. Recently, Brouillet's et al. study (2010) looks at the EC concept in a more pragmatic way, trying to find empirical evidence of the claim, that language has a motor component. The results showed the different motor response of pulling or pushing during the verbal proclaim of the words "YES" or "NO". According the results, concepts "YES" and "NO" really have the active modality."YES" and "NO" are associated with the motor system, which is, according to authors of the study, low-level based within the hierarchy of cognitive processes. Madan and Singhal in their study (2012) examine the ability to remember high/low manipulability words and the results suggested the better remembering of words like "CAMERA" (high manipulability) than "TABLE" (low manipulability). According to previous neuroimaging research of Rueschenmeyer, van Rooij, Lindemann, Willems, & Bekkering (2010), Madan (2012) suggested, that "words representing objects that can be functionally manipulated, such as a tool or instrument, involve more activation of motor-related brain regions than words that represent objects that are limited to basic volumetric manipulations, such as a piece of furniture or an appliance." (Madan & Singhal, 2012) This suggestion was supported in this study. Motor embodied aspects of language seem to have impact on the individual's ability to remember particular contents.

3.6 To summarize empirical evidence

All available empirical studies dealing with AM in the EC framework supported their main hypothesis and set the EC concept as a relevant factor influencing cognition, particularly autobiographical memory retrieval. Some of the research findings, especially event components issues (Dijkstra, 2006), fit with Rubin's claim that AM consists of both general semantic knowledge and embodied specific event details. And further, the studies set the language (as the component related to higher cognitive processes) to play important role in the matter of what we remember and in AMs memory retrieval. Language is likely to be as well relevant aspect of retrieval as the inclusion of basic body subsystems (e. g. sensory and motor).

4. Conclusion

In this paper I dealt with autobiographical memories retrieval within the embodied cognition framework. As summarized above, there is strong empirical evidence that AM retrieval is influenced by EC components. Recent studies supported earlier claims (Riskind, 1983), more recent ones (Clark, 1999; Sutton 2005, 2006) and others, that memory retrieval can be boosted within the context of a situation, especially related to individual's body experience. Research illustrates that in the basic levels of experience like body postures, specific aspects of particular events, language aspects and taking the same body position when retrieving the autobiographical memory, can significantly facilitate the retrieval of this memory. It can also increase the effect of retrieval and help to retrieve more memories, than in other, neutral positions. All available evidence suggests the importance of body involvement in our cognitive processes on both, basic and higher, abstract levels of cognition and its involvement in the mechanism of autobiographical memories retrieval.

The AM retrieval is very likely to be fusion of basic embodied sensory and motoric activation and schematic, more abstract knowledge, which both has, however, strong embodied roots. The information from environment and the way the human is able to work with it creates our further way of doing so. It shows there is an active interaction forming and shaping the individual. This active interaction also affects the aspect of

reality one would choose to understand. Simply, like Eelen et al. (2013) says, for example, the handedness is the important factor when interacting with environment, it transports one's body schema into the way of one's thinking and therefore also his behavior and remembering. Although, e.g. researchers Mahon and Caramazza (2008) offer another explanation of conceptual processing within motor and sensory activation and they deny the explicit EC account in this issue, the EC approach considerably grows in the field of cognitive science and successfully help to explain the empirical observation and research.

In more pragmatic way, in the commercial sphere, the user experience and user-friendly interface design, considering the connection of the organism into the designed system, is ever more accented. Dijkstra (2014) and Eelen (2013) summarize the EC attitudes in this issue. This shows the necessity of embodied aspects consideration not only in the academic sphere and in the field of cognitive science, but also in practical matters like education, man-machine interaction and technologies, especially in user interface design, and also in the field of physiotherapy, medicine and psychotherapy, in which autobiographical memory is more than relevant factor.

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