Grouping by Similarity Benefits Visual Working Memory Even in the Absence of Spatial Proximity: An ERP Study

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Visual working memory (VWM) performance benefits from grouping of the elements of the visual scene. Previous findings demonstrate that, at least, some Gestalt grouping principles enhance VWM capacity (Jiang, Olson & Chun, 2000; Peterson & Berryhill, 2013; Woodman, Vecera & Luck, 2003; Xu, 2006; Xu & Chun, 2007). Particularly, Peterson and Berryhill (2013) investigated the influence of the Gestalt grouping principle of similarity on the performance of VWM. Their results indicate that VWM performance could benefit from grouping by colorsimilarity, but this benefit was constrained by spatial proximity and occurs only when previously grouped items were tested.

The present work aims to investigate whether spatial proximity is always necessary to improve VWM performance, and whether this improvement relates to a more efficient processing of visual information (chunking) or, conversely, derives from an automatic attentional capture of grouped stimuli, leading to a selective benefit in the encoding and storage of the grouped elements. To achieve this, we conducted an experiment using a changing detection task (Peterson & Berryhill, 2013; Todd & Marois, 2004) in which none, 2 or 4 items from a 3 x 3 matrix were grouped by similarity and appeared next to each other or separated by an intermediate element while electroencephalogram (EEG) was recorded.

We hypothesize that the need for spatial proximity to improve VWM performance will diminish or even disappear when the number of items grouped by similarity increase, and that the benefit will be restricted to the trials in which previously grouped items are tested.

Behavioral results showed that the relevance of spatial proximity depends on the number of elements grouped by similarity, becoming unnecessary when 4 items instead of two were grouped. Moreover, the benefit in VWM performance was restricted to trials in which the probe stimuli were previously grouped.

In addition, event related potentials (ERPs) showed modulations in amplitude at early right occipito-parietal

components as a function of number of items grouped and spatial proximity.

Overall the results indicate that spatial proximity is not always necessary to benefit VWM and that the improved performance results from an encoding bias favoring grouped items.

Acknowledgments

This work has been funded by Universidad Nacional de Educación a Distancia and by a Doctoral Fellowship from MECD granted to Antonio Prieto (FPU13/05914).

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