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Different subjective awareness measures demonstrate the influence of visual identification on perceptual awareness ratings



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ABSTRACT

We compare four subjective awareness measures in the context of a visual identification task and investigate quantitative differences in terms of scale use and correlation with task performance. We also analyse the effect of identification task decisions on subsequent subjective reports. Results show that awareness ratings strongly predict accuracy for all scale types, although the type of awareness measure may influence the reported level of perceptual awareness. Surprisingly, the overall relationship between awareness ratings and performance was weaker when participants rated their awareness before providing identification responses. Furthermore, the Perceptual Awareness Scale was most exhaustive only when used after the identification task, whereas confidence ratings were most exhaustive when used before the identification task. We conclude that the type of subjective measure applied may influence the reports on visual awareness. We also propose that identification task decisions may affect subsequent awareness ratings.

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1. Introduction

Subjective measures of consciousness, such as confidence ratings (Dienes & Perner, 2004; Dienes & Seth, 2010) or the Perceptual Awareness Scale (Ramsøy & Overgaard, 2004) have now become very popular in studies dedicated to investigating conscious awareness. Such subjective scales are used to investigate awareness in subliminal perception (Sandberg, Timmermans, Overgaard, & Cleeremans, 2010), attentional blink (Sergent & Dehaene, 2004), blindsight (Overgaard, Feh, Mouridsen, Bergholt, & Cleeremans, 2008) and implicit learning (Dienes & Seth, 2010), to list just a few examples. The main reason for this resurgent and now widespread use of subjective measures is that they afford easy quantification whilst retaining the very feature one is interested in when attempting to measure conscious experience, namely its subjective character (Overgaard, Jensen, & Sandberg, 2010). Indeed, just like objective measures such as identification or recognition tasks (Holender, 1986; Merikle, Smilek, & Eastwood, 2001), subjective scales of awareness quantitatively probe the accessibility of a percept or a mental representation on a numerical scale, allowing for the fine-tuned assessment of

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conscious awareness and its relationship with task performance, as well as facilitating comparisons between different conditions.

Congruently, many researchers now seem to agree that subjective measures are better tuned to the measurement of conscious awareness than objective tasks or free verbal reports (see: [Dienes & Seth, 2010](#); [Koch & Preusschoff, 2007](#); [Sandberg et al., 2010](#); [Wierzchoń, Asanowicz, Paulewicz, & Cleeremans, 2012](#)). However, there is continuing disagreement on what is in fact measured with a particular subjective scale. This issue is related to the response taxonomies that are used to probe participants' awareness. For instance, consider the Perceptual Awareness Scale (PAS, [Ramsøy & Overgaard, 2004](#); [Sandberg et al., 2010](#)) or the continuous scale (CS, [Sergent & Dehaene, 2004](#)). In both cases, participants are asked to rate the visibility of a stimulus using scale ratings that range between “no experience” and “maximal visibility” (in the case of PAS, judgements that fall between the scale's extremes are described with labelled intermediate steps, whereas CS is continuous). Researchers have claimed that both measures constitute direct and purely introspective measures of stimulus visibility ([Ramsøy & Overgaard, 2004](#); [Sandberg et al., 2010](#)). In other words, PAS and CS are often considered as pure measures of awareness of the stimulus rather than as measures of awareness of knowing that one is aware of the stimuli ([Dretske, 2006](#); so-called “judgement knowledge”). In contrast, confidence ratings (CR, [Dienes & Seth, 2010](#)) and post-decision wagering (PDW, [Persaud, McLeod, & Cowey, 2007](#); [Ruffman, Garnham, Import, & Connolly, 2001](#)) are more explicitly directed towards assessing participants' certainty in their judgements (that is awareness of possessing experience-related knowledge relevant to the judgement rather than the direct experience itself). In confidence ratings, certainty is expressed through a scale describing the lowest ratings as “not confident at all” and the highest ratings as “very confident”. Similarly, with post-decision wagering, participants express their certainty by betting on their judgements with real or artificial money. Here, the scale presupposes that low stakes express low certainty whereas high stakes are assumed to be used when participants are highly confident in their judgements (i.e. are aware of judgements). PDW is thought to be more intuitive for participants (e.g. it has been used in developmental, [Ruffman et al., 2001](#)) and used in animal studies ([Middlebrooks & Sommer, 2012](#)) but has also been criticised as being less sensitive. This is because the scale seems to involve more conservative response criteria due to risk aversion ([Clifford, Arabzadeh, & Harris, 2008](#); [Dienes & Seth, 2010](#); [Fleming & Dolan, 2010](#); [Schurger & Sher, 2008](#); [Szczepanowski, 2010](#)).

Further, we have recently proposed an alternative taxonomy the feeling of warmth scale (FOW, [Wierzchoń et al., 2012](#)). The scale has previously been used as a measure of intuition in problem solving ([Metcalfe, 1986](#)). We argued that FOW allows us to probe conscious awareness more directly than either CR or PDW, as the scale ratings are not influenced by participants' decision strategies, such as risk aversion (see: [Schurger & Sher, 2008](#)), or personal theories on certainty (e.g. the illusion of validity – see: [Tobena, Marks, & Dar, 1999](#)).

Given this (welcome) plethora of subjective scales of awareness, it seems essential to carry out experiments that aim to compare the scales directly so as to assess the sensitivity of each of them as well as the influence of other factors such as risk aversion. Different groups have recently carried out such systematic comparisons in the context of perceptual tasks ([Sandberg et al., 2010](#); [Szczepanowski, 2010](#); [Szczepanowski, Traczyk, Wierzchoń, & Cleeremans, 2013](#); [Zehetleitner & Rausch, 2013](#)) and memory tasks ([Dienes & Seth, 2010](#); [Wierzchoń et al., 2012](#)). However, not all available scales have been compared in the context of the perceptual task and there is no widespread agreement on the interpretation of the differences observed between the scales. Thus, our first aim is to investigate whether awareness ratings will show quantitative differences in terms of scale use and correlation with task performance for perceptual studies. Based on the previous studies we reason that the most pronounced differences should be observed between PAS, that is considered to be a direct measure of subjective visibility ([Ramsøy & Overgaard, 2004](#)), and other subjective scales, that rather seems to measure participants' metacognitive judgements on the perception ability. Furthermore, we expect that PDW results will be affected by risk aversion and thus PDW will assess the awareness with lower sensitivity.

In order to interpret the differences between subjective measures of awareness, we have recently proposed a model which aims to describe how awareness is examined with each of the scale taxonomies in context of an artificial grammar learning task ([Wierzchoń et al., 2012](#)). The model assumes that all subjective scales of awareness measure metacognitive awareness, i.e. participants' subjective judgement knowledge ([Dienes & Scott, 2005](#)). Following this assumption, we proposed that the different scales are distinguishable in two main aspects: the range of states of awareness that they are sensitive to, and the lowest point in the spectrum that they can reliably measure ([Wierzchoń et al., 2012](#)). It is, however, questionable whether the same assumptions apply to perceptual awareness scales, so we will analyse the results in this manner. It is essential to answer this question because it touches upon one of the most fundamental issues in consciousness research, namely the unity of consciousness (see e.g. [Bayne, 2010](#)). Perceptual awareness and introspective (metacognitive) awareness are often referred to as separate processes ([Armstrong, 1981](#)), but e.g. higher-order theories assume that conscious perception necessarily depends on awareness of knowing ([Cleeremans, 2011](#); [Lau & Rosenthal, 2011](#); [Pasquali, Timmermans, & Cleeremans, 2010](#); [Rosenthal, 2012](#)). Thus, it seems important to see whether the model we proposed, which assumes that all subjective scales of awareness necessarily measure judgement knowledge, may be applied in context of perceptual awareness.

Furthermore, following other assumptions of higher-order theories of awareness, we hypothesised that the observed relation between task performance accuracy (the task upon which awareness is estimated) and awareness ratings may be modified not only by the type of subjective measure applied (and thus the rating criteria involved), but also by the availability of multiple different cues that may influence accuracy, participants' subjective experience, or both. One of the important cues that seems to be available to participants in all studies investigating subjective measures of awareness

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