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Cultural differences in attention: Eye movement evidence from a comparative visual search task

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ABSTRACT

Individual differences in visual attention have been linked to thinking style: analytic thinking (common in individualistic cultures) is thought to promote attention to detail and focus on the most important part of a scene, whereas holistic thinking (common in collectivist cultures) promotes attention to the global structure of a scene and the relationship between its parts. However, this theory is primarily based on relatively simple judgement tasks. We compared groups from Great Britain (an individualist culture) and Saudi Arabia (a collectivist culture) on a more complex comparative visual search task, using simple natural scenes. A higher overall number of fixations for Saudi participants, along with longer search times, indicated less efficient search behaviour than British participants. Furthermore, intra-group comparisons of scan-path for Saudi participants revealed less similarity than within the British group. Together, these findings suggest that there is a positive relationship between an analytic cognitive style and controlled attention.

1. Introduction

Cross-cultural studies of visual perception have revealed numerous examples of cultural diversity (e.g., Chua, Boland, & Nisbett, 2005; Goh, Tan, & Park, 2009; Kitayama, Duffy, Kawamura, & Larsen, 2003; Masuda & Nisbett, 2001; McKone, Davies, Fernando, Aalders, & Wickramariyaten, 2010). A robust finding appears to be in hierarchical perception, with different groups demonstrating a relative bias towards the global or local level of a stimulus or scene. In particular, it seems that people from an individualistic culture (i.e. one that focuses on the skills and achievements of the individual) demonstrate an analytical style, preferentially attending to focal parts of a visual scene. In contrast, people from a collectivist culture (i.e. one that focuses on group-based membership and collective achievement) appear to demonstrate a holistic style, attending more to the structure of a scene and the relationship between its parts (Chua et al., 2005; Masuda & Nisbett, 2001, 2006; Miyamoto, Nisbett, & Masuda, 2006; Nisbett & Miyamoto, 2005). Thinking styles tend to correspond to national cultures, with a bias towards individualism in Western countries, and towards collectivism in Eastern countries (Hofstede, 2001).

The majority of these findings have utilised relatively simple judgement tasks, as well as scene perception and recognition tasks. For example, Kühnen, Hannover, and Schubert (2001) associated individualistic cultures with more efficient performance on the Embedded Figures Test (EFT: Witkin & Berry, 1975), where participants are required to locate a simple shape embedded in a more complex global structure. This is complemented by studies such as that reported by McKone et al. (2010), who found that East Asian

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participants (from Hong Kong, China, Singapore, Malaysia, Indonesia, and Korea) showed a stronger global advantage in a Navon task than their Australian counterparts (although see Hakim, Simons, Zhao, & Wan, 2017). Moreover, Masuda and Nisbett (2001) examined whether Japanese and Americans differed in their patterns of attention to the background. Participants were shown animated vignettes featuring underwater scenes. They were asked to describe the content of the vignettes and then to complete a recognition task that consisted of some repeated and some new objects, against either familiar or new backgrounds. The participants were then asked to judge whether they had seen each object during the first inspection. Findings indicated that the Easterners offered more detailed statements about the background, whilst the Westerners tended to begin their descriptions by referring to the most salient objects. Furthermore, Easterners were much more likely to begin by making a reference to the context and, in the recognition phase, the Easterners' scores were higher for the objects presented in their original backgrounds. In another study that used a preference task followed by a recognition test, American participants appeared to fixate more on focal objects than Chinese participants, and tended to look at them more quickly. In the recognition phase, the Chinese participants were less likely to recognize familiar objects when they were presented in new backgrounds (Chua et al., 2005).

Based on an individualism-collectivism framework, individualistic cultures tend to emphasize personal goals, and encourage the desire to be different, whereas collectivist cultures emphasize the priority of group goals, and value obligations (Hofstede, 2001). Correspondingly, it has been argued that this dimension is reflected in the preferred cognitive styles of individuals – characteristics and social practices relating to culture are seen to influence cognitive development, resulting in the adaptation of independent (analytic)/interdependent (holistic) cognitive styles that, in turn, shape the way the individual responds to his/her environment (Witkin & Berry, 1975).

Interestingly, however, it is unclear whether these cultural differences are observable in more complex visual behaviour, such as search. Visual search is a fundamental daily activity, and has been widely used to provide insight into the guidance and allocation of task-based visual attention for over 30 years (e.g., Donnelly et al., 2007; Gerhardstein & Rovee-Collier, 2002; Neider & Zelinsky, 2006). As a result, search tasks should provide a more robust test for theories of culture-based differences in everyday visual behaviour. Some headway has been made in the relatively few studies published by other laboratories. For example, Kuwabara and Smith (2012), required American and Japanese preschool children to search a natural scene for a target object placed amongst cluttered distractor objects. American children demonstrated faster search time to find targets, suggesting that their attention might be more focused on individual objects. However, this group difference disappeared when participants performed the same task using 2D artificial stimuli consisting of an array of common objects. In another study, conducted by Masuda and Nisbett (2006), American and East Asian participants were asked to identify the difference between two images in a flicker paradigm, in which the original image and a modified one were repeatedly presented in a sequence, with a blank screen interleaved between each of them. In one condition the difference between the images was at the level of the focal object (e.g., changes in the colour of a vehicle), and in another the difference was at the level of contextual information (e.g., changes in the location of a sidewalk). Analysis revealed that whilst Americans were faster at detecting focal changes, East Asian participants were faster at detecting contextual changes. Again, these differences were related to, respectively, analytical and holistic thinking styles that are seen to be the product of cultural background.

Although search time is a useful assay of attentional processing in these tasks, eye tracking paradigms can provide a finer grain of detail across the time course of a search trial. The particular advantage of measuring eye movements is that one has insight into the spatial and temporal aspects of search behaviour, including the number, duration, and locus of fixations. These properties are known to reflect parametric properties of the search task (e.g., Köerner & Gilchrist, 2008; Vlaskamp & Hooge, 2006) and can also provide us with a clearer assay of regions of the image that different participants preferentially process. In addition, sequences of fixations can be used to produce a scanpath for a given trial, which can reflect the strategies that participants employ (e.g., Gilchrist & Harvey, 2006; Locher & Nodine, 1974) or the systematicity of their exploratory behaviour (Henderson & Hollingworth, 1999; Pellicano et al., 2011). Therefore, in the context of exploring cultural differences in search behaviour, eye movement analyses contribute both a measure of where participants preferentially look, and how systematic (or consistent) that behaviour is across the experiment.

There have been very few published studies of cultural differences that report eye movement data, although one insight was provided by Miellet, Zhou, He, Rodger, and Caldara (2010), who investigated the use of extrafoveal information during visual search. East Asians and Western Caucasians were required to locate animals of different sizes within natural scenes, whilst the display was modulated using a gaze-contingent Blindspot technique (i.e. the foveal portion of the image, at the point of fixation, was removed contingent with the participant's gaze). The size of this deletion was varied between 0°, 2°, 5°, or 8° of visual angle. On the basis of previous findings, the researchers predicted that East Asian participants would be less affected by the loss of foveal information than Western Caucasians. However, they did not find any reliable differences between the groups for search time or eye movement measures in all of the Blindspot conditions. In contrast, however, analysis of scanpath information using the ScanMatch algorithm (Cristino, Mathot, Theeuwes, & Gilchrist, 2010) provided additional detail. Miellet et al. calculated matching scores for their participants by comparing the scan paths of each participant with all the other participants of the same cultural group (an intra-group comparison), and also calculated inter-group matching scores by comparing the scan paths of each participant of one group with all the participants of the other group. ScanMatch analysis revealed significantly lower inter-group matching scores in the 5° and 8° Blindspot conditions, and also when the target was absent, compared to intra-group comparisons. This demonstrates that the groups were employing reliably different scan paths to inspect the scene, and that this was more consistent within groups. The team attributed this finding to the impact of culture on exploration strategies only in specific conditions, when there were large central scotomas.

Despite these compelling demonstrations of cultural differences in visual attention, there are some important caveats to consider before we construct theories that account for the underlying mechanisms. The first is that such differences are not always apparent in