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.

[1]Department of Psychology, University of California, Los Angeles, 1285 Franz Hall, Box 951563, Los Angeles, CA 90095-1563, USA
[2]Brain Research Institute, 695 Charles E. Young Drive South, Los Angeles, CA 90095, USA

*Correspondence: odegaard.brian@gmail.com (B. Odegaard).

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Letter Response

Ensemble Perception, Summary Statistics, and Perceptual Awareness: A Response

Michael A. Cohen,[1,*] Daniel C. Dennett,[2] and Nancy Kanwisher[1]

The extent to which perception is rich or sparse is a foundational issue in consciousness studies. According to those who claim that perception is rich, observers are aware of more information than they can attend to or remember [1]. Meanwhile, those who believe perception is sparse directly link awareness to the finite capacities of attention and working memory [2–4]. However, this view is often criticized since these limited mechanisms are thought to be unable to account for the impression of a rich, detailed perceptual experience that most observers have [5]. In our recent article [6], we argued that this criticism is misguided and that these supposedly limited cognitive mechanisms can support a much richer perceptual experience than is often claimed. By representing information as visual ensembles and summary statistics [7], observers are able to perceive far more than just a few items at a given time. Summary statistics give observers access to some information about the entire scene in the form of an ensemble percept. We claimed that ensembles and summary statistics explain the intuitive sense of a rich perceptual experience without having to rely on a new type of conscious experience, namely phenomenal consciousness [1]. Put more simply, the sparse view is not so sparse after all.

In response to our article, McClelland and Bayne [8] suggest that there are two alternate views of the data we described: a deflationary view and an overflow view. According to the deflationary view, ensemble representations are not a part of phenomenology at all and only affect post-perceptual judgments. While this is a logical possibility, it is unclear what reason there is to believe that this is the case. More broadly, what empirical evidence could there be to support this claim? If participants can attend to, remember, openly talk about, and even confirm their experience of an ensemble percept, what reason is there to believe that such representations are not consciously experienced?

McClelland and Bayne also put forth an overflow view of ensemble representations in which observers are phenomenally aware of the individual items that make up an ensemble but are simply unable to store those individual items in memory.

Again, while this is a logical possibility, it is unclear how to empirically verify that such fleeting perceptual experiences exist. What evidence could confirm that observers consciously experience information that is not ever attended to, remembered, or used to make any types of decisions [9]? McClelland and Bayne suggest that further development of no-report paradigms might one day empirically verify the idea of perceptual overflow [10]. While we do not want to discourage the development of new methods and paradigms, it is unclear how it will be possible to verify or probe the contents of conscious experience when observers' reports are not considered.

Instead, we are largely in agreement with Odegaard and Lau [11] who argue that what is needed is the generation of precise hypotheses for which we can then gather the relevant data. Overall, we believe researchers working towards understanding consciousness should focus on scientifically tractable questions for which there are experimental paradigms that can confirm or reject a particular hypothesis. In this case, we believe there are many outstanding issues regarding the perception of ensembles and summary statistics that can shed light on the nature and quality of perceptual experience.

[1]Department of Brain and Cognitive Sciences, McGovern Institute for Brain Research, Massachusetts Institute of Technology, Cambridge, MA, USA
[2]Center for Cognitive Studies, Department of Philosophy, Tufts University, Medford, MA, USA

*Correspondence: michaelthecohen@gmail.com (M.A. Cohen).

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Spotlight

The Benefits and Costs of a Rose-Colored Hindsight

Andreas Kappes[1] and M.J. Crockett[1,*]

Self-serving biases lead people to see themselves and their future through rose-colored glasses. New research by Kouchaki and Gino suggests this rosy view also extends backwards: memories of unethical behavior are less vivid than memories of good deeds. This so-called 'unethical amnesia' has many individual benefits, but also carries social costs.

'A moral being is one who is capable of reflecting on his past actions and their motives–of approving of some and disapproving of others' (Charles Darwin, *The Descent of Man, and Selection in Relation to Sex*)

Charles Darwin argued that a defining feature of human morality is an ability to reflect upon past misdeeds [1]. However, recent work by Kouchaki and Gino [2] questions this ability. In nine studies, participants were asked to either remember events in which they cheated, imagine possible events in which they could have cheated, or were given the opportunity to actually cheat. A few days later, they were asked to recall the details of these events. In each of the studies, participants who cheated (or imagined cheating) recalled the events less vividly compared to participants who did not cheat. This so-called 'unethical amnesia' only affected the experience of recollecting one's own immoral actions; people reported remembering vividly others' unethical behavior, as well as personal events that were unpleasant but not immoral. Unethical amnesia had clear benefits for dishonest participants, relieving the emotional discomfort spurred by their immoral actions. However, unethical amnesia also had social costs: the less vividly and clearly participants perceived their unethical past, the more they cheated again later. The findings are consistent with the idea that people seek to balance self-interest against maintaining a positive self-concept [3]. Unethical amnesia allows people to behave selfishly while preserving a moral self-image.

What cognitive mechanisms might give rise to unethical amnesia? The fact that it was observed several days after cheating, but not immediately after, implicates biased retrieval rather than biased encoding. Research on motivated forgetting shows that suppression of unwanted memories during retrieval interferes with long-term retention of the undesirable memory traces [4]. This effect is cumulative, such that the more times an unwanted memory is suppressed, the less likely it will be remembered. As a result, people might selectively forget the more unflattering chapters of their past. Such retrospective editing of memories in the service of a positive self-image in some ways resembles prospective editing of beliefs, which leads to unrealistic optimism [5]. The learning process here is biased in a way that causes people to integrate good news but neglect bad news when updating their beliefs. The studies by Kouchaki and Gino imply that self-enhancing biases can operate retrospectively as well as