Trends in Cognitive Sciences

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Letter

Methodological Considerations to Strengthen Studies of Peripheral Vision

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In a recent issue of *Trends in Cognitive Sciences*, Cohen *et al.* [1] argue that the study of visual summary statistics represents an elegant method to account for the richness of visual experience in the periphery. We resoundingly agree that employing ensemble statistics is a strong step towards resolving questions of how conscious we are of our visual surroundings. However, we think the explanatory power of this approach can be augmented by focusing on two specific areas: (i) psychophysical quantification of metacognitive capacities and decision biases associated with peripheral vision; (ii) distinction between perceptual decisions that involve different levels of detail. Consideration of these issues will facilitate the development of precise hypotheses about peripheral phenomenology and yield useful data from experiments investigating summary statistics; we explain how below.

Metacognitive and Decisional Assessments

In Box 2 of their article, Cohen *et al.* provide two vivid demonstrations to show how observers may overestimate the capacity of peripheral vision to identify stimuli. However, to provide a formal account of such overestimation and relate it to summary statistics, we need to quantify the degree to which such overestimation occurs. Fortunately, the tools for such quantification are already available in signal detection theory (SDT) frameworks [2,3]. For instance, if a subject is required to make a response to whether color can be detected in the periphery, classical SDT offers a way to quantify such detection bias (i.e., propensity to say 'Yes, there is color') independently from the sensitivity or capacity to perform the task. Congruent with the overall hypothesis here, it has been shown that detection biases are liberal in the periphery [4] or under covert inattention [5], and evidence indicates that these are likely to reflect perceptual rather than response biases. Likewise, if the task requires subjects to identify which specific color is presented in the periphery, subjects may be overly confident in their discrimination or identification performance. Analytic tools based on the SDT framework are now available for quantifying such biases at the subjective confidence level and measuring how confidence judgments may reflect actual performance [6].

Fine-Grained Decisions versus Coarse Categorizations

Since subjective confidence is typically assessed with respect to perceptual decisions (i.e., how likely the relevant decisions are correct), it is important to carefully consider the nature of the decision itself. For example, while some tasks in the periphery require detection of stimuli, others require two-choice discrimination, categorization, or even more fine-grained decisions such as absolute identification. Previous research indicates that attentional processes differentially impact perceptual thresholds depending on whether the decision requires detection or discrimination [7]. Peripheral vision may likewise be particularly good at coarse-level decisions but relatively poor at fine-grained tasks. It would be informative to test how these differences in performance may differentially impact subjective metacognition as well. Studies probing ensemble statistics may particularly benefit from systematically addressing these issues. For instance, subjects may be able to evaluate the mean of a group of elements to detect whether relevant information is present, but do they maintain a precise enough representation of the variability of the group to conduct valid discriminations? What about identifying the absolute mean or variance of an ensemble statistic? If observers can do these tasks in the periphery, would such performance also be reflected in their subjective percepts? Alternatively, the degree of unconscious processing involved might differ across tasks.

One particularly intriguing idea is that there may be a canonical decision type that one tends to make in the periphery (i.e., a decision observers tend to make as a default) during navigation of the world outside the laboratory. Intuitively, for the periphery such decisions may be relatively coarse grained and driven by summary statistics. Interestingly, it has been reported that subjective confidence ratings in different tasks may influence each other [8], so our performance in this canonical decision may influence subjective perception in other decisions as well.

Concluding Remarks

Peripheral vision suffers in terms of processing sensitivity and can provide only a noisy representation of the visual surround [9]. Aggregating over these noisy estimates can provide an accurate 'gist' of the world that contributes to performance in a given task. However, higher-order, metacognitive processes might be necessary to produce subjective reports that are more reliable indicators of conscious experience [10]. Therefore, we posit that by using tools that quantify both task performance and metacognitive awareness, as well as considering how 'fine-grained' the decisions are in experiments, this field will excel in generating precise hypotheses and gathering relevant data to more fully explain the true phenomenology of the visual periphery.

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