

Dynamic variability in mnemonic systems: a way to study the consolidation process

B. Berberian • M. D. Giraudo

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Background

Classically, the within-subject variability is considered as the result of the noise present in the system and, in consequence, as random process without temporal structure. However, Giraudo and Pailhous (1994, 1999), inspired by the studies conducted by Bartlett (1932) and the studies in motor control (Collins & Deluca, 1993; Gilden, Thornton & Mallon, 1995; Newell, Gao & Sprague, 1995; Slifkin et Newell, 1998; Gilden, 2001) showed that two processes are simultaneously involved in the formation of visuospatial memories: One process is responsible for the accuracy of image generation, and a second process is responsible for image variation. So, the variability cannot be considered as the simple result of noise but as a way for studying the information organization in memory, that is the consolidation process. In the present study, we focused on the effects of image complexity on the variability of repeated reproduction, the hypothesis being that the consolidation process took place through an organization of the information perceived that allowed to reduce the number of degrees of freedom to be controlled simultaneously.

Method

Participants were instructed to memorize and then reproduce in three experiments a configuration of dots (7, 12 or 17) 40 times in succession. In the first experiment, the subject saw the target configuration at each trial during the twenty first trials and reproduced it

between each presentation. Then, during the twenty last trials, the subject reproduced the target twenty times successively without renewed presentation. In the second experiment, the subject saw the target at the first trial then reproduced it twenty times successively from memory. From trail 21 to trial 40, the subject saw and reproduced the target at each trial. In the experiment 3, the procedure was the same than in the first experiment but the target configuration was composed of simple forms (in reference to Gestalt Theory).

Results

The results showed that as target complexity increased, the number of trials necessary to reach a steady state also increased. Nevertheless, the level of variability reached in steady state was equivalent in the three experiments. This relaxation time is accompanied by an organization of the image (simplification of the perceived configuration and development of relationship between dots). Moreover, when the target configuration is simple (that is a good form), the relaxation time is very short (almost instantaneous) and the number of dots had no effect on this time.

Conclusions

These results are interpreted in the framework of the dynamical approach. In particular, the decrease in the complexity of the stimulus by the freezing of the number of degrees of freedom to be controlled appeared to be good candidate to explain the dynamics of the consolidation process at the behavioural level.

