

Reactivation of Physical Motor Information in the Memory of Action Events

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When attempting to memorize action sentences (e.g., open an umbrella), performing the action of the sentence (enacted encoding) results in better memory performance than simply memorizing the sentences (verbal encoding). This memory enhancement is called the enactment effect. Magnetoencephalography (MEG) was used to elucidate whether the enactment effect is due to physical motor information or whether movement representation is the critical factor in the enactment effect. Physical motor information, which is implicated in the primary motor cortex, represents the speed, form, and kinematic sense of a movement, while movement representation indicates semantic and conceptual information such as movement formulae, movement ideas, and movement imagery, which are especially associated with the parietal cortex. We measured activities within the motor region and parietal cortex during a

recognition test and compared activities during recognition with enacted and verbal encoding condition. The results showed that recognition performance was better for enacted encoding (Table 1, Fig. 1). The MEG data indicated that the left primary motor cortex with enacted encoding condition was activated in all subjects (Fig. 2, A), though with verbal encoding condition, this activation appeared in only one subject. These activities were observed between 150 and 250 ms after recognition stimuli. Moreover, activities in the right parietal cortex following enacted encoding were greater than those following verbal encoding, and the activities appeared 600–700 ms after onset of the recognition stimuli (Fig. 2, B, C). These results suggest that the enactment effect occurs by the reactivation of the physical motor information and that this information facilitates activities related to movement representation.

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Table 1 – Mean proportion of Pr, hits, and false alarm scores during recognition with enacted and verbal encoding

Encoding condition	Pr		Hit		False alarm	
	M	SE	M	SE	M	SE
Enacted encoding	0.59	0.05	0.75	0.05	0.16	0.02
Verbal encoding	0.24	0.08	0.57	0.04	0.33	0.05

Note. The t test showed significant differences for the Pr, hit, and false alarm between the 2 conditions. M = mean; SE = standard error.

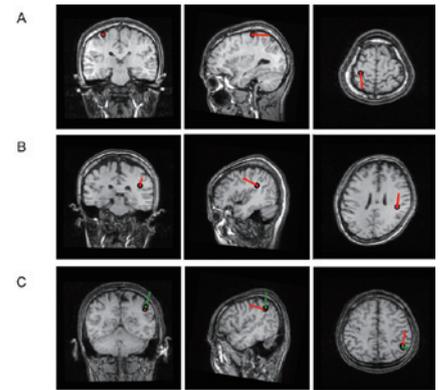
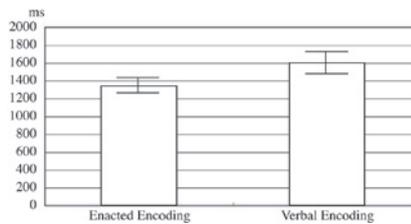


Fig. 2 Equivalent current dipoles (ECD) with enacted/verbal encoding condition during the recognition task.

Fig. 1 Mean reaction time of the hit responses (correct responses to memorized sentences). Significant difference was observed between the 2 conditions. Error bars indicate standard error.

Long-Term Grooming Partnerships Between Unrelated Adult Females in a Free-Ranging Group of Japanese Monkeys (Macaca fuscata)

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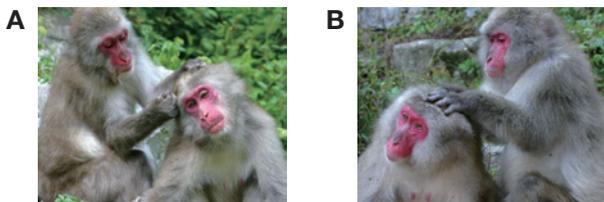


Fig. 1 Long-term grooming relationships that have been maintained between same-aged unrelated females over a 10-year period. Females were 23 and 22 years old, respectively, in A and B.

In Japanese monkeys (Macaca fuscata), females generally remain in their natal group throughout their lives and tend to continuously maintain affiliative relationships with related females such as mothers, sisters, grandmothers, and granddaughters for years. Such affiliations are also found between unrelated females. However, there are few studies on the continuity of long-term affiliative relationships between unrelated females.

Social grooming is a common and frequently observed affiliative behavior. In Japanese monkeys, more than half the grooming bouts in groups occur among closely related females. Although the number of available females in a group increases, the number of female grooming partners does not increase. Therefore, not only related female grooming partners but also unrelated female grooming partners that are included among the limited number of grooming partners should be considered to be important.

In order to examine the presence of long-term grooming relationships among unrelated females, we recorded grooming interactions of 18 adult females (16 to 32 years)

in a free-ranging group of Japanese monkeys at Katsuyama in 2003 and compared them with those recorded 10-year period earlier, i.e., in 1993. In 2003, on an average, each female who had survived the 10 years had grooming interactions with 2 surviving old partners with whom she was recorded to have grooming interactions in 1993, indicating that each of the females had maintained grooming relationships with some surviving unrelated old partners over the 10 years (Fig. 1). As the age difference in grooming dyads of such surviving old partners was usually three years or less, affiliative relationships that had developed through social play when females were immature might be maintained through social grooming after animals grew up (Fig. 2). In 2003, moreover, each female had grooming interactions with closely related females of the surviving old grooming partners. In 2003, however, each female had grooming interactions with several unrelated females who were other than the surviving old grooming partners or their related females.

These findings indicate that with regard to grooming relationships, female Japanese monkeys are basically conservative, showing a tendency to concentrate their grooming interactions on closely related females and certain familiar unrelated females such as surviving old partners and some females closely related to these partners. At the same time, however, female Japanese monkeys also showed a progressive trait for grooming since they did form grooming relationships with new partners.

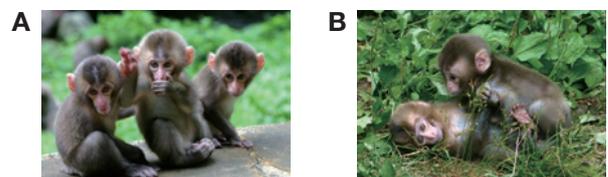


Fig. 2 Play between 3-month-old infant Japanese monkeys. Affiliative relationships that developed between same-aged infants through social play could continue through long-term grooming relationships even after growing up.