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The role of stimulus' instability in the reproduction of visuospatial pattern

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Background

Considering the dynamics of image stabilization, Giraudo and Pailhous (1999) asked participants to reproduce a complex, noisy visuospatial pattern several times in succession. Subjects were shown to experience difficulty stabilizing the image in memory up until the point the disturbance induced by the presentation of the variable pattern ended. At that point, a steady state is reached instantaneously. The pattern was a configuration composed of 12 dots and that involved a large number of information units (as defined by Leeuwenberg 1968, 1971) or, alternatively, a great number of degrees of freedom that had to be controlled simultaneously (Tuller et al. 1982). For instance, with N = number of dots and D = the dimension of the pattern, 23 degrees of freedom [(N = 12 x D = 2) – 1] are involved in the Giraudo and Pailhous (1999) study.

It is thus possible that the difficulty of image stabilization pattern were due to complexity. This complexity could have two sources: the number of dots forming the configuration, and the structure of the configuration itself. Concerning the latter, it has been shown, since the seminal work of Bartlett (1932) that reproduction of a stimulus from memory involves transformations that result in schemas or chunks. In this respect, Gestalts psychologists (Koffka 1935; Köhler 1947) emphasized the importance of the principle of good form, that is, the notion that simple geometrical forms are easily recognizable and memorized. In this context, small variations that are introduced in a structured pattern (chunking pattern) could fail to be disturbing because they fail to be perceived (to the extent that the general form is not modified). In contrast, when small variations are introduced in a complex pattern that does not represent a "good form", the same variations could result in more interference, to the extent that subjects, failing to perceive a coherent global structure, now focus on the different dots' position. Concerning the number of dots forming the configuration, Kosslyn et al. (1988) have shown that the larger the number of elements, the more difficult is the mental image generation. In this context, reducing the number of dots could thus reduce or even eliminate the difficulty involved in stabilizing the image, whereas increasing this number could result in higher interference. In the current study, to better understand the relationship between visual perception and visual memory, we analyzed the role of small variations in dot position when such variations are applied to complex versus simple (structured) patterns (Giraudo and Pailhous 1999).

Method

Over two experiments, participants were presented with patterns composed of 7, 12 or 17 dots that presented very small variations in position. On each of the first 20 trials, participants were presented with the same pattern and had to reproduce it. From trial 21 on, pattern presentation ended, and participants were asked to perform 20 new reproductions from memory (without renewed presentation). Each participant thus performed 40 successive trials. In the first experiment, the patterns were as far as possible from "good forms", whereas in the second experiment, the patterns presented the characteristics of "good forms" (in reference to Gestalt Theory). In each experiment, 30 participants were randomly assigned to one of three conditions (7, 12 or 17 dots).

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Results

The results were analyzed (1) in terms of accuracy (on the first 20 reproductions), that is, the discrepancy between the target pattern and each successive reproduction, and (2) in terms of variability over the 40 reproductions (that is, the discrepancy between each successive reproduction independently of the target). Results showed that both the time course and the level of accuracy reached at steady state depended on: (1) the number of dots, (2) the degree of pattern chunking. In others words, the higher the number of dots, the longer the relaxation time, and the closer the patterns were to good forms, the higher the accuracy. However, such effects did not appear for variability (the discrepancy between each reproduction and the next when no target was present). Indeed, the results showed that in both cases, and regardless of the number of dots, participants had difficulty in stabilizing the image in memory until the interference induced by pattern presentation ended. At that point, the level of variability instantaneously decreased to reach a steady state which was equivalent for the different patterns (7, 12 or 17 dots), and also for complex or simple forms.

Conclusions

These results (1) confirmed the previous results obtained by Giraudo and Pailhous (1999) emphasizing the independence between accuracy and variability, (2) highlighted the specificity of visual perception regarding visuospatial memory. In particular we observed that visual perception was sensitive to very small variations in dot position, even if the pattern presented was very simple, whereas memory appeared insensitive to the same variations regardless of whether the presented pattern was simple (good form) or complex.

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