Target article by Ruth Rosenholtz

Crisis, contextualized: A Much Broader Theoretical Shift is Needed

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Abstract: We agree that while there is a "crisis" in visual attention, the Rosenholtz' article does not offer bold enough solutions. We argue that the real crisis extends beyond attention, reflecting a broader need for theoretical integration. Addressing this requires abandoning artificial subdivisions and adopting a more ecologically valid, contextually grounded approach to cognition.

Rosenholtz' article diagnoses nothing less than a "crisis" in the science of visual attention. While we applaud the author's initiative to ban attention from her lab for a year and search for non-attentional explanations, we are both disappointed by the fact that the concept sneaks back in at the end of the article and unconvinced by the suggestion that an atheoretical list of still to-explained empirical phenomena and a few speculations are a bold-enough cure for a true crisis. The more so, as a closer look reveals that they are little more than re-inventions of three wheels.

First, Rosenholtz suggests that decision complexity and task factors might play a role in accounting for bottlenecks in performance. While we agree with the suggestion, this is particularly old news. Systematic research on cognitive bottlenecks by using the so-called PRP (Psychological Refractory Period) design in combination with factorial logic has generated hundreds, if not thousands of articles over almost the last hundred years, all pointing to the same conclusion: the key bottleneck underlying human performance is response selection, whereas perceptual and otherwise "early" stages of processing reflect no or only hardware-related limitations, such as the resolution of the retina or other early-vision limitations discussed by Rosenholtz (Pashler, 1984, 1994). However, the more complex the response decision is, the more multitasking is hampered.

Second, Rosenholtz considers the possibility that the task, and the purpose of perceptual/attentional activities might matter for understanding, probably even explaining processing bottlenecks. Again, we certainly agree, but this is old news as well. Various authors, including Allport (1987) and Neumann (1990) have suggested that "perception is for action", and the Theory of Event Coding (Hommel, 2004; Hommel et al., 2001), the arguably most comprehensive perception-action theory to date, considers perception an integral part of human intentional action. This also accounts for the first observation, namely, that bottlenecks mainly reflect limitations of action, rather than of perception.

Third, Rosenholtz' article is not the first to identify a problem with the concept of attention. The second author and numerous colleagues have argued that the concept is obsolete because it lumps together numerous empirical phenomena without any theoretical reason (Anderson, 2011; Di Lollo, 2018; Hommel et al., 2019)—so that the fact that no integrative, fully comprehensive attentional theory can be found is hardly surprising. Rather than avoiding this trap and/or providing a functionally justified identification of to-be-explained phenomena, Rosenholtz applies the old-fashioned logic of defining and subdividing the research field in a purely semantic fashion. This is obvious from the choice of focusing on "visual attention", which falsely suggests that the processing and selection of visual information follows an entirely different mechanistic logic than, say, the processing of auditory, tactile, and proprioceptive information. As argued elsewhere (Hommel, 2020; Hommel et al., 2019), this is unlikely to carve nature at its true joints and likely to multiply empirical research without any hope for theoretical integration.

Hence, if there is a crisis, it is unlikely to be effectively addressed without a much more disciplined theoretical strategy. This strategy, we believe, would need to give up the widespread idea that brain mechanisms care for semantic musings and subdivisions and integrate the broader context of each performance under consideration into the theoretical analysis. It is true that scientific practice always tends to develop in the opposite direction: to-be-investigated empirical phenomena tend to undergo finer and finer subdivisions, stimulating increasingly artificial experimental designs and paradigms to study them in isolation, which in turn inflates the number of theoretical claims and working hypotheses with an ever-decreasing empirical scope (Hommel & Colzato, 2015). And yet, successful theoretical integration and the building of functioning "big theories" call for the exact opposite: a concerted effort to interconnect more and more empirical designs and tiny questions, so as to reduce, rather than to multiply, the number of subdivisions of both our phenomena and our theoretical concepts.

Another, theoretically particularly important implication of such a de-focusing strategy is that tasks should be put back into the context that they are carried out in. Experimental instructions are asking for actions, and it is actions that provide our dependent measures. Accordingly, even if our main interest is focused on one particular processing chain, we always need to consider the entire process of generating a response to a particular stimulus in our theoretical analysis. Popularizing this

approach in the science of visual and other kinds of "attention" (or of the phenomena that we mistakenly or not believe to deserve this label) seems very likely to resolve most of the "crisis" that Rosenholtz diagnoses.

Our personal conclusion is therefore, yes, we do have a crisis, but it goes miles beyond the field of visual attention and rather involves cognitive (neuro)science as a whole. As Ulrich Neisser wrote in his book *Cognition and Reality* (Neisser, 1976), "…cognitive psychologists must make a greater effort to understand cognition as it occurs in the ordinary environment and in the context of natural purposeful activity. This would not mean an end to laboratory experiments, but a commitment to the study of variables that are ecologically important rather than those that are easily manageable". Along these lines, some have proposed a "cognitive ethology" approach where we don't assume that cognitive processes are invariant, stop relying only on artificial model tasks and instead collect complex real-world data (Kingstone et al., 2008). Others have advocated for a "synthetic approach" to cognition that involves identifying a common principle associated with a well-understood ecologically relevant basic mechanism and building an account of whatever phenomena we are interested in based on this principle (Hommel et al., 2019). In any case, however, the cognitive and the neurocognitive sciences need to become much more theoretical and integrative, which, we are afraid, calls for a bolder approach than that suggested by Rosenholtz.

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