



Commentary

Optimizing subjective measures of consciousness ☆

Morten Overgaard^{a,*}, Bert Timmermans^b, Kristian Sandberg^a, Axel Cleeremans^b^a Cognitive Neuroscience Research Unit, Hammel Neurorehabilitation and Research Center, Voldbyvej 15, 8450 Hammel, Denmark^b Consciousness, Cognition & Computation Group, Université Libre de Bruxelles, Brussels, Belgium

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ABSTRACT

Dienes and Seth (2010) conclude that confidence ratings and post-decision wagering are two comparable and recommendable measures of conscious experience. In a recently submitted paper, we have however found that both methods are problematic and seem less suited to measure consciousness than a direct introspective measure.

Here, we discuss the methodology and conclusions put forward by Dienes and Seth, and why we think the two experiments end up with so different recommendations.

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1. Introduction

The striking contemporary resurgence of interest in empirical approaches to consciousness has brought about a methodological challenge: What are we to make of subjective reports? Cognitive science, with a few exceptions (see e.g., “Verbal reports as data”, Ericsson & Simon, 1980) has tended to disregard them or to dismiss them altogether, preferring so-called objective data as the primary source of evidence regarding what a participant knows or does not know about a particular state of affairs. While this approach is legitimate in some cases, it becomes problematic when studying consciousness as conscious contents may dissociate from behavior. Subjective experience, indeed, cannot be observed “from the outside”. Therefore, in order to test the validity of any objective method, one is forced to somehow calibrate it using subjective methods, and thus a model for the use of subjective reports seems unavoidable. Nevertheless, despite a number of theoretical papers on subjective reports (e.g. Overgaard, Gallagher, & Ramsøy, 2008; Seth, Dienes, Cleeremans, Overgaard, & Pessoa, 2008), studies comparing objective and subjective methods have been few and in between. Dienes and Seth (2010), together with Sandberg, Timmermans, Overgaard, and Cleeremans (2010), are amongst the first to engage in this endeavor. In this commentary, we discuss Dienes and Seth’s study to evaluate the extent to which the experiments are suggestive of an “optimal” method to collect subjective reports, or whether this goal is complicated by confounding factors.

In Dienes & Seth’s implicit learning paradigm, participants first memorized letter strings and were subsequently told that they had in fact been constructed according to specific “rules”. Participants were then to discriminate novel letter strings that did or did not obey these “rules”. One group of participants reported how confident they were about each decision (confidence rating (CR): “guessing” (no knowledge at all) or “sure to some degree”), and a second group had to wager (low or high; one or two sweets) on the correctness of each of their decisions (post-decision wagering (PDW)). Persaud and colleagues (Persaud & McLeod, 2008; Persaud, McLeod, & Cowey, 2007) have argued that PDW constitutes a better method

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* Corresponding author. Fax: +45 89 49 44 00.

E-mail address: mortover@rm.dk (M. Overgaard).

to assess awareness, as the prospect of monetary gain motivates the participants to reveal all their knowledge. Thus, the measure should in theory minimize the risk of misclassifying conscious knowledge as unconscious.

Contrary to this, however, Dienes and Seth found that CR is actually more sensitive than PDW – their wagering participants were reluctant to place high wagers due to risk aversion. In a second experiment, Dienes & Seth altered the way participants have to wager in two ways so as to minimize participants' risk aversion (no-loss gambling). First, participants could wager only one sweet and no longer lost it when answering incorrectly, and second, instead of wagering on the correctness of their response, participants could now choose a random card draw with a 50% chance of obtaining a sweet. They were instructed to choose this option when, and only when they felt that their grammaticality decision was completely random. These instructions seem similar to the instructions for the CR in the first experiment in that the first response option is defined as “guessing”, and the second is defined as “anything that does not qualify as guessing”. Not surprisingly, the new instructions caused PDW to perform at the same level as CR.

Based on their two experiments, Dienes and Seth conclude that CR and some form of PDW both are reasonable measures of consciousness that do not significantly vary from each other, and that both can be recommended for future studies. However, based on the above, it should be noted that PDW had to be substantially modified to produce results as good as CR.

In this light, we raise a crucial issue: although Dienes and Seth point out the many similarities between awareness (and measures of awareness) in implicit learning and perceptual awareness paradigms, it is an empirical question whether Dienes & Seth's conclusions about the measures (regarding their equivalence as well as their adequacy) extend to studies of perceptual awareness. We (Sandberg et al., 2010) recently conducted such a scale comparison experiment within the field of visual awareness. In the following we will discuss the consequences of our findings for the measures of awareness used in implicit learning paradigms.

2. Comparing measures of consciousness

In our experiment, we (Sandberg et al., 2010) compared three measures of subjective perceptual experience: The Perceptual Awareness Scale (PAS), CR, and PDW. In the experiment, participants were briefly presented with one of four masked geometrical shapes and had to indicate the correct shape in a forced-choice task. Following each trial, participants had to indicate their subjective experience on a 4-point version of one of the three scales (each participant responded using only one scale), where only the instructions and the scale anchors differed (PAS: no experience, vague experience, almost clear experience, clear experience; CR: not confident at all, slightly confident, quite confident, very confident; PDW: imaginary amounts €5, €10, €15, €20). We determined (1) which scale correlated best and most consistently with performance (indicating awareness) and (2) whether we could detect above-chance performance in the absence of awareness and how the scales differ from each other in terms of revealing such unconscious processing.

Regarding the extent to which reported consciousness correlated with performance, our results indicated that PAS was more exhaustive than CR in detecting conscious influences on performance, and that CR in turn was more exhaustive than PDW. Furthermore, as in Dienes & Seth's first experiment, people using PDW were more inclined to give low wagers for stimulus intensities for which it was clear from PAS that stimuli were mostly perceived consciously. Since we did not include the Dienes & Seth suggested modifications to PDW, this result can be explained by participants' risk aversion. However, and crucially, the same was true for CR: even though it fared slightly better than PDW, participants claimed to be guessing for stimuli that PAS showed to be processed, at least to some extent, consciously. As Dienes and Seth showed that risk aversion does not predict confidence ratings, the superior results of PAS over CR must be explained by something else.

One straightforward yet somewhat controversial interpretation of our results is that participants perform the task exactly as instructed. In other words, when they are asked to specifically report what they experience, this is what they will do. Likewise, when asked to wager, they will perceive it as a gambling situation, and in this type of situation, factors such as emotional arousal, risk aversion, and gambling strategy may influence task performance and consciousness rating. Finally, when asked to report their confidence, participants consider how much they trust the correctness of the report they just issued. The crucial difference here lies in the fact that whereas PAS in principle refers to visual experience regardless of the issued response, both CR and PDW refer explicitly to so-called “judgment knowledge”, meaning that rather than being just a reflection of perceptual experience, participants have to evaluate how this knowledge contributed to their response. Consequentially and crucially, other cognitive processes than those specifically related to reporting the experience influence the results in these latter two cases. According to Dienes and Seth, “one could for example wager low even though one had some confidence in order to minimize loss”—similarly, one could have no confidence in the correctness of one's response even though one had a partial or vague experience of the stimulus. Such a vague experience could for instance be seeing just a weak glimpse, or a part, of something on the screen, but having no idea what it was. On a PAS scale, a participant having this experience would report a “vague experience”, but in order to report some degree of confidence, the participant would have to know that this very vague experience is indeed enough to improve the accuracy of the identification task slightly. In other words, it may be a prerequisite for the use of a CR scale that subjects entertain the idea that even small changes in experience correlate with performance.

Based on their two experiments, Dienes and Seth conclude that CR and some form of PDW both are reasonable measures of consciousness that do not significantly vary from each other, and that both can be recommended for future studies. However, in spite of a number of similarities between the Dienes and Seth study and our above-mentioned study (Sandberg et al.,

2010), we arrive at different conclusions. Our study indicates problems that are shared by PDW and CR so that neither, rather than both, of them can be recommended to measure conscious experience in cases where it is possible to ask the subject to report their conscious experience directly.

As our results based on the CR and PDW scales are highly similar to the findings of Dienes and Seth, it seems obvious to raise the question of whether our PAS findings can be extended to the implicit learning paradigm as well.

3. Different paradigms, different measures?

Would a scale that does not require knowledge of the influence of particular aspects of experience on task performance also lead to superior results within an implicit learning paradigm? And is it at all possible to construct a PAS-like scale for an implicit learning paradigm? PAS ratings refer to the clarity of the perceptual experience. As such, the experimenter is simply asking the participants to report what they saw. In artificial grammar learning, the knowledge (“structural knowledge”) that drives above-chance performance in the classification task may consist of abstract rules, of statistical regularities or of exemplars or fragments thereof (see Cleeremans et al., 1998; Cleeremans & Dienes, 2008). The corresponding conscious knowledge can be defined as involving awareness of what motivated your decision (judgment knowledge). From this perspective one could argue in favor of confidence ratings, or even wagering, because one is interested in whether people know on what knowledge they based their decision, without the experimenter probing one specific type of structural knowledge. However, the problem remains that participants fail to recognize what determined their performance, and claim to be guessing. Conversely, a high confidence rating need not reflect consciousness per se. Consider the following (very simple) example. One person who is a non-native English speaker knows that one says “I am” and not “I are”, and he is fully aware of why this is the case, whereas a native English speaker also knows that “I am” is correct, contrary to “I are”, but has no idea why this is the case. “I are”, to him, just sounds wrong. The two subjects may have the same amount of confidence that their report is correct, yet they are conscious in quite different ways. Before attempting to construct an awareness scale suited for the implicit learning paradigm, it would thus seem necessary to define the knowledge to be considered conscious knowledge, but this is no easy task. Confidence ratings have served as a convenient way of avoiding the definition of conscious knowledge, but with our recent empirical results there is reason to believe that this solution has flaws of its own.

Thus, it seems to us that implicit learning researchers face a difficult dilemma. On the one hand, there is reason to believe that confidence ratings may not be the best way to gain knowledge about conscious experience, but on the other hand, it seems a non-trivial task to adjust a PAS-like scale to an implicit learning paradigm. This is because, if one would want to probe for conscious experience of structural knowledge, one faces two problems: first, what knowledge to probe; and second, how to probe for such knowledge without making this knowledge explicit to the participant? Nevertheless, it seems a logical conclusion, based on the above, that such practical difficulties should be overcome since current attempts to “objectify” measures of consciousness fare worse than does the direct, introspective measure.

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