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Brief article

Body posture facilitates retrieval of autobiographical memories ☆

Katinka Dijkstra *, Michael P. Kaschak, Rolf A. Zwaan

Department of Psychology, Pepper Institute on Aging and Public Policy, Florida State University, Tallahassee, FL 32306-1270, USA

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Abstract

We assessed potential facilitation of congruent body posture on access to and retention of autobiographical memories in younger and older adults. Response times were shorter when body positions during prompted retrieval of autobiographical events were similar to the body positions in the original events than when body position was incongruent. Free recall of the autobiographical events two weeks later was also better for congruent-posture than for incongruent-posture memories. The findings were similar for younger and older adults, except for the finding that free recall was more accurate in younger adults than in older adults in the congruent condition. We discuss these findings in the context of theories of embodied cognition.

Keywords: Embodied cognition; Autobiographical memory; Posture; Congruence; Aging

1. Introduction

How are autobiographical memories retrieved? As yet, no comprehensive theoretical account of the retrieval processes involved in the recall of autobiographical memories exists. However, several researchers have attempted to identify factors

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* Corresponding author. Tel.: +1 850 644 1877; fax: +1 850 644 7739.
E-mail address: dijkstra@psy.fsu.edu (K. Dijkstra).

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that facilitate their retrieval (Mace, 2004; Reiser, Black, & Abelson, 1985; Wagenaar, 1986). Retrieval can be enhanced under conditions of context dependence, i.e., when experimental conditions or cues are similar to the original event (Riskind, 1983; Smith, 1979). This improved retrieval has been explained as a result of encoding specificity. On this hypothesis, memory retrieval will be better to the extent that the conditions under which the item is retrieved are similar to the conditions under which the item was originally encoded (Thomson & Tulving, 1970).

The encoding-specificity account has received support in several studies. One study involved instructing participants to have a smile on their face and being in an upright erect position while they recalled pleasant or unpleasant experiences in their lives in one condition and instructing participants to have a downcast expression with head and neck bowed and body slumped while they recalled pleasant or unpleasant experiences from their lives in another condition (Riskind, 1983). Access to pleasant or unpleasant life experiences improved when participants were positioned in postures and facial expressions congruent with the emotional valence of these life experiences than when postures and facial expressions were incongruent with the emotional valence of these life experiences (Riskind, 1983). Another study demonstrated that nonsense syllables were relearned more quickly when the subject was in a body position congruent with the one that was assumed during learning compared to when the subject was in an incongruent body position (Rand & Wapner, 1967).

Thus, both posture and facial expression facilitate recall of information or autobiographical memories if they are congruent with the encoding context. Research on mood congruence and encoding specificity provides converging evidence on compatibility of mood and the emotional valence of the stimuli materials. Positive or negative information is more accessible in subjects with a congruent emotional disposition (Bower, 1981; Laird, Wagener, Halal, & Szegda, 1982).

This collection of findings reflects the importance of sensory and motor functions in memory retrieval. They are consistent with a view that conceptualizes cognitive processes as an integral part of the sensorimotor environment in which memory for a stimulus or event is stored in the cognitive machinery that processed it. Specifically, memory for a stimulus or event is stored in the perceptual and motor pathways that were involved in the processing of the event (Barsalou, Niedenthal, Barbey, & Ruppert, 2003; Damasio, 1999; Glenberg, 1997). As Damasio (1999) notes:

> The brain forms memories in a highly distributed manner. Take, for instance, the memory of a hammer. There is no single place in our brain where we will find an entry with the word hammer followed by a dictionary definition of what a hammer is. Instead... there are a number of records in our brain that correspond to different aspects of our past interaction with hammers: their shape, the typical movement with which we use them, the hand shape and hand motion required to manipulate the hammer, the result of the action, the word that designates it in whatever many languages we know (p. 220).

Thus, the notion of "embodiment" in cognition provides a framework for explaining the existence of the aforementioned encoding specificity effects, one that may be extended to other motor-based memory effects, such as the memory advantages observed for subject-performed tasks (e.g., Engelkamp & Zimmer, 1997). Moreover, autobiographical memories can be considered a form of embodied simulation in which persons remembering an event in the past go through similar visual, kinesthetic, spatial, and affective aspects that were part of the original experience (Wilson, 2002).

Wells and Petty (1980) illustrate this body-cognition compatibility in a study in which participants nodded their heads faster after receiving an agreeable message than after receiving a disagreeable message (they were told they had to nod or shake their heads to test whether their headphones would fall off with either movement). The nod was compatible with the agreeable message whereas the shake was not. A similar compatibility effect was demonstrated for a word recognition task in which participants nodded or shook their heads while simultaneously studying a word list including positive and negative adjectives (Förster & Strack, 1996). Recognition for words was higher when head movement and word valence was compatible (nodding-positive) than when it was not. Both studies suggest that compatibility of the stimulus materials with head action facilitates performance at the time of the task as well as for subsequent memory tasks.

This literature suggests that the memory trace of an experience includes the body posture in which the experience was acquired. The facilitation of a compatible body position with the content of the stimuli materials to be processed or remembered could be the result of a greater availability of processing resources. Compatible conditions of embodiment and cognitive tasks would require fewer processing resources than incompatible embodiment and cognitive tasks because congruent embodied states, such as postures, contain the cue with which to process the stimulus materials most effectively (Barsalou et al., 2003). Therefore, if a certain body position was assumed during an experience, retrieval of that experience should be facilitated if the original body position is reassumed compared to if an incongruent body position is assumed. Our main goal was to test this hypothesis.

Our study expands on Riskind (1983) in several ways. First, whereas Riskind examined the effect of mood-congruent postures, we examine the effect of a finer gradation of postures, namely activity-specific postures. Second, we examined whether facilitation of congruent body position would extend to an unexpected delayed recall task in addition to the facilitation of access to retrieval of life events. If this result is found, it would be the first demonstration of the long-term effects of congruence on memory for autobiographical memories. Third, we included older adults in our study in an effort to assess whether or not they would show similar facilitation relative to younger adults. Encoding-specificity effects have been demonstrated in cued recall tasks in both younger and older adults (Puglisi, Park, Smith, & Dudley, 1988), hence both age groups may benefit from encoding specificity. However, given episodic memory deficits (Zacks, Hasher, & Li, 2000) and a steeper forgetting rate in older adults (particularly for longer time delays; Wheeler, 2000), older adults may not

experience extended benefits from congruence of body position in encoding and retrieval conditions to the same extent as younger adults.

We expected better access, i.e., shorter response latencies, to autobiographical memories in a congruent condition (similar body position as the original experience) compared to the incongruent condition (different body position as the original experience) for both younger and older adults. With regard to potential extended benefits for the delayed free recall task, we expected no age differences and a congruence effect if extended facilitation was the result of congruent postures.

2. Method

2.1. Participants

Thirty-two younger adults (mean age = 21.5, $SD = 4.9$, mean education = 14.8, $SD = 1.4$) and 30 older adults (mean age = 69.7, $SD = 7.9$, mean education = 16.1, $SD = 3.8$) participated in the experiment; both groups were in self-reported good health. Younger participants received course credit in return for participation; older adults received $10.

2.2. Procedure

Participants retrieved autobiographical memories from specific events in the past in different body positions. To practice the procedure and to ensure they understood the instructions, participants talked about their earliest childhood memory while sitting at a desk. After this, participants retrieved a total of eight memories. Memories were chosen that implied different body positions and that were likely to have been experienced by all participants. The memories included a memory of one time participants: (1) went to the dentist office, (2) played sports, (3) opened the door for a visitor, (4) were at a concert and clapped their hands, (5) waved at someone, (6) placed their hand on their heart. Fillers included (7) a memory of an event that happened yesterday and (8) an imaginary event. Filler items served the purpose to hide the true purpose of the study and to make subsequent recall more difficult. All participants received the same memory prompts. Body position varied, however, for the experimental items between participants as memories were retrieved in either congruent or incongruent body positions.

The congruent body position was consistent with the implied position of the memory (e.g., lying down in a recliner for the dentist memory), whereas the incongruent body position was not (for example, standing up with the hands on the hips for the dentist memory). Filler items were always prompted in the same body position by participants (standing upright with hands on the back of the chair for the "yesterday" memory and standing upright with hands on the table for the "imaginary" event) as the nature of the memory or fantasy and its implied body position was unknown to the experimenter until retrieval. For each participant, half the memories (three memories total) were retrieved in a congruent body position (e.g., retrieving a

sports memory while being in the sports position), and half (three memories total) were retrieved in an incongruent body position (e.g., retrieving a dentist memory with the hands on the hips). The experimenter did not prompt the memory until after the body position was assumed. If the prompt included a form of motion, i.e., waving, or clapping, the memory was prompted after completion of that motion. As explained during the practice session, all memories had to be descriptions of personal events from the past and were at least one sentence long. Task instructions are listed in Appendix A.

To assess what sports the participant had played in the past, a list of sports played was added to a demographic questionnaire participants filled out with their consent forms. When the participant retrieved a sports memory, the experimenter picked one of the sports filled out on the list that could be acted out easily (e.g., assuming the position of playing baseball but not swimming).

After each memory was retrieved in a certain posture, participants answered a few questions while being in that position, such as their age at the time of the memory, whether they relived the experience while retrieving it, and how (did they form an image of the event, did they reexperience how they felt, or both). The age at the time of the memory provided an indication of the remoteness of the memory, whereas the affect and imageability of the memory provided an indication of the ease of access to the original experience. A score of 0 was assigned if the participant did not form an image of the event nor reexperienced the event, a score of 1 was assigned if the participant either formed an image of the event or reexperienced their feelings from the time of the original experience, and a score of 2 was assigned if the participant both formed an image of the event and reexperienced the event. These questions were added to give participants sufficient time to mentally revisit the original event and to assess whether the experience of reliving the event would affect access or subsequent retrieval of the event.

We randomized the order of memories, the order of the fillers, and the order of congruent versus incongruent postures. The session was recorded on audio and video tape for the purpose of later transcription and to assess response times. Response times were measured by using a video counter for the videos captured onto a laptop computer (accuracy was about 1 ms). Response time for a memory was calculated by measuring the time between the end of the prompt by the experimenter and the onset of the verbal response. Due to equipment failure, response time data were not available for three participants, one older participant and two younger ones.

When all eight memories were retrieved, the experimenter read a debriefing sheet that stated that the participant had to call the first author two weeks after participating in the experiment on a Wednesday. Because all participants were scheduled on a Tuesday, Wednesday, or Thursday, the phone call took place between 13 and 15 days after the experiment. The reason provided for the phone call was that it was a prospective memory task, a task to remember to do something in the future, whereas in fact the phone call served as an opportunity for the unexpected delayed recall task.

When the participant called back after two weeks, the experimenter first ensured that the participant had time to talk for a few minutes. Then, she asked the partic-

ipant to free recall any memories he/she had talked about two weeks earlier. After the participant was no longer able to retrieve memories, the experimenter proceeded to cue the participant for the remaining memories. For example, the cue for the "wave" memory would be, "two weeks ago, you retrieved a memory based on one particular time you waved at someone. Do you remember what you said?" The experimenter wrote down all remembered events. When the participant could no longer think of any more memories, or retrieved all of them, the experimenter thanked the participant and ended the phone conversation. All participants remembered to call back at the appointed time.

3. Results

Table 1 lists mean RT (in s) in the congruent and incongruent condition segregated by age group. A mixed ANOVA with one within-subjects (congruent vs. incongruent) and one between-subjects factor (age group: younger vs. older) was conducted to assess differential access to memories. There was a main effect of condition, $F(1,57) = 7.84$, MSe $= 11.98$, $p < .01$ indicating shorter RTs in the congruent condition, no main effect of age group, $p = .538$, and no condition by age group interaction, $p = .081$.

Table 2 lists mean proportion of remembered items in the free and prompted recall phase in the congruent and incongruent condition. An item was considered remembered if the participants described the same event as during the experiment. Filler items were not included in the analysis as they were not retrieved in a congruent or incongruent body position. Once an item was remembered in the free recall phase, it could no longer be remembered in the prompted recall phase. We performed a mixed ANOVA with one within-subjects (condition: congruent vs. incongruent) and one between-subjects factor (age group: younger vs. older) to assess differential free recall of items. There was a main effect of condition, $F(1,60) = 17.14$, MSe $= .037$, $p < .001$, no main effect of age group, $p = .167$, and a condition by age group interaction, $F(1,60) = 6.37$, MSe $= .037$, $p < .05$. Subsequent t-tests revealed that free recall was higher in the congruent than in the incongruent condition, $t(61) = 4.05$, $p < .001$, and that free recall in the congruence condition was higher in the younger group compared to the older group, $t(60) = 2.49$, $p < .05$.

We conducted a mixed ANOVA with one within-subjects (condition: congruent vs. incongruent) and one between-subjects factor (age group: younger vs. older) to assess differential total recall of items (free recall and prompted recall). There was

Table 1
Mean RT (in s) and *SD* (in parentheses) of autobiographical memories in younger and older adults

	Younger mean (*SD*)	Older mean (*SD*)
Congruent	5.26 (2.49)	7.38 (3.87)
Incongruent	7.44 (5.64)	8.77 (5.15)

Table 2
Mean proportion (and *SD*) of remembered items in younger and older adults

	Younger mean (*SD*)	Older mean (*SD*)
Free recall congruent	.37 (.23)	.21 (.27)
Free recall incongruent	.14 (.23)	.16 (.24)
Prompted recall congruent	.46 (.25)	.51 (.26)
Prompted recall incongruent	.54 (.31)	.49 (.35)
Total recall congruent	.83 (.19)	.72 (.35)
Total recall incongruent	.68 (.25)	.64 (.43)

a main effect of condition, $F(1, 60) = 7.00$, MSe = .058, $p = .010$, no main effect of age group, $p = .276$, and no condition by age group interaction, $p = .400$.

The fact that the congruence effect seemed stronger for younger adults than older adults for the free recall measure may be due to the fact that younger adults seemed to have relived their experiences to a greater extent than older adults, $t(60) = 2.03$, $p < .05$ (mean reliving score for younger adults = 1.26, for older adults = 1.04, range .14–2.0). Another explanation is that the younger adults' memories were more recent than those of the older adults, $t(60) = 7.47$, $p < .001$ (mean remoteness of younger adults = 4.70 years, $SD = 4.6$, vs. mean remoteness of older adults = 25.48 years, $SD = 15.01$).

4. Discussion

Our main hypothesis predicted better access to autobiographical memories in the congruent body position than in the incongruent condition for both age groups. This hypothesis was supported. There was facilitation of memory access and recall in the congruent body posture condition in both younger and older adults when accessing their autobiographical memories. Similar to other research findings (Riskind, 1983), personal life events from the past seem easier to access when the body position is similar to the one in the original experience.

There was a congruence effect in the free recall task, with performance on the delayed recall task being superior when autobiographical memories were originally retrieved in a memory-congruent posture. This effect was seen in free recall alone, and in total recall of items (free and prompted recall together). For free recall, the congruence facilitation was greater in younger adults than older adults. The age difference in free recall is consistent with studies demonstrating steeper forgetting rates in delayed recall tasks in older adults relative to younger adults (Wheeler, 2000). However, this does not explain the congruence effects in free and total recall nor does it explain similar recall patterns for younger and older adults in the combined total recall measure. Rather than a steeper forgetting rate in older adults being responsible for differences in recall performance, it may be that there was a congruence effect for both age groups and an additional facilitation of reliving the events and recency of events in younger adults during free recall. The act of reliving the (more recent)

event, in combination with the congruence of body position, may have provided the most optimal conditions for recall under difficult retrieval conditions (free recall).

A potential weakness of the study could be demand effects in which participants started expecting what type of memory should be retrieved based on the body position they were in at that time. This would be more likely to occur in the body congruent than in the body incongruent condition because participants in the body incongruent condition would take on a certain body position but retrieve a memory that did not relate at all to the position they were in. If demand effects indeed occurred, then the response times for the last memory in the congruent condition should be significantly faster than the first memory in that condition. Participants would know what to expect later in the experiment but not earlier in the experiment. Results of *t*-tests indicated that his was not the case, $t(56) = 1.12$, $p = .265$ (mean RT in seconds for first memory in congruent condition = 7.68, $SD = 7.81$, $N = 59$, mean RT for last memory in congruent condition = 6.16, $SD = 6.05$, $N = 57$). Regarding the incongruent postures, we could either expect a general practice effect of retrieving memories in incongruent body positions, resulting in shorter response times over the course of the experiment or increasing hindrance of the incongruent body position, resulting in longer response times later into the experiment. No such patterns were observed, $t(53) = 1.13$, $p = .263$ (mean RT for first memory in incongruent condition = 7.80, $SD = 7.42$, $N = 56$, mean RT for last memory in incongruent condition = 9.54, $SD = 9.49$, $N = 57$), suggesting no demand effects of the manipulation.

Physically assuming an elaborate body position plays a major role in access to autobiographical memories and their subsequent recall. Assuming a memory-congruent body position helps both younger and older adults to gain access to their memories. This demonstrates encoding specificity in an autobiographical memory domain with the same body position during retrieval and the original experience facilitating access to that experience. Our findings are also consistent with the notion of memory traces as being highly distributed and ''embodied'' (Damasio, 1999; Glenberg, 1997). Facilitation as a result of encoding specificity is not likely to extent beyond a temporal facilitation of body position at the time the memory is retrieved. The finding that body position-congruent memories are retained better over a two week retention period can be better explained by an embodied cognition account. Autobiographical memories are based on our experiences that take place in an environment which is reconstructed along with visual, sensorimotor and affective components of the experience. This results in an elaborate and contextually rich memory trace that is more resistant to forgetting when it fits with the environment of the original event in a congruent condition than when it is not congruent with this environment. The fact that the effect of congruence in free recall was greater in the younger group that relived the experiences to a greater extent than the older group supports this notion.

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Appendix A. Task instructions for one participant

Memory 1: incongruent – opening door
Please, stand up, go to the book case and place your hands on the shelf. Now, tell me a memory of one particular time you were opening the door for a visitor.

- How old were you when the event happened? _____
- Are you reexperiencing the event? yes/no

If yes, how are you reexperiencing it? (do you visualize or feel what happened)

Memory 2: congruent – concert
Please, sit up straight in the chair as if you are attending a concert, and clap your hands several times. Now, think of a memory of a particular time you were at a concert and clapped your hands.

- How old were you when the event happened? _____
- Are you reexperiencing the event? yes/no

If yes, how are you reexperiencing it? (do you visualize or feel what happened)

Memory 3: incongruent – memory about sports
Sit in the chair, lean forward and place your elbows on the table and your hands on your head. Now, tell me what a memory of one particular time you were playing____
(Choose one sport from the ones marked by participants, one that can be simulated in a body position).

- How old were you when the event happened? _____
- Are you reexperiencing the event? yes/no

If yes, how are you reexperiencing it? (do you visualize or feel what happened)

Memory 4: congruent – waving
Please, stand up and wave. Now, tell me a memory of one particular time you waved at someone.

- How old were you when the event happened? _____
- Are you reexperiencing the event? yes/no

If yes, how are you reexperiencing it? (do you visualize or feel what happened)

Memory 5: Filler – made up memory
Please, go to the table and place both hands on the table. Now tell me a memory of an event that never happened.

Memory 6: incongruent – hand on heart
Please, sit down in the chair and tell me a memory of one particular time you placed your hand on your heart, for example when saying the pledge of allegiance.

- How old were you when the event happened? _____
- Are you reexperiencing the event? yes/no

If yes, how are you reexperiencing it? (do you visualize or feel what happened)

Memory 7: congruent – lying down
Please, lean back in the recliner, open your mouth and tell me a memory of one time you were at the dentist.

- How old were you when the event happened? _____
- Are you reexperiencing the event?

If yes, how are you reexperiencing it? (do you visualize or feel what happened)

Memory 8: Filler – memory of yesterday
Please, stand behind the chair with your hands on the back of the chair.
Tell me a memory of an event from yesterday.

- How old were you when the event happened? _____
- Are you reexperiencing the event?

If yes, how are you reexperiencing it? (do you visualize or feel what happened)

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