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No Magic Bullet in Sight: A Reply to Firestone and Scholl (2017) and Durgin (2017)

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It is a pleasure and privilege to engage in the ongoing debate regarding the existence of top-down influences on perception, particularly effects obtained within the economy of action (Proffitt, 2006) and motivated perception accounts (Balcetis & Cole, 2014). It is, however, surprising that, as the primary criticism, Firestone and Scholl (2017, this issue) and Durgin (2017, this issue) once again raise their previously made point of participants' ability to infer experimenters' intentions (i.e., experimental demand effects, Orne, 1962). Indeed, I already discussed this potential problem at length (Schnall, 2017, this issue). As noted, although this concern may apply to the original backpack findings published 18 years ago (Bhalla & Proffitt, 1999), a substantial body of evidence has been generated in the interim that does not have this limitation.

The findings detailed in Schnall (2017) need not be reiterated here. Additional recent research investigated the contribution of naturally occurring weight differences in perceivers (i.e., biological "backpacks"; Taylor-Covill & Eves, 2016, p. 331). For example, overweight people overestimate distances, but only as a function of their actual body weight rather than what they believe their weight to be (Sugovic, Turk, & Witt, 2016). Similarly, overweight people found hill slants to be steeper before a weight-loss program than they did after they lost weight as evidenced by reduced body fat (Taylor-Covill & Eves, 2016). Of particular relevance to Durgin's critique (2017), Zadra, Weltman, and Proffitt (2016) substantiated the previously observed effect of glucose supplementation on perceptual estimates (Cole & Balcetis, 2013; Schnall, Zadra, & Proffitt, 2010): After having consumed a drink high in glucose, athletes who engaged in strenuous cycling perceived distances to be shorter than they did after having consumed a sugar-free placebo drink. There is no scope for experimental demand characteristics to account for Zadra et al.'s (2016) findings because, as in the earlier work, taste differences between glucose-containing and glucose-lacking drinks were ruled out in separate samples (Schnall et al., 2010), and because a double-blind design was employed (Cole & Balcetis, 2013). Furthermore, individual differences relating to exercise performance predicted visual perception, such that greater exertion—reflected by higher heart rate, caloric expenditure, oxygen uptake, and blood lactate—was associated with greater distance estimates (Zadra et al., 2016).

Firestone and Scholl (2017) and Durgin (2017) fail to provide competing interpretations for these and many other findings because there are none; they can only be explained by an effort-related energetics account of perception (Proffitt, 2006). Instead, the critiques focus on papers (Durgin et al., 2009; Durgin, Klein, Spiegel, Strawser, & Williams, 2012; Shaffer, McManama, Swank, & Durgin, 2013) that involved participants' post-hoc rationalizations after having been given convoluted instructions aimed at "eliminating" demand characteristics. For obvious reasons, experimental designs that remove the potential for participants to generate study hypotheses in the first place are superior to designs that introduce manipulations that are likely to produce the attributional processes and demand characteristics that they are intended to avoid.

One can view perception as being exemplified by complex visual illusions—devised by vision scientists—that only human beings are able to appreciate, as Firestone and Scholl (2017) do in their Figure 1. Alternatively, one can view perception as a naturally occurring, dynamic process in which current goals and motivations continuously calibrate an animal's action capabilities in the face of quickly changing information, and which therefore helps the animal meet adaptive challenges laid out by evolutionary pressures. It is now widely accepted that the brain is a "prediction machine" that constantly works to come up with better models of the environment in an

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effort to minimize prediction error (Clark, 2013; Friston, 2010; Lupyan, 2015). Such processes have been well-documented in the perceptual domain, for example, for object recognition (Bar, 2003), for which the orbitofrontal cortex (OFC) has been proposed to be the primary neural structure that allows top–down modulation of early visual input (O'Callahan, Kveraga, Shine, Adams, & Bar, 2017). Indeed, the OFC receives input from various visceral and sensory areas (Rolls, 2004), and one of its key functions is to predict the value of potential rewards as a function of current biological states of the organism (Levy & Glimcher, 2012; Padoa-Schioppa & Cai, 2011). Many other seemingly "low"-level perceptual processes are similarly shaped by top–down influences (for reviews, see Lupyan, in press; O'Callahan et al., 2017; Otten, Seth, & Pinto, in press; Teufel & Nanay, 2017). Intriguingly, consistent with embodied accounts that view perception as being intrinsically linked to action (Proffitt, 2006), recent research on fruit flies shows that walking through space changes the firing pattern of single direction-selective neurons involved in vision (Fujiwara, Cruz, Bohnslav, & Chiappe, 2017). More specifically, leg movements alter the membrane potential of visual neurons even in blind flies, thus suggesting that nonvisual motor input drives the activation of the cells previously thought to control vision alone.

In light of all this evidence, it strikes me as implausible that the estimates of spatial layout studied within the economy of action and motivated perception accounts are the one and only exception to the rule that animals with biological and social needs take in new information that helps them learn about changing action contingencies in a world full of uncertainty. It is therefore puzzling that part of Firestone and Scholl's (2017) and Durgin's (2017) reasoning appears to be that, without a consciously experienced change in perception, whatever process is influenced does not really constitute perception. Consistent with my proposal, however, other commentators have also cautioned that distinguishing perceptual and nonperceptual processes on a phenomenological level is likely an intractable problem for which no appropriate methodology exists (Teufel & Nanay, 2017). I therefore look forward to the discovery of the magic bullet that separates perception from judgment and seeing from thinking. At present, there is no evidence for such a tool on a behavioral level, and it does not look promising on the neural level either.

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