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Introspective access to implicit shifts of attention

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ABSTRACT

Literature in metacognition has systematically rejected the possibility of introspective access to complex cognitive processes. This situation derives from the difficulty of experimentally manipulating cognitive processes while abiding by the two contradictory constraints. First, participants must not be aware of the experimental manipulation, otherwise they run the risk of incorporating their knowledge of the experimental manipulation in some rational elaboration. Second, we need an external, third person perspective evidence that the experimental manipulation did impact some relevant cognitive processes. Here, we study introspection during visual searches, and we try to overcome the above dilemma, by presenting a barely visible, "pre-conscious" cue just before the search array. We aim at influencing the attentional guidance of the search processes, while participants would not notice that fact. Results show that introspection of the complexity of a search process is driven in part by subjective access to its attentional guidance.

1. Introduction

The term introspection refers to the cognitive mechanism through which individuals can access their own mental states (Flavell, 1979; Lyons, 1986). Like any other cognitive process, introspection also presents certain functional determinants (Jack & Shallice, 2001; Overgaard, 2006), that we can study experimentally in psychology (Jack & Roepstorff, 2002, 2003, 2004; Schooler, 2002) and neuroscience (Fleming & Frith, 2014). It has been proposed (Carruthers, 2010) that individuals would introspectively access only mental states with low cognitive complexity (e.g., perceptual states). On the contrary, information related to a cognitive process would remain inaccessible to consciousness. In particular, literature converges on the idea that reports about cognitive processes preceding a decision would not be truly introspective, but rather interpretative (Overgaard & Sandberg, 2012). In effect, recent evidence in social psychology (Johansson, Hall, Silkström, & Olsson, 2005; Johansson, Hall, Silkström, Tärning, & Lind, 2006; but see Petitmengin, Remillieux, Cahour, & Carter-Thomas, 2013) suggest that when participants are asked to describe the causes guiding their behavior, they systematically engage in *confabulatory* explanations.

The concern for this matter was inaugurated by cognitive psychologists in the 1960s, who – with insufficient experimental evidence – suspected that individuals could not access to higher order mental processes (Mandler, 1975; Miller, 1962; Neisser, 1967).[1] Formally, this pessimistic view on introspection was stated in the seminal publication of Nisbett and

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[1] Nisbett and Wilson (1977, p. 232) emphasize this point: "It is the *result* of thinking, not the *process* of thinking, that appears spontaneously in consciousness" (Miller, 1962, p. 56) [...] "The constructive processes [*of encoding perceptual sensations*] themselves never appear in consciousness, their products do" (Nessler, 1967, p. 301).

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Wilson (1977), in which they define the class of mental content that is accessible via introspection. These authors proposed the distinction between accessible mental contents (cognitive states) and inaccessible ones (cognitive processes). This claim comes from a systematic review of experiments in social psychology (research areas included attribution, cognitive dissonance, subliminal perception, problem solving, etc.), from which they concluded that introspective access would be restricted to the cognitive states (i.e., perceptual mental state) before or after the decision. On the contrary, information related to the cognitive processes which constitute decisions, would be inaccessible to participants (Fig. 1).

Against Nisbett and Wilson's theory, several conceptual and methodological objections have been raised (Ericsson & Simon, 1980; Smith & Miller, 1978; White, 1988). Among the most important are the following: First, Nisbett and Wilson (1977) do not propose a clear distinction between a cognitive *process* and a cognitive *state*. The authors only offer a vague definition of a cognitive process: "*causes that guided, lead to or motivate a decision*". In a subsequent article, Nisbett and Ross (1980) define a cognitive process as "*the causal relation between events or mental contents*". The lack of clarity in the definition of what is postulated as inaccessible goes over time generating confusion in the literature. A conceptual strategy to clarify this, and that additionally facilitates the design of experiments - without eluding the original problem (see Footnote 1) - is to define a cognitive process simply as "*the sensory and representational transformations that occur between a stimulus and a response*" (Reyes & Sackur, 2014). Indeed, when participants are requested to report "*the causes that motivate behavior*" it is highly probable that participants would resort to *a priori* theories (because folk epistemology associates "causes" with "theory"). This effect should be decreased when it is demanded to simply report "*the sensory transformation*" that precedes a decision (Engelbert & Carruthers, 2011). Secondly, another problematic aspect is the response mode in Nisbett and Wilson's experiments, which are often based on verbal reports. The problems associated with introspective verbal reports have been extensively discussed in the literature (Ericsson & Fox, 2011; Ericsson & Simon, 1980; Fox, Ericsson, & Best, 2011; Schooler, 2002, 2011). Many authors converge on the idea that verbal reports must involve a *translation* of the information of interest (Schooler, 2002). This opens the possibility that cultural factors, *a priori* beliefs, personality factors or aspects of the researcher-participant relationship could alter the formation of introspective judgments. The previous point is particularly relevant for the study of limits of introspection. In effect, most cognitive processes investigated by Nisbett and Wilson presented high cognitive complexity; as a consequence, they demand that participants execute high-level forms of reasoning or at least integrate many information sources. The high complexity of the task, added to the low experimental control of introspective verbal-report, are factors that favor confabulation (Ericsson & Simon, 1980). In response, recent advances in the field of introspection of mental states (Corallo, Sackur, Dehaene, & Sigman, 2008; Marti, Sackur, Sigman, & Dehaene, 2010) have all been achieved by focusing on elementary cognitive tasks, and replaced verbal reports by quantified reports. Our conceptual and experimental work is guided by the idea that the inaccessibility of cognitive processes can be overcome if we take into account both lines of objections.

Recently, we (Reyes & Sackur, 2014) and others (Marti, Bayet, & Dehaene, 2015) evidenced that under precise experimental conditions, participants' introspection was able to accurately access the basic cognitive process in visual search tasks (i.e., the mechanisms of a decision). As commented before, so as to reach this conclusion, it was necessary to resort to much simpler and controlled experimental conditions than what is generally the case in the literature supporting the inaccessibility of cognitive processes. In effect, both studies mentioned above relied on visual search as first order task, on which participants were asked to apply introspection. This task has the convenient property of being experimentally well understood and controllable (Treisman & Gelade, 1980; Wolfe, 1994). Our previous results open the possibility that the controversy about the differential access to mental content (i.e., access to cognitive processes *vs*. access to perceptual states) does not depend on the nature of such contents (Carruthers, 2010), but more on the functional aspects of the introspective mechanism itself.

In Reyes and Sackur (2014), we investigated the introspective access to the cognitive processes underlying two visual search processes. The logic of such experiments was the following: we tell the participants to participate in a visual search task, in which two conditions are presented; one simple and fast, in which the target "pops out", the other being more difficult and requiring an effortful and "serial" exploration of the visual scene. Importantly, in every trial and after every search condition we asked participants to describe the cognitive strategy that they had carried out to trigger the response. Our interest was to investigate if such subjective estimate was consistent or not with the type of underlying cognitive processing to each experimental condition, which is possible to objectively track. In detail, two experimental conditions were studied: difficult, effortful searches (conjunction searches: search L among Ts) and easy, pop-out searches (feature searches: search X among Ts). It has been repeatedly shown (Treisman & Gelade, 1980; Wolfe, 1994; Wolfe, Võ, Evans, & Greene, 2011) that these two types of searches engage attention in a markedly different way: difficult searches lead to a sequential scanning of the search array with little *exogenous* attentional guidance, while in pop-out searches, attention is directly driven to the target, as if the whole array had been processed in parallel.

In visual search there is an extensive debate about how attention is modulated. For instance, the Feature Integration Theory (FIT, Treisman & Gelade, 1980) suggests that in feature searches (FS) the visual system extracts in parallel, pre-attentively, the set of basic characteristics of the scene, which are necessary and sufficient to select the response. On the contrary, in conjunction searches (CS) attention is deployed serially one item, or group of items, at a time. In feature searches response times are independent from perceptual load since the characteristics of the target stimulus favor a pre-attentional processing. In contrast, in conjunction searches there is no such pre-attentional processing. As a consequence, response times increase as a funcion of perceptual load. Other models argue that there is a continuum of more or less efficient searches (Thornton & Gilden, 2007; Wolfe, 1994, 2007; Wolfe, Cave, & Franzel, 1989). In accordance with this, *inefficient visual searches* (e.g., search L among Ts) exhibit prominently *capacity limits*, whereas *efficient searches* (e.g., search X among Ts) do not incur