Role of simple primitive shapes in complex distractors: Do shared features affect search times?

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A stochastic algorithm has been developed to generate distractor shapes for visual searches. These distractors evolve according to genetic rules from a random starting point. Nevertheless, using subject response times without any information about the target, it is possible to evolve distractors that make the target easy or hard to find in visual search. In one version, 12 subjects, searched for the silhouette of a rabbit. In each generation, each trial used one of 12 distractors. After 8 generations, distractors that make search hard were not identical to each other, nor did they look like rabbits. What makes a "hard" search? We hypothesize that there are primitive preattentive component shapes (Wolfe, 1996) that the visual system looks for during visual search for more complex items (e.g. rabbit). We chose six candidate preattentive rabbit components and use an adaptive generalized Hough transform to determine if these components became more evident of several 'generations' of evolution. The generalized Hough transform algorithm gives a measure of the extent to which a candidate primitive profile fits the distractor outline shape. It was found that the most difficult distractors do in fact contain more primitive features of the target; for example, the elongated ellipse of the rabbit's "ears". Evolution did not produce more of control primitives like triangles or squares. Results suggest that during search of complex shapes, the human visual system is not guided to the whole target but rather to a set of component shapes. These primitives may represent a preattentive language for shape processing.