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Corticocentric bias in cognitive neuroscience

Commentary on **Chapman & Huffman** on *Human Difference*

Orit Nafcha and Shai Gabay
Department of Psychology
The Institute of Information Processing and Decision Making (IIPDM)
University of Haifa

Abstract: Chapman & Huffman (2018) note that our tendency to categorize leads to a sense of human superiority that helps justify violence against nonhuman animals. Yet animals are turning out to have capacities previously thought to be uniquely human. We add a further factor that may contribute to the false sense of human superiority: the "corticocentric" bias of neuroscience. An evolutionary approach may help identify species similarities and differences, providing a better understanding of the uniqueness of each species.

Orit Nafcha, doctoral candidate in Psychology, University of Haifa, studies social behavior in Archerfish, the influence of social context on cognition, and the influence of different types of rewards on attentional processes and habitual behavior. **Website**

Shai Gabay, senior lecturer in Psychology, University of Haifa, studies the evolution and role of subcortical areas in attention, perception, mathematical abilities, social processes and mental representations. **Website**

Chapman & Huffman (2018) point out that humans have mistakenly assumed they are superior to nonhuman animals, a moral claim that often leads to mistreatment of other species. We describe a further reason for this incorrect sense of superiority: a "corticocentric" bias that overemphasizes cortical regions — larger and more evolved in humans than in other animals — as the basis of human cognition (Parvizi, 2009). We tend to attribute "higher" cognitive abilities to cortical regions that are highly developed in our own species, neglecting subcortical regions shared across multiple species. This leads to an underestimation of animals' cognitive abilities, enhancing our perception of dissimilarities between humans and animals (see Amiot et al., 2017, for a social psychological standpoint).

The limitations of commonly used methodological tools for studying the neural basis of cognitive functions are also a factor in this corticocentric bias. Functional magnetic resonance imaging (fMRI), for example, has greatly advanced our understanding of the neural basis of cognition; yet despite its relatively high spatial resolution, it is much less sensitive to subcortical activity, which has a lower signal-to-noise ratio compared to cortical activity (LaBar, Gitelman, Mesulam, & Parrish, 2001). Nor can fMRI and other imaging techniques reveal direct causal connections between brain activity and cognitive events.

To help identify differences and commonalities between human and nonhuman cognitive abilities, we recommend developing experimental tools to study the role of evolution in human cognition, using similar cognitive tasks across species to study subcortical versus cortical mechanisms. Posner's (1980) cuing task, typically used to study attention in humans, requires rapid responding to the presentation of a target and measures reaction time to cued versus un-cued targets. This task (and many other human cognitive tasks) can also be used with Archerfish, who are able to shoot down insects by spitting water. Archerfish respond to targets presented on a computer screen in a laboratory setting, and their reaction time can be measured. We have shown that they have both reflexive and voluntary attentional capacities similar to those observed in humans (Gabay et al., 2013; Saban, Sekely, Klein, & Gabay, 2017). As in human stereoscopic studies, presenting different visual information to each eye separately (cue to one eye, target to the other, or both cues to a single eye) can isolate monocular (subcortical) versus binocular (cortical) neural channels. This technique has shown that subcortical structures are involved in specific aspects of attentional orienting (Gabay & Behrmann, 2014).

An evolutionary perspective suggests that human faculties are grounded in phylogenetically older neural regions. Neural circuitry may be recycled and adjusted for different purposes (Anderson 2007, 2010; Dehaene, 2005). Cortical regions can take control of subcortical mechanisms to develop new abilities. For a better understanding of the similarities between human and nonhuman species, the focus should be on why different species have similar cognitive functions and how these helped them adapt to their specific needs.

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