

Moving backwards and forwards in time: Recalling dance from long-term memory

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Recalling complex non-verbal motor sequences, such as contemporary dance, provides insights into cues and associates in long-term memory (LTM). Four dancers recalled material that they had not performed for between 3-31 years; they initially recalled the material in silence, although the material had been associated with particular musical excerpts. Eight exercises were recalled either immediately or after an unfilled delay and using self-motion or a mannequin. Recall was greater when immediate rather than delayed; self- versus mannequin-motion had little impact on the length of material recalled. Qualitative data indicated that music and dancer movement were important cues to LTM, transitions were sometimes forgotten, and images associated with movement recall were kinesthetic, verbal, visual, and auditory. The results suggest an interplay of procedural and declarative knowledge and activation of multimodal images.

Keywords: movement; dance; procedural memory; declarative memory; non-verbal behavior

At once non-verbal, communicative, and expressive, contemporary dance is also visual, spatial, temporal, auditory, kinesthetic, affective, and dynamic. This study investigates four dancers' use of cues and associations when recalling complex dance sequences from LTM after intervals from 3-31 years.

Retrieval cues and associates in long-term memory

Jazz and classical musicians use knowledge of formal musical structure to aid retrieval (Chaffin and Imreh 2002, Noice *et al.* 2008). Motor cues aid actors'

recall of text and contextual cues significantly aid retrieval (Noice and Noice 1997, 2002). Music prompts increased recall for prose and verse, and the recall of such material tends to begin and end at breath pause locations (Rubin 1997).

In contemporary dance, there is no set repertoire of steps or verbal associates. Contemporary dance and choreographic traditions are passed on not in words but by showing and doing (Grove 2005). In the absence of notation and scores the dancers are dynamic archives of works that they have rehearsed and performed. Smyth and Pendleton (1994) proposed that movement involving configuration of body parts is encoded kinesthetically. Overby (1990) has suggested that, while novice dancers prefer a visual mode of thought, experienced dancers are inclined to use both verbal and visual modes of thinking.

Margaret Barr dance-drama

Margaret Barr had a choreographic career that spanned more than 60 years and three continents. Barr described her work as *dance-drama* because she was interested in both the inherent drama of the body in motion and its ability to create and sustain the human drama of her primarily narrative based works. Barr's technique classes were a series of set studies performed to the driving rhythms of Carl Orff's *Carmina Burana*. This choreographed material explored a broad range of movement dynamics including the elegant simplicity of her lyrical studies to the extremes of strong, direct, thrusting sequences. Throughout her classes great attention was given to the rhythm of the breath cycle as the dancer moved. For Margaret the dramatic moment in a breath cycle was the "breath pause"—the moment of stasis between the inhalation of breath and its exhalation.

Long term recall of dance: Choosing a method of investigation

The opportunity to observe four mature dancers recalling movement material that they have not performed for between 3-31 years is unique and challenging. There is a need to exercise some experimental control by systematically manipulating potentially informative key variables although variables such as dancer age, years of exposure, years since previous recall/performance, current dance involvement, and body flexibility were out of our control. Cues to recall were brought under partial experimental control with the dancers asked to recall a specific dance exercise prompted initially by its verbal label, and to recall using either their own body or a small mannequin, either immediately or after a 20 s delay. Delayed rather than immediate recall gives time

for mental rehearsal and visual and/or motor imagery that should enhance recall. The body versus mannequin conditions permitted the investigation of procedural recall in the form of self-motion versus motion of another figure without use of words. We anticipated greater recall using self-motion.

METHOD

Participants

Four female dancers who had all trained with the same choreographer volunteered for the study (mean age=55.38 years, SD=10.13, range=44.0-68.5). Two had performed the choreographer's dance material within the past three years, whereas the oldest participant had not performed it for 22 years (dancer 2, C) and the second youngest participant for 31 years (dancer 3, F).

Materials and procedure

The eight exercises to be recalled were: *Headwork Series*, *Simple Arms*, *Complex Arms*, *Egyptian*, *Spiral*, *Thursday night class "Lyric": Assyrian Bull*, *Figure 8 Arm Rolls*, and *The Falls*. Each had a descriptive label and was associated with a particular piece of recorded music. Participants recalled four exercises using their own body and four using the mannequin, either immediately or 20 s after the label had been given. The mannequin was a 30 cm wooden artist's doll as used in life drawing and art. A questionnaire asked: (1) "would you describe how you felt performing under each of these conditions: (a) immediate body, (b) immediate doll, (c) delayed body, (d) delayed doll?", (2) "how do you feel that music, others in room, social, and emotional factors affected recall of this movement material from your long-term memory?".

RESULTS

The duration of recalled material performed by individual participants was calculated as a proportion of the music excerpt duration. Quantitative recall data have been calculated from the 3 participants who had not performed the material for 3 years (dancer 1), 22 years (dancer 2) or 31 years (dancer 3). Table 1 shows the duration (in seconds) of material recalled by exercise and by recall condition. The proportion of recalled material duration as a function of the musical (veridical) excerpt is also shown. In Table 2, proportion of recall duration is presented according to recall condition. It was hypothesized that recall is greater in the delayed than in the immediate recall condition. However, the mean proportions indicate the reverse with proportion recall of

Table 1. Duration of recall by dancer and seven exercises showing raw scores (in seconds) and as proportions of the duration of the associated musical excerpt. (Proportions shown in brackets; 0 refers to zero recall.)

	<i>Headwork Series</i>	<i>Simple Arms</i>	<i>Complex Arms</i>	<i>Egyptian</i>
	<i>199 s</i>	<i>50 s</i>	<i>50 s</i>	<i>150 s</i>
Dancer 1 (K)	68.00 (0.34)	34.00 (0.68)	45.00 (0.90)	27.00 (0.18)
Dancer 2 (C)	29.00 (0.15)	78.00 (1.00)	31.00 (0.62)	54.00 (0.36)
Dancer 3 (F)	23.00 (0.12)	36.00 (0.72)	34.00 (0.68)	10.00 (0.06)
Mean	40.00 (0.20)	49.33 (0.80)	36.66 (0.73)	30.33 (0.21)
	<i>Spiral</i>	<i>Fig. 8 Arm Rolls</i>	<i>The Falls</i>	
<i>cont.</i>	<i>50 s</i>	<i>135 s</i>	<i>50 s</i>	
Dancer 1 (K)	36.00 (0.72)	30.00 (0.22)	53.00 (1.00)	
Dancer 2 (C)	25.00 (0.50)	0	27.00 (0.54)	
Dancer 3 (F)	67.00 (1.00)	15.00 (0.11)	42.00 (0.84)	
Mean	42.66 (0.74)	15.00 (0.11)	40.66 (0.79)	

0.55 (SD=0.38) in the immediate recall condition and 0.44 (SD=0.31) in the delayed recall condition. There was no difference between proportion recall duration when the dancer's own body was used (mean=0.50, SD=0.29) compared with when the mannequin was used for recall (mean=0.49, SD=0.40).

Dancers reflected on their recall of each exercise and completed a short written questionnaire. Their responses are organized below according to independent variables, cues, memory associates, and images.

Recall using the mannequin: "immediate doll condition required thinking as I moved it, i.e. feeling it in my own body as I moved the doll" (K), "doll totally unable to move—disjointed—results lacking flow and staccato positioning which [is] what all/most dancers try to avoid" (C), "could not visualize movement on the doll. Perhaps a real body would have triggered more memory" (F).

Immediate versus delayed conditions: "immediate and delayed body didn't make much difference more that it immediately came to mind or not" (S). W commented that having time to rehearse the exercises in the delayed recall condition led to some confusion, while F wrote that in the delayed body recall condition she "had a lot of trouble remembering anything first without moving."

Table 2. Mean duration recall proportions collapsed across seven exercises and three dancers and shown as a function of recall condition. (SD shown in brackets.)

<i>Recall condition</i>	<i>Immediate body</i>	<i>Immediate mannequin</i>	<i>Delayed body</i>	<i>Delayed mannequin</i>
Mean proportion	0.53 (0.35)	0.56 (0.40)	0.47 (0.24)	0.41 (0.39)

Auditory imagery: During different exercises (*Headwork*, *Simple Arms*, *Spiral*), all four dancers noted that during recall an inner voice was active: “forward, back, bring wrist forward, bring wrist back” (W), “forward, back, forward, back, side, side, then around” (K), “forward and right, up and over” (C). All commented on their recall of Barr’s voice as they performed the exercises and the rich intonation and drama of her voice in their imagery.

All dancers commented on the importance of music. For W, recalling *Spiral* “music is such a key; it tells you there’s nine swings,” and more generally “absence of music meant that I had to ‘hum’ the music to myself as I was dancing/recalling,” “the music for me is essential to conveying the ‘right’ sequence.” C commented that she did not think she knew some exercises without the music; the music rather than a label would trigger recall. For F, the rhythm of the music was important. For K, the music timed the movement, “lack of the music made remembering more difficult.”

What is forgotten? Two of the four dancers reported forgetting a transition: at the opening of *Spiral* (W), forgetting how to get up after a particular phrase (F), and finishing an exercise suddenly having forgotten the middle section (F). This pattern is consistent with schema theory “junction errors” and “switches”—a kind of structural performance cue (Chaffin *et al.* 2002).

DISCUSSION

For an artform such as contemporary dance, where formal notation is more the exception than the rule, dancers’ brains and bodies are repositories of works of art that have been learned and memorized. The present study demonstrates that multi-modal cues elicit and accompany long-term memory for movement. Music, with its inherent sequential and temporal order, is a provocative and effective cue. Imagery is not only visual and verbal but also kinesthetic and auditory. Transitions between movement sequences may be susceptible to forgetting, especially in the absence of sequential cues from music. The dancer’s opportunity to move is important for dance recollection. Future studies might focus on the learning and memorization of new mate-

rial. Interference paradigms could also be used effectively to shed light on the nature of the memory code.

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