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Unconscious influences on decision making: A critical review

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Abstract: To what extent do we know our own minds when making decisions? Variants of this question have preoccupied researchers in a wide range of domains, from mainstream experimental psychology (cognition, perception, social behavior) to cognitive neuroscience and behavioral economics. A pervasive view places a heavy explanatory burden on an intelligent cognitive unconscious, with many theories assigning causally effective roles to unconscious influences. This article presents a novel framework for evaluating these claims and reviews evidence from three major bodies of research in which unconscious factors have been studied: multiple-cue judgment, deliberation without attention, and decisions under uncertainty. Studies of priming (subliminal and primes-to-behavior) and the role of awareness in movement and perception (e.g., timing of willed actions, blindsight) are also given brief consideration. The review highlights that inadequate procedures for assessing awareness, failures to consider artifactual explanations of "landmark" results, and a tendency to uncritically accept conclusions that fit with our intuitions have all contributed to unconscious influences being ascribed inflated and erroneous explanatory power in theories of decision making. The review concludes by recommending that future research should focus on tasks in which participants' attention is diverted away from the experimenter's hypothesis, rather than the highly reflective tasks that are currently often employed.

Keywords: awareness; conscious; decision making; deliberation; intuition; judgment; perceptual-motor skills; unconscious

1. Introduction

Psychology is concerned with understanding how the mind controls and determines behavior. Fundamental to this goal is whether unconscious influences play a significant role in the generation of decisions and the causation of behavior generally. Everyday notions such as "gut instinct" and "intuition" capture the idea that subtle influences falling outside awareness can bias behavior. Claims that "People possess a powerful, sophisticated, adaptive unconscious that is crucial for survival in the world" (Wilson 2002, p. vii) and that we should think less rather than more about complex decisions (Dijksterhuis et al. 2006b) have a strong grip on both theoretical perspectives and the public imagination (e.g., Gigerenzer 2007; Gladwell 2005; Lehrer 2009). This article evaluates a wide range of research findings from the past 20 or so years that have contributed to the development of this perspective.

The unconscious has of course played a major role in the history of psychology, certainly predating Freud's comprehensive development of the concept. But in the past few years it has been the focus of extensive research in mainstream experimental psychology, including cognition, perception, and social behavior, as well as in cognitive neuroscience, behavioral

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economics, and other domains. Our focus is on the core process of decision making, which relates to all of these areas.

In this article we take decision making to refer to the mental processing that leads to the selection of one among several actions (choices). Construed this way, we exclude examples such as neurons or brain networks making "decisions," and we do not consider the visual system's computation of low-level properties to be decision making. We view consciousness as a property of individuals and hence do not believe it serves any useful purpose to ask whether area V5's computation of motion, for example, is or is not conscious. (It is, in contrast, perfectly reasonable to ask whether an individual's judgment of motion is conscious).[1]

The outline of the article is as follows: We begin by describing a framework for illustrating how unconscious processes could be causally effective in decision making (as defined above). We then articulate some of the requirements for an adequate test of awareness and discuss the legacy of Nisbett and Wilson's (1977) highly influential work. The body of the article reviews three major areas of research from the decision-making tradition in which unconscious factors have been studied: multiple-cue judgment, deliberation without attention, and decisions under uncertainty. A final section considers research from the priming literature, both subliminal priming and the so-called primes-to-behavior studies that are prevalent in social cognition (e.g., Bargh et al. 1996). Although few of these studies relate specifically to decision making, they are provocative illustrations of possible unconscious influences on behavior and thus warrant consideration in our review.

We do not, however, claim to offer a comprehensive literature review of all the research domains relevant to our guiding question. In particular, we give only very brief consideration (in sect. 6) to the literature investigating awareness of decisions about movements (e.g., Libet 1985), illusory conscious will (e.g., Wegner 2004), and neuroscience phenomena such as blindsight (e.g., Weiskrantz 1986). Restricting our focus of course leaves us open to the criticism that we are "looking in the wrong place" for the evidence. Our response would be twofold: First, pragmatic considerations make it impossible to consider all the evidence in a single article, but we contend that the areas we selected have been highly influential in bolstering claims for unconscious decision making. Second, the areas we focus on in the core of the review are those that are most readily identified as involving decisions in the sense defined above. In the motor-movement and neuroscience domains, the nature of the decision being made and the information relied upon to make that decision are, arguably, less well defined in the first place, thus making discussions of peoples' awareness of them that much more difficult. We expand on these issues further in section 6.

Our critical analysis points to a surprising conclusion, that there is little convincing evidence of unconscious influences on decision making in the areas we review, and that, as a consequence, such influences should not be assigned a prominent role in theories of decision making and related behaviors. This conclusion is consistent with the view that conscious thoughts are by far the primary driver of behavior (Baumeister et al. 2011) and that unconscious influences – if they exist at all – have limited and narrow effects.

1.1 A framework for the components of decision making

Our first step in examining the role of the unconscious in theories of decision making is to propose a framework for thinking about how decisions *could* be influenced by unconscious processes. The framework is based on the *lens model* (Brunswik 1952), popularized in the judgment and decision making field by Hammond, Stewart, and many others (for overviews, see Hammond & Stewart 2001; Karelaia & Hogarth 2008).

The basic premise of the lens model is that a decision maker views the world through a "lens of cues" that mediates between a stimulus in the environment and the internal perceptions of the decision maker, as shown in Figure 1. The double convex lens in the center of the diagram shows a constellation of cues that diverge from a criterion or event in the environment (left side of figure). The decision maker uses these cues to achieve (e.g., correctly estimate) the criterion, and so these cues are shown as converging (right side of figure) on a point of response or judgment in the mind of the decision maker. The lens model conceptualizes decision making as being guided by judgment (see note 1). An application of the lens model in the domain of medical diagnosis (e.g., Harries et al. 2000) would construe the physician as attempting to decide on the best treatment (the judgment) for a patient by determining the likelihood of a disease (the criterion) given the symptoms (cues) relied upon in making the judgment.

Figure 1 identifies five points (labeled A–E) at which an unconscious influence might be exerted on decisions. Point A captures the idea that an event or criterion in the environment that is not consciously perceived by the decision maker nonetheless influences behavior. An example might be lack of awareness of the feedback from making a correct or incorrect diagnosis. Point B is lack of awareness of contingencies or relations between consciously perceived cues and the criterion or outcome. The idea here is that there are properties of the stimulus environment (termed "ecological validities") that reliably predict a criterion, but that the individual might be unable to report or describe these relationships. For example, a doctor might be unaware that certain consciously perceived symptoms are predictive of an illness (e.g., Crandall & Getchell-Reiter 1993). A lack of awareness of the cues relied upon to make a judgment or decision is illustrated by Point C in the figure. For example, a diner might be unaware that the relative position of an option on a menu influenced his choice (Dayan & Bar-Hillel 2011); relative position in this scenario is simply not registered in consciousness. The difference between B and C is subtle: In one case (C) it is unawareness of a cue, whereas in the other (B) it is unawareness of the ecological or predictive validity of the cue. (Arguably, lack of awareness of a cue entails lack of awareness of its validity, hence cases of unawareness at C entail unawareness at B as well.)

Point D refers to a lack of awareness of one's utilization of cues. A doctor, for example, might appropriately base his or her diagnosis on features present in a mammogram, and might be aware of the features, but be unaware or mistaken about how he or she incorporates those features into his or her decision. The doctor might, for instance, be unaware of a complex non-linear rule he or she is tacitly employing to integrate information conveyed by the cues. Unawareness of cues (C) also entails unawareness of one's utilization (D) of those cues. Finally, Point E indicates lack of awareness of choosing or making a judgment. Consider a lawyer

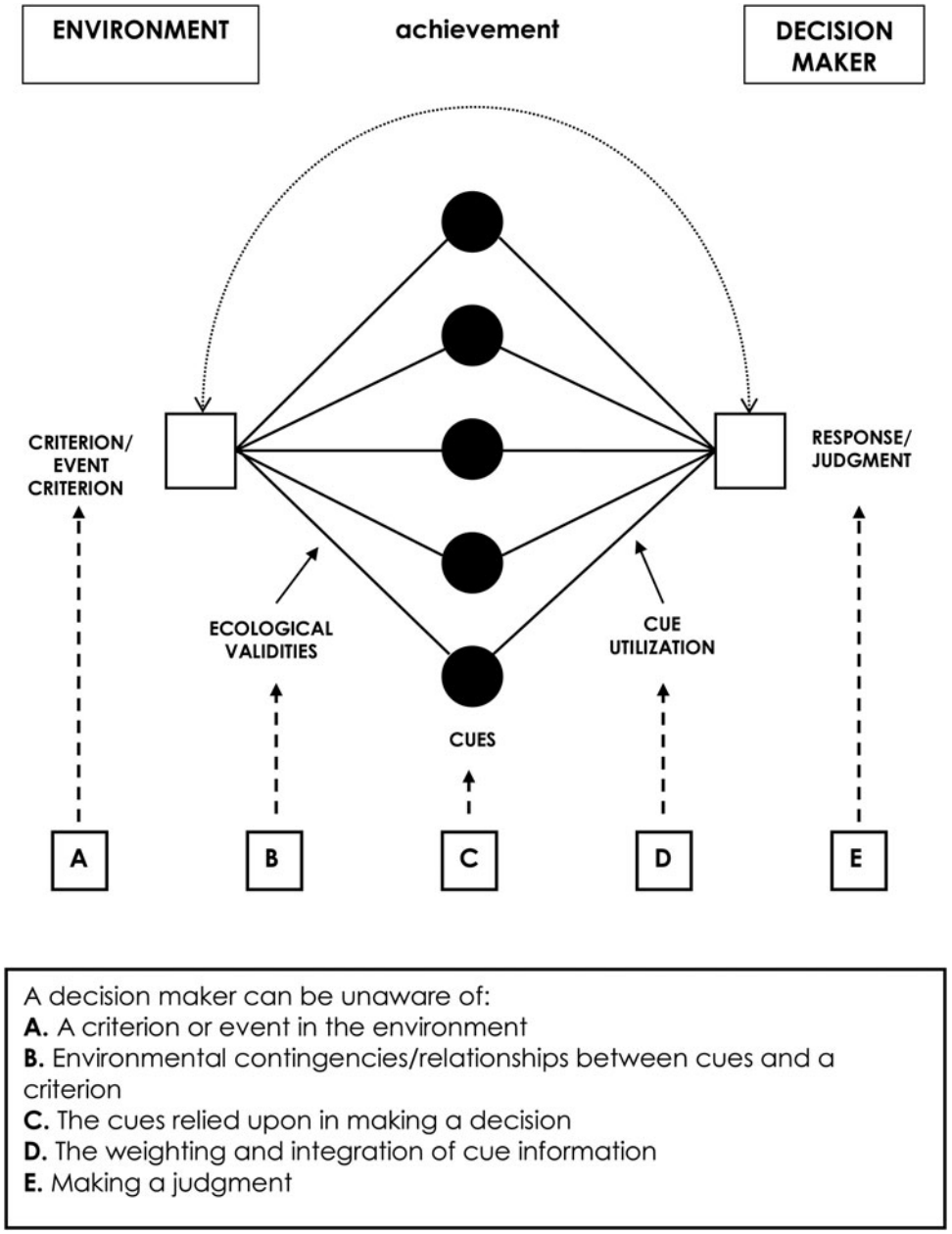

Figure 1. A lens model framework illustrating possible loci of unconscious influences on decision making.

who uses the right of peremptory challenge against a potential juror, based on an unconscious judgment or stereotyping of the juror as racially biased.

Our use of the lens model as a framework is illustrative, and there are other formal frameworks such as signal detection theory and sequential analysis (see Gold & Shadlen 2007) for conceptualizing the elements of decision making.[2] Nonetheless, it affords some structure for evaluating the major areas of our review. Before turning to these areas, however, in the next section we outline a set of criteria that further help to evaluate possible unconscious influences on decision making.

1.2 Criteria for the assessment of awareness

Research on the role of awareness in decision making typically (but not invariably) seeks to contrast two types of measurement, one being some behavioral index of performance and the other being an awareness assessment based on the individual's report, verbal or otherwise. An unconscious influence on decision making is inferred if performance is affected by some cue or factor that is not reflected in awareness. Underlying theoretical constructs are not the same as the measurements that we take of them, and this is as true of awareness as it is of any other psychological construct. It is therefore essential to recognize that an assessment of awareness will only be informative if it is relatively free from bias and error.

The criteria that need to be met by adequate awareness measures have been the subject of extensive previous discussion (e.g., Dawson & Reardon 1973; Ericsson & Simon 1980; Lovibond & Shanks 2002; Shanks & St. John 1994). In brief, the more reliable, relevant, immediate, and sensitive an awareness assessment is, the less

Table 1. *Criteria for adequate assessments of awareness*

Criterion	Explanation
Reliability	Assessments should be unaffected by factors that do not influence the behavioral measure (e.g., experimental demands, social desirability).
Relevance	Assessments should target only information relevant to the behavior.
Immediacy	Assessments should be made concurrently (so long as they do not influence the behavior) or as soon after the behavior as possible to avoid forgetting and interference.
Sensitivity	Assessment should be made under optimal retrieval conditions (e.g., same cues are provided for measuring awareness as for eliciting behavior).

likely it is to be distorted by bias or error. Table 1 provides brief explanations of these criteria. As we shall see, many of these criteria are not met by studies claiming to show unconscious influences on behavior.

The relevance criterion (called the "information" criterion by Shanks & St. John [1994]) merits further consideration. Although it may seem obvious that, in order to be suitable, an awareness assessment must target information that is relevant to the decision, experimental tasks often prompt violations of the criterion. A case in point arises in situations in which the researcher embeds a rule in the experimental materials and asks whether unconscious acquisition of this rule can influence behavior (see Fig. 1, Point B). Examples include artificial grammar learning (in which participants study strings of items that are constrained to follow certain transition rules, e.g., Pothos 2007) and invariant learning (in which structural relations govern the permissible stimuli). Much of the implicit learning literature is predicated on the idea that participants can often respond on the basis of such rules without being able to describe them. It is very tempting for researchers to assume that participants' task performance must be based on an abstraction of the underlying rule governing the structure of the stimuli (e.g., Marcus et al. 1999). Yet numerous studies (e.g., Brooks & Vokey 1991; Johnstone & Shanks 2001; Newell & Bright 2002) have documented how performance in these tasks can often be more appropriately explained via learning of entire stimulus configurations together with similarity-based decision making, or in terms of learning micro-rules. In such cases, the fact that participants may be unable to report the rule does not mean that it is unconsciously influencing behavior: To claim otherwise is to violate the relevance criterion.

A further issue in regard to the relevance criterion concerns the influence of distal versus proximal cues on decision making.[3] The key issue is to what extent people are unaware of the information that is triggering their decision at the point of choice (proximal cues), as compared to information in the past (distal cues) that might have caused the current information (thoughts) to be present at the point of choice. Consider a situation in which some distal cue (your mother advised you as a child that spinach is a good source of iron) caused a proximal cue (your current belief that spinach is healthy), which in turn influences a current decision (to select spinach off the menu). Even though you might be unaware of the distal influence on either your current belief or your decision, you might be perfectly able to justify your decision in terms of your proximal belief. Under such circumstances it is plainly inappropriate to claim that the decision is influenced by an unconscious factor.

There are, in summary, a number of important criteria that must be met in the design of an adequate awareness assessment (see Table 1). Although these requirements are extensive, it is important to note that the criteria are not unrealistic or unattainable. Some of the studies described at length below took considerable pains to deal with these issues of awareness measurement, by measuring awareness concurrently with performance (e.g., Lagnado et al. 2006) or via multiple convergent questions (Maia & McClelland 2004) or by employing nonverbal performance measures assumed to index awareness (e.g., wagering: Persaud et al. 2007), using questions that are reliable, relevant, and sensitive. We do not believe that these criteria set the bar too high for assessing whether an influence is unconscious. The criteria do not force researchers to employ qualitatively different forms of assessment, merely to use standard ones in a more careful way with due recognition to the fine details of the experimental task and its demands.

1.3 The legacy of Nisbett and Wilson

To a considerable extent, the willingness of contemporary experimental psychologists to embrace the possibility of unconscious influences on behavior can be traced to the highly influential work of Nisbett and Wilson (1977). Nisbett and Wilson launched a powerful series of arguments that people typically lack insight into their own mental processes. Key among their claims were (a) that people often misreport causal influences on their behavior, falsely reporting factors that did not in fact influence their performance and failing to acknowledge factors that truly were causal, and (b) that people are rarely any more accurate in explaining their own behavior than outside observers are, prompting the famous conclusion that "if the reports of subjects do not differ from the reports of observers, then it is unnecessary to assume that the former are drawing on 'a fount of privileged knowledge'" (Nisbett & Wilson 1977, p. 248). When people do give veridical reports, it is because they make use of a priori implicit theories about causal relationships between stimuli and responses, rather than because they have privileged conscious access to their own mental processes.

We will not extensively review the evidence that has accumulated on these issues since Nisbett and Wilson's (1977) article was published (for relevant discussions, see Adair & Spinner 1981; Ericsson & Simon 1980; Smith & Miller 1978; White 1980; 1988). However, we will mention two significant challenges to Nisbett and Wilson's (1977) viewpoint. First, a number of their

demonstrations under (a) above fail to meet our criteria regarding adequate assessments of awareness (see Table 1). Consider an experiment in which participants chose between (and justified their choice from) four consumer products that were in reality identical. Nisbett and Wilson (1977; more details of the original experiments are given in Wilson & Nisbett 1978) found that participants tended to select the right-most of four alternatives (e.g., pairs of stockings) but did not mention position when justifying their choice, or flatly denied being influenced by position when asked directly (this would be an example of unawareness located at Point C in the lens model of Fig. 1). Instead, participants mentioned attributes such as the quality of the stockings. The problem with this finding is that asking participants about position fails the relevance criterion, as position is almost certainly not a proximal cause of choice (this argument was originally made by Smith & Miller 1978). It is at best a distal cause whose influence is mediated via the participant's true decision rule.

In such sequential choice situations, people tend to study the options one at a time, usually (but depending on culture) from left to right (Wilson & Nisbett [1978] confirmed that this was the case in the experiment). Suppose that the decision rule is that *if the current item is no worse in terms of quality than the previous item, then prefer the current item*. After the initial item, each subsequent one is mentally compared with its predecessor (Li & Epley 2009; Mantonakis et al. 2009), and because the items are identical, the resulting final choice is the right-most pair of stockings. Even though the rule may lead (wrongly) to the belief that one item is superior to the others, the choice is in no sense determined by spatial position. Spatial position only has an influence insofar as it affects how the items are sequentially sampled. Indeed, under such circumstances it is perfectly correct for participants to report quality as the basis of their decision, as their decision rule incorporates judgments of quality, and to deny being influenced by position. To establish that the choice is being driven by unconscious influences, it would be necessary to show that participants deny employing a sequential comparison process, but this is not what Nisbett and Wilson (1977) asked their participants. Claiming that their participants were unconsciously influenced by position is like claiming that an individual who chooses the apartment she saw on Thursday, after seeing others on Monday, Tuesday, and Wednesday, is unconsciously influenced in her choice by the day of the week.[4]

The second way in which subsequent research challenges Nisbett and Wilson's (1977) position is equally damaging. It appears far too strong to claim that individuals' responses can be predicted just as well by observers, who have access to nothing more than the public features of the stimuli and context, as they can be by the individuals' own verbal reports on their mental processes. Apart from raising a number of serious methodological problems with Nisbett and Wilson's original studies (e.g., Guerin & Innes 1981; Smith & Miller 1978; White 1980), later research has clearly shown predictive advantages for actors over observers (Gavanski & Hoffman 1987; White 1989; Wright & Rip 1981). It is apparent that in many of the sorts of situations cited by Nisbett and Wilson, we do in fact have introspective access to our conscious mental states, and the verbal reporting of these states conveys privileged information about the causes of our behavior.

Having provided a framework for thinking about how unconscious processes might influence decisions, and having articulated some of the requirements for an adequate test of awareness, we now turn to three major areas in which unconscious factors have played a prominent role.

2. Unconscious influences in multiple-cue judgment

Research into multiple-cue judgment focuses on situations in which people attempt to predict an environmental criterion on the basis of imperfect probabilistic indicators – just as a doctor might try to diagnose a disease on the basis of symptoms, medical history, and results of diagnostic tests. A long-standing question in this field is the extent to which such judgments are based on explicitly available knowledge. This question is of psychological importance because if "experts lack self-insight into the processes underlying these judgments, they may be unconsciously biased" (Evans et al. 2003, p. 608). This section investigates this claim first by reviewing evidence relating to the development of self-insight in novices learning experimental multicue judgment tasks, and second by examining the literature on the self-insight of experts performing real-world multiple-cue judgments.

Following the pioneering work of Hammond and colleagues (see Hammond & Stewart 2001), many studies in this area have employed the lens model framework of Figure 1 to examine judgment. In a standard study participants make judgments about a series of "cases" (e.g., patients) for which information is available from a set of cues. Multiple linear regressions are then performed from the judgments to the cues to measure the "policies" that judges adopt. The beta weights obtained from these regressions give an indication of the cues that influenced the judge, as well as the relative extent of this influence. These beta weights are described as the implicit or tacit policy underlying judgment (indicated on Fig. 1, Point D, as cue utilizations).

To examine the extent of insight into judgments, these implicit policies are then compared with self-assessments of the importance of cues for determining judgments. Importance can be assessed in a variety of ways, such as asking judges to divide 100 points between the cues, with higher numbers indicating greater reliance on a cue. The strength of the correlation between these ratings of importance and the beta weights derived from multiple regression is taken as indicating the extent of insight. A widely accepted consensus from this research is that there is often a lack of correlation between the two measures of the usage of cues, reflecting judges' poor insight (Arkes 1981; Evans et al. 2003; Slovic & Lichtenstein 1971).

2.1 Examining insight in novice judges

According to some researchers, the reason for this poor insight is that judges learn how to make their judgments in an implicit manner (e.g., Evans et al. 2003), and these

processes are thus inaccessible to introspection. Testing such an account in established experts is of course difficult because the relevant learning has already been accomplished. Thus researchers have studied the acquisition of judgment policies in laboratory analogues of typical real-world judgment tasks.

An illustrative study is that of Evans et al. (2003) who asked participants to predict the suitability of fictional job candidates for an unspecified job on the basis of "ability tests." The complexity of the task was manipulated by varying the ratio of relevant and irrelevant ability tests. Relevant tests contributed a constant value (+1 or −1) to the linear model that determined feedback; irrelevant tests contributed zero. Participants learned over a period of 80 to 100 trials with corrective feedback and were then given 40 test trials in which no feedback was provided. At the end of the test, participants rated each test on a scale from 1 (*less relevant*) to 7 (*more relevant*).

Evans et al. (2003) assessed "implicit" knowledge by measuring participants' revealed beta weights from test judgments and "explicit" knowledge by calculating a difference score between ratings given to relevant and irrelevant cues. In their second experiment, Evans et al. claimed to find a dissociation between these two measures of knowledge. Cue polarity (positive/negative) and absolute cue number (4 or 6) had large effects on the self-insight and performance scores (correlations between the criterion and prediction – labeled "achievement" in Fig. 1) but no effect on the explicit knowledge scores. Moreover, the difference between ratings for relevant and irrelevant predictors only differed from zero for one of three prediction tasks. This pattern of results led Evans et al. to conclude: "we have compelling evidence that performance … was largely mediated by implicit learning" (p. 615).

There are, however, reasons to question such a strong conclusion. Participants were faced with different job tasks in each experimental session, each one involving a different relevant/irrelevant cue ratio and different numbers of positive and negative predictors. Self-ratings of cue relevance were made at the end of each task, thereby failing the *immediacy* criterion for assessment (see Table 1). The *sensitivity* of the measures can also be questioned: There were 40 intervening test trials *without* feedback before ratings were made, and there were three different tasks per session, all with common labels for cues (A–F). Both of these factors could have increased the chance for cross-task confusion, making the low levels of explicit knowledge rather unsurprising.

In a recent study Rolison et al. (2011) used similar methods to investigate the role of working memory capacity (WMC) in multicue judgment. They found that WMC correlated with performance when tasks involved negative predictors, but not when all relevant cues were positive predictors. Rolison et al. interpreted this pattern as evidence for reliance on deliberative processes in tasks with negative cues, and on implicit processes in tasks with exclusively positive cues. However, their data also showed the same associations and lack of associations between WMC and explicit knowledge of the underlying task structure. Thus a plausible alternative explanation is that performance was mediated by explicit knowledge in all tasks, but that the latter sometimes is and sometimes is not related to WMC.

Taken together, these illustrative experiments provide little evidence that unconscious processes influence multicue judgment. The dominant pattern across the experiments in both the Evans et al. (2003) and Rolison et al. (2011) studies was of significant positive correlations between measures of performance and explicit knowledge of cue relevance/usage. In those instances where such correlations were absent, procedural artifacts (e.g., timing of awareness assessment) may have been responsible.

In recognition of the problems of retrospective interrogation of explicit knowledge, Lagnado et al. (2006) used an approach in which participants learning a multiple-cue judgment task were probed throughout training trials for the explicit basis of each prediction. On each trial participants were asked to rate how much they had relied on each cue in making their prediction. The "explicit" cue ratings were then compared with the "implicit" weights derived from running "rolling" regressions (a series of regressions from predictions to cues across a moving window of consecutive trials; cf. Kelley & Friedman 2002).

The take-home message from the analysis of these data was that participants clearly distinguished between strong and weak predictors on *both* the implicit and explicit measures of cue reliance. This ability occurred fairly early in the task and was maintained or increased across training. Lagnado et al. (2006) also reported strong positive correlations between individuals' cue reliance ratings and implicit regression weights. The overall pattern strongly suggested that people had access to the internal states underlying their behavior and that this access drove both online predictions and explicit reliance ratings. Note that it is unlikely that the requirement to make online ratings altered participants' judgment strategies, as an additional experiment demonstrated that overall accuracy in the task was unaffected by the inclusion of the online ratings. In a recent study, Speekenbrink and Shanks (2010) extended this approach by using a "dynamic lens model" to assess participants' insight in an environment in which cue validities changed across the course of an experiment. Consistent with Lagnado et al. (2006), Speekenbrink and Shanks found little evidence for the contribution of implicit processes: Participants learned to adapt to changes in the environment, and their reports of *how* they changed their reliance on cues reflected their *actual* reliance on those cues as evidenced by their predictions.

2.2 Assessing expert knowledge

Much of the work examining expert judgment has focused on the necessary antecedent conditions for the development of "intuitive" expertise (e.g., Hogarth 2001; Kahneman & Klein 2009; Shanteau 1992) and the relative accuracy of expert and statistical judgment (Dawes et al. 1989; Meehl 1954; Vrieze & Grove 2009). Our focus here is somewhat different; we are interested in the rather smaller literature that has examined the extent and nature of experts' self-insight into the cues they use in real-world judgment tasks.

Slovic and Lichtenstein (1971) were early to note that there were "serious discrepancies" (p. 49) between the explicit weights provided post hoc by judges and the implicit weights they placed on cues as evidenced by regression modeling. One source of this discrepancy was judges' tendency to overestimate the importance placed on minor cues and to underestimate their reliance on major cues. For example, Slovic et al. (1972) reported a

correlation of only 0.34 between the implicit and explicit weights of 13 professional stockbrokers performing a stock selection task. The low correlation was attributed to the variance of explicit weights across the individuals: Each of the eight predictor variables was rated as most important by at least one judge, and some variables were rated subjectively more important than the regression analysis warranted.

The "serious discrepancies" identified by Slovic et al. (1972) and many others (e.g., Balzer et al. 1983; Phelps & Shanteau 1978) seem problematic for the view that we have access to the information influencing our behavior. These results would seem to suggest that there are indeed unconscious influences on the process of weighting and integrating cue information (see Fig. 1, Point D). However, the strength with which such conclusions can be drawn depends crucially on the methods used to elicit the importance ratings. It is quite possible that judges have good insight, but that experimenters have not provided them with sufficient opportunities to report the knowledge that they possess. It is also possible that judges confuse questions about the "importance" of cues for the task environment (i.e., ecological validities; see Fig. 1, Point B) with their "importance" for their own judgment process (i.e., cue utilizations; see Fig. 1, Point D) (cf. Lagnado et al. 2006; Speekenbrink & Shanks 2010; Surber 1985). As we shall see, there is considerable justification for these concerns.

2.3 Insight through policy recognition

In an influential brace of articles, Reilly and Doherty (1989; 1992) examined an alternative way of assessing insight and drew significantly more optimistic conclusions about experts' knowledge of their judgment policies. Their novel procedure used a policy selection or "recognition" test that involved identifying one's own policy (described by normalized cue utilization indices) from an array of possible policies. In both articles, across a variety of hypothetical judgment tasks, this policy recognition method of assessing insight revealed much higher levels of self-insight into implicit and explicit policy profiles than indicated in previous research.

Harries et al. (2000) extended the policy recognition approach by assessing self-insight in medical general practitioners. The doctors had taken part in a policy-capturing study 10 months prior to the insight assessment. They had been asked to make prescription decisions (e.g., whether to prescribe lipid-lowering drugs) for 130 hypothetical patients, each described by 13 cues (e.g., hypertension, cholesterol level, age), and to rate the importance of each cue for their judgments. In the follow-up, the doctors were presented with two arrays each containing 12 bar charts. The first array displayed implicit policy profiles (regression weights), and the second explicit profiles (importance ratings) both on standard bar charts. The 12 charts included the participant's own policy and 11 others randomly selected from the total pool of 32 participants. Their task was to rank the three policies in each set that they thought were closest to their own.

Consistent with Reilly and Doherty (1989; 1992), the doctors were significantly above chance at picking both types of policies. The average hit rate (having one's own policy in the three selected) was 0.48 for implicit and 0.50 for explicit policy recognition. This level of performance is clearly far from perfect but it is considerably better than the 0.25 hit rate expected by chance. This replication is important because it not only demonstrates self-insight in genuine domain experts (instead of undergraduate students), but also rules out one possible explanation for Reilly and Doherty's findings. In their study some participants mentioned selecting explicit policies on the basis of explicit memory for the particular numbers of points they had distributed to individual cues (e.g., "I know I used 2.5 for one attribute"). Such memory for specifics, rather than insight into the actual policy, is less likely to have been a contributing factor in the Harries et al. (2000) study, given that policy recognition was conducted 10 months after the judgment task and importance ratings were represented as bar charts. Note that although the test used in these studies does not meet the immediacy criterion for awareness assessment (see Table 1), the use of recognition rather than free recall makes it a more *sensitive* and arguably *relevant* test of insight.

The recognition measures used in the Reilly and Doherty studies revealed an "astonishing degree of insight" (Reilly & Doherty 1989, p. 125), but the standard measures (e.g., correlations between implicit and explicit policy weights) showed the same poor to moderate levels as seen in many previous experiments. Furthermore, in both studies predictions on hold-out samples of judgments (i.e., cross-validation) demonstrated that models using implicit weights were superior to those using explicit weights in almost 100% of cases. Thus there appears to be "something else" captured in the implicit policies that participants are unable to communicate in their explicit policies.

However, the lower predictive accuracy of explicit weights and the tendency for people to state that they have relied on more cues than are apparent from their judgments (e.g., Slovic et al. 1972) might also be partially artifactual. Harries et al. (2000) pointed out that explicit weight estimates are based on a sample size of one – that is, they are made once, at the end of a series of (often) hundreds of judgments. As such they fail the *immediacy*, *sensitivity*, and *reliability* criteria for awareness outlined in Table 1. In contrast, the implicit weights are calculated from *all* trials and are thus more likely to capture patterns of cue use. Thus the low correlation between the two types may be due to the weakness of the cue importance measure.

The mismatch between stated and actual cue use could also be attributable to another aspect of typical experimental designs: the use of orthogonal cue sets (cf., Harries et al. 2000; Reilly & Doherty 1992). Policy-capturing studies aim to discover reliance on *particular* cues; this is very difficult to do if a stimulus set contains highly intercorrelated cues, and so experimenters take pains to develop orthogonal cue sets. However, this can lead to problems if a judge uses cues inconsistently across cases.

Harries et al. (2000) cited the example of a doctor using *overweight* or *blood pressure* interchangeably in making a decision about hypertension (because the two cues are highly correlated in reality). If the doctor was then presented with hypothetical cases in which these cues were orthogonal, he or she might still switch between them in his or her judgments but rate them both highly important at the end of the task. The regression analysis would then

reveal equal but only moderate reliance on the cues, which would mismatch with the high importance ratings. In support of this possibility, Reilly and Doherty (1992) reported higher correlations between explicit and implicit weights in the representative conditions of their experiments (in which existing cue intercorrelations were maintained) than in their orthogonal conditions (in which they were reduced/eliminated; see Dhami et al. [2004] for further discussion of the important impact of representative designs and Beckstead [2007] for an illuminating treatment of the statistical methods for assessing policy recognition tests).

2.4 Summary and conclusions

The multiple-cue judgment literature presents a rich source of information about the potential role of unconscious influences. Although the received wisdom in studies of both novice and expert judges suggests poor insight into the factors underlying judgment, a close analysis of the data reveals a somewhat more optimistic picture. Our critique also highlights the importance of distinguishing genuine self-insight (or lack thereof) from artifacts that are inherent in the methods used to assess judgment.

One possible solution to this problem is to adopt a *verbal policy-capturing* method in which structured interviews are used to elicit explicit policies. Ikomi and Guion (2000) used such a technique with flight instructors and found that their "declared" policies were more accurate in predicting judgments than implicit weights for 12 of their 19 participants. An alternative approach is to reconsider the model underlying judgment. Policy-capturing studies are wedded to the idea that judgments involve the weighting and adding of individual cues (i.e., a linear additive model), but people might be using similarity to previously encountered instances (Brooks et al. 1991), or applying sequential heuristics (Gigerenzer 2007) in making their judgments. These judgments might well be consciously mediated but would appear unconscious if participants were asked to explain what they were doing in terms of attribute weights, yielding inadvertent failure to meet the relevance criterion.

More research using various ways of assessing explicit knowledge is required before strong conclusions can be drawn, but at the very least we can say that many studies have revealed reliable access by participants into the thoughts underlying their judgments.

3. Deliberation without attention: Does "not thinking" release the powers of the unconscious?

Dijksterhuis et al. (2006b) made the bold claim that when faced with complex decisions (what car to buy, where to live), we are better advised to stop thinking and let our unconscious decide. Dijksterhuis et al. argued that explicit consideration of options and attributes overwhelms our capacity-limited conscious thought. In contrast, the unconscious is capacity-*unlimited* and can therefore weight information appropriately and decide optimally (Dijksterhuis & Nordgren 2006). In terms of our framework, as with the studies reviewed in section 2, unconscious processes are purported to exert influence at Point D in Fig. 1 – the weighting and integration of information to determine cue utilizations. Such advice flies in the face of standard prescriptions for decision making (e.g., Edwards & Fasolo 2001; Newell et al. 2007b) and also runs counter to research that has strongly challenged the related notion of "incubation" in creative thinking (Weisberg 2006), and so the evidence on which such claims are based deserves intense scrutiny.

In the standard experimental paradigm, participants are presented with information about three or four objects (e.g., cars) described by 10 or more attributes (e.g., mileage) and are asked to choose the best object. In most experiments *best* is determined normatively by the experimenter assigning different numbers of positive and negative attributes to each option. Attribute information is presented sequentially and typically in random order about the four options. Following presentation of the attributes, participants are assigned to one of three (or sometimes only two) conditions. In the unconscious thought condition, participants are prevented from making a decision for a few minutes by engaging in some distracting activity (e.g., solving anagrams). This distraction period is claimed to facilitate unconscious thought – "cognitive and/or affective task-relevant processes [which] take place outside of conscious awareness" (Dijksterhuis 2004, p. 586). In the conscious thought condition participants are asked to think carefully about their choice for a few minutes, while in the immediate condition participants are simply asked to make their decision as soon as the presentation phase has finished.

The final choices made by participants in these three conditions reveal (sometimes) that distraction leads to better choices and/or better differentiation between good and bad options than either conscious thought or an immediate decision. For example, Dijksterhuis et al. (2006b) reported that 60% of participants chose the best car after being distracted compared to only 25% following conscious deliberation. The literature on unconscious thought is now burgeoning; we focus on two key issues: the reliability of the effect and alternative explanations that do not necessitate the involvement of unconscious processes.

3.1 Reliability of the unconscious-thought effect

Demonstration of the benefit of unconscious thought on choice requires two criteria to be satisfied. First, choices following distraction need to be significantly better than those following deliberation, and, second, they need to be better than those following an immediate decision. In view of the amount that has been written about the merits of unconscious thought, it is surprising how rarely these criteria have been satisfied in one experiment. Both criteria are important. Demonstrating that distraction leads to better choices than deliberation could either mean that distraction is beneficial or that deliberation is detrimental. The latter conclusion is less surprising, especially if the conditions for deliberation are suboptimal (cf. Mamede et al. 2010; Newell et al. 2009; Payne et al. 2008; Shanks 2006; Wilson & Schooler 1991). The second criterion is thus a crucial prerequisite for drawing any conclusions about the added benefit of unconscious thought.

In the first published work on unconscious thought, Dijksterhuis (2004) reported three experiments that compared attitude ratings and/or choices following distraction,

deliberation, and immediate processing. None of these experiments satisfied the two criteria outlined above. Moreover there were troubling (and unexplained) patterns in the data. For example, in Experiments 1 and 3 significant differences between some conditions were only found for males who constituted the clear minority in the sample. Thus even in this foundational study the evidence for unconscious influences was rather flimsy. It appears that when it comes to the role of unconscious processes, once an (intuitive) idea has taken hold, a momentum appears to build that is belied by the strength of the existing data. But despite this rocky start, it is now clear that there are several demonstrations of the effect – both in terms of improvements relative to conscious thought and immediate thought (see Strick et al. 2011, for a meta-analysis), although experiments in which all three conditions are tested and significant differences are found between each are still the exception rather than the rule (e.g., Dijksterhuis et al. [2009] and Lerouge [2009] – but see González-Vallejo & Phillips [2010] for a re-evaluation of the former).

These positive findings are, however, tempered by several studies that have compared all three thought conditions in a single experiment and failed to demonstrate any advantage of unconscious thought over conscious and/or immediate decisions (Acker 2008; Calvillo & Penaloza 2009; Huizenga et al. 2012; Mamede et al. 2010; Newell et al. 2009; Payne et al. 2008; Rey et al. 2009; Thorsteinson & Withrow 2009; Waroquier et al. 2010). The reliability of the effect is also questioned by an earlier meta-analysis of the unconscious-thought literature. Acker (2008) found that across 17 data sets there was "little evidence" (p. 292) for an advantage of unconscious thought. He also found that the largest unconscious thought effects were in the studies with the smallest sample sizes. Note that this is exactly the pattern predicted if one adopts exploratory rather than confirmatory research practices (Simmons et al. 2011; Wagenmakers et al. 2011) and is also consistent with a publication bias operating (i.e., preferential publication of statistically significant effects – Renkewitz et al. 2011).[5] In line with these conclusions, Newell and Rakow (2011) presented a Bayesian analysis of 16 unconscious-thought experiments from their laboratories (including both published and unpublished studies) and found overwhelming evidence in support of the null hypothesis of no difference between conscious and unconscious thought.

A charitable interpretation is that it is too early to draw strong conclusions about the robustness of the effect (cf. Hogarth 2010). Vagaries of procedures, experimental instructions, differences in population samples, and differences in stimulus materials are all likely to contribute noise and hamper interpretation. But what about those cases where an effect is found? Do such results necessitate the involvement of an intelligent unconscious?

3.2 Explanations of the deliberation-without-attention effect

Proponents of the unconscious-thought theory (UTT) argue that deliberation without attention works because of the increased capacity and superior information-weighting ability of unconscious relative to conscious thought (Dijksterhuis & Nordgren 2006). However, substantiating these claims has proved somewhat problematic on both theoretical and empirical grounds (for a wide-ranging critique of the "capacity principle" of UTT, see, e.g., González-Vallejo et al. 2008). With regard to superior weighting of information, the experimental evidence is equivocal at best. In the standard paradigm described above, participants' own subjective attribute weightings are ignored because the importance of attributes is predefined by the experimenter (e.g., Nordgren et al. 2011). Often this is done in an implausible manner. For example, in Dijksterhuis et al.'s (2006b) study the number of cup holders in a car was deemed as important as the fuel economy (obviously cup holders are far more important): Both were given the same single-unit weight in the calculation of the best and worst cars. With these experimenter-defined weighting schemes, it is impossible to know whether the best choice is indeed the one favored by all participants.

Newell et al. (2009) examined this issue by asking participants, after choices had been made, for importance ratings for each attribute (e.g., How important are cup holders?). In so doing, Newell et al. were able to determine, retrospectively, the best option for each participant and then see how often participants chose the option predicted by their idiosyncratic weights. The results were clear: Regardless of the condition (conscious, unconscious, or immediate), the majority of participants chose the option predicted by their own idiosyncratic weights. In a similar vein, Dijksterhuis (2004) reported that conscious and unconscious thinkers did not differ significantly in terms of the correlations between their idiosyncratic attribute weightings and attitudes toward options.

This last finding was echoed in a recent study by Bos et al. (2011), who demonstrated that participants in both an immediate and an unconscious-thought condition were able to differentiate between cars that had a high number of "important" positive attributes (*quality* cars) from those that had several "unimportant" positive attributes (*frequency* cars) (a conscious thought condition was not included). While unconscious thinkers were significantly better at this differentiation (their difference scores were larger), there was no significant difference in the extent to which participants obeyed their own weighting schemes. Moreover, because a conscious thought comparison group was not run, we do not know if it was the operation of some active unconscious process that improved weighting or simply the additional time between presentation of the alternatives and the elicitation of the decision.

A study by Usher et al. (2011) sheds further light on the weighting issue. They asked participants to rate the set of attributes from which the objects were composed *before* the decision task. A unique set of objects was then created, via computer software, to ensure that one object was the best for each individual participant, one the worst, and two others in-between. The standard decision task was then conducted with conscious- and unconscious-thought groups (no immediate group was included). Almost 70% of the distracted participants chose the best option, while fewer than 30% of those asked to think carefully did so. This is a compelling result suggesting more optimal weighting in unconscious than conscious thought, but without the immediate group for comparison, the Usher et al. results (on their own) do not satisfy our earlier criteria: The added value of unconscious processing, relative to an immediate judgment, cannot be assessed.

Several authors have asked whether the deliberation-without-attention effect is due to *disadvantages* conferred on conscious thought via particular experimental procedures rather than any hypothesized *advantages* of unconscious thought. For example, Payne et al. (2008) examined whether conscious thinkers did poorly in the standard experimental task because they were forced to think about the problem for too long. Such persistence could, according to Payne et al., lead to a shift in attention toward less relevant information (cf., Rey et al. 2009; Wilson & Schooler 1991). To test this idea, Payne et al. compared participants in the standard conscious- and unconscious-thought conditions with a "self-paced" conscious thought condition in which participants were told they would have as much time as they liked to deliberate and decide." The results were clear-cut: Participants in the unconscious and self-paced conditions outperformed those in the conscious condition but did not differ from each other. Payne et al. interpreted this combination of findings as evidence for poor performance of inappropriately constrained conscious thought rather than for superiority of unconscious thought.

A second re-interpretation of the unconscious-thought effect focuses on the possibility that participants make their decisions *before* entering the deliberation or distraction periods. The notion is that because attribute information is presented serially (and often randomly) about each option, participants engage in *on-line* processing, updating their impression of each option as subsequent pieces of information are presented (e.g., Lassiter et al. 2009; Newell et al. 2009; cf. Hastie & Park 1986). In the distraction condition, where post-information-acquisition processing is prevented (or discouraged), participants default to these on-line impressions when asked to make their final decision. In contrast, those given the opportunity to deliberate attempt to integrate the large amount of attribute information into a single "memory-based judgment" (Hastie & Park 1986; Lassiter et al. 2009). The result is that the retrieved on-line judgments (or first impressions) are sometimes superior because conscious thinkers are hampered by fragmentary and poorly organized memory for the attributes (cf. Shanks 2006). Even authors who have challenged this interpretation (e.g., Strick et al. 2010) reported that 60% of their participants made decisions on-line. If this proportion is representative, then it provides a serious challenge to many previous studies that have argued that participants deliberate (either consciously or unconsciously) after information has been presented (for similar arguments, see also Newell & Rakow 2011).

Usher et al. (2011) attempted to counter these problems by using a novel procedure in which multiple periods of distraction/deliberation were interpolated between the presentations of attribute information. They argued that this interpolation reduced the likelihood of participants deciding before being exposed to the thought manipulation. Under these conditions a small advantage for unconscious thought was still found. This result is particularly striking because the conditions for deliberative thinking were more suitable – there was less chance that attribute information could have been forgotten, and there were fewer pieces of information to think about at each "thinking interval." Why filling these intervals with distraction (anagram solving) led to improvements in judgment remains a challenge to both the made-the-decision-before and the poor-conditions-for-deliberation alternative interpretations. However, even Usher et al. did not take this result as unequivocal evidence for active unconscious processes (p. 10).

3.3 Summary and conclusions

The notion that "sleeping on it," in the sense of allowing a passage of time to elapse during which one is distracted, improves our decisions is enduring, appealing, and in line with anecdotal experience. Dijksterhuis and colleagues have struck a chord in the research community (and the public imagination) with an experimental paradigm that appears, to some extent, to provide empirical evidence for the soundness of the deliberation-without-attention recommendation. What is very clear, however, from our review is that the robustness and explanation of the deliberation-without-attention effect is far from settled (cf. Hogarth 2010). Given this state of affairs, suggestions to rely on the unconscious in applied domains such as legal reasoning (Ham et al. 2009) seem extremely premature.

One noteworthy feature of the vast majority of unconscious-thought research on decision making is that it has been done with students making inconsequential, hypothetical choices about situations that they may not have much experience with – for example, buying cars. Indeed, one of the few studies that examined the influence of distraction and deliberation in experts drew rather sobering conclusions for proponents of UTT. Mamede et al. (2010) showed that expert doctors given a structured diagnosis-elicitation-tool during the deliberation period produced more accurate diagnoses in complex cases than when they were distracted or made an immediate diagnosis. In fact, conscious deliberation gave rise to a 50% gain in diagnostic accuracy over an immediate diagnosis. This result illustrates that experts given appropriate conditions for deliberation can access relevant knowledge and improve their reasoning. Interestingly, in the same study *novice* doctors made poorer diagnoses in complex cases following deliberation compared to an immediate judgment (the accuracy of deliberative and distracted diagnoses did not differ) – suggesting that the period of structured deliberation is only useful if particular key facts are already part of one's knowledge base (Mamede et al. 2010).

In summary, although the deliberation-without-attention effect has spurred welcome debate, ultimately, even if the effect can be reliably obtained, its existence falls well short of providing unequivocal evidence for the involvement of active unconscious processes in the construction of cue utilizations (Fig. 1, Point D).

4. Awareness in decisions under uncertainty

In decisions under uncertainty, the payoffs from the choice alternatives are unknown. Repeated sampling can allow these payoffs to be learned. Decision strategies then translate the learned payoffs into sequences of choices.

4.1 The Iowa Gambling Task

Consider the choice between decks of cards where each card turned from each deck yields some reward or

penalty, but nothing is known at the outset about the distribution of these outcomes. Someone playing this game has the opportunity to learn that the long-run payoffs of the decks differ and hence can adapt their sampling of the decks to reflect the payoffs. This essential structure describes the Iowa Gambling Task (IGT), devised by Bechara et al. (1994). In the years since it was first described and studied, a vast literature has grown up around this simple choice task (see Dunn et al. 2006).

The conventional structure of the task employs four card decks and 100 card selections. Two of the decks yield positive payoffs of $100 for each card, and the remaining two decks yield payoffs of $50. However, some of the cards yield simultaneous losses. These are programmed to be more substantial on the decks that yield $100 payoffs such that in the long run these decks are disadvantageous and yield average net losses (equal to −$25), while the decks with $50 payoffs are advantageous and yield positive average net payoffs (equal to +$25). Within each pair of decks, one has larger but less frequent punishments, but the average payoff is equal. Thus in the long run the best strategy is to select cards from one or both of the advantageous decks and avoid the disadvantageous ones.

In addition to assessing choice behavior in this task, Bechara et al. (1997) probed participants' awareness of the task structure. After the first 20 trials and then after every additional 10 trials, participants were asked to describe what they knew and felt about the task. The majority of participants eventually reached a "conceptual" period in which they were able to describe with confidence which were the good and bad decks, and in this period they unsurprisingly selected from the good decks on the majority of trials. Prior to the conceptual period was a "hunch" period, described by Bechara et al. (1997) as involving a reported liking for the good over the bad decks, but with low confidence and reports of guessing. In the phase before this (the "prehunch" phase) participants "professed no notion of what was happening in the game" (Bechara et al. 1997, p. 1294). Crucially, then, the question is whether awareness correlated with card selections or whether, in contrast, participants selected from the good decks in the prehunch phase before being aware of the differences between the decks in terms of their average payoff. It is this latter outcome that Bechara et al. (1997) claimed to observe in their data, concluding that "normals began to choose advantageously before they realized which strategy worked best" and that "in normal individuals, nonconscious biases guide behavior before conscious knowledge does" (p. 1293). Elsewhere, it has been claimed that "this biasing effect occurs even before the subject becomes aware of the goodness or badness of the choice s/he is about to make" (Bechara et al. 2000, p. 301).

Studies employing the IGT have a very natural interpretation within the lens model framework of Fig. 1. The decks can be conceived of as the cues, and their relationships to reward and punishment (the criterion) are captured by their ecological validities. The participant's goal is to judge the likely payoff for choosing each deck and to make a decision accordingly. If participants indeed learn to make advantageous deck selections, then their utilizations are appropriately tuned to the validities, yielding high achievement. Inability to report which are the good or bad decks is unawareness located at Point B in Fig. 1.

In view of the enormous amount written about the IGT and this pioneering study, it is remarkable to note that the key behavioral observation with regard to normal participants – more selections from good than bad decks in the prehunch period – was not in fact statistically significant in the Bechara et al. (1997) study. Preference for cards from the good decks was significant in the hunch and conceptual periods, but by that stage, of course, the participants possessed some conscious knowledge that could be guiding their choices. And the failure of this preference for the good decks in the prehunch period to reach significance is unlikely to be due simply to low power, because in two direct replications, with the same assessment of awareness, Maia and McClelland (2004) and Wagar and Dixon (2006) did not even observe a numerical preference for the good decks in the prehunch period.

In addition to their replication of the original study, Maia and McClelland (2004) tested another group of participants but employed a much more careful assessment of their awareness of the nature of the task at regular intervals. This careful assessment satisfied the criteria listed in Table 1. Rather than simply recording responses to open-ended questions regarding what they thought and felt about the task, Maia and McClelland required their participants to rate each deck on a numerical scale, to explain their numerical ratings, to report in detail what they thought the average net winnings or losses would be if 10 cards were selected from each deck, and to state which deck they would choose if they could only select from one deck for the remainder of the game. Answers to these questions provided a range of assessments of awareness against which actual card selections could be compared. In addition, Maia and McClelland ensured that the classification of decks as good or bad was based on the actual payoffs experienced by the individual participant to that point. Bechara et al. (1997) fixed the sequence of payoffs from each deck in the same way for each participant and scheduled very few penalties on the bad decks across the early trials. Thus a participant selecting early on from the bad decks might actually be making good choices, because the penalties that ultimately make such decks bad have not yet been experienced. Plainly, it is crucial to classify selections as good or bad in relation to what the participant has actually experienced, not in relation to the long-term but unknown average.

When card selections were compared with reported awareness under Maia and McClelland's (2004) improved method, it was apparent that awareness if anything was more finely tuned to the payoffs than the overt selections were. Far from observing selections from the good decks in participants who could not report which were the good decks, Maia and McClelland found that conscious reports about the decks were more reliable than overt behavior. This might indicate that participants were still exploring the task and acquiring further information about the decks, but it clearly provides no support for the claim that nonconscious biases occur before individuals have relevant conscious knowledge. Maia and McClelland's results were replicated by Wagar and Dixon (2006), and similar outcomes were obtained by Evans et al. (2005), Bowman et al. (2005), and Cella et al. (2007), who in three separate experiments found that preferential awareness ratings for the good over the bad decks emerged before the point at which preferential card selections favored the good

decks. By the time behavioral choice revealed a preference for the good decks, awareness was sharply discriminating.

Maia and McClelland's (2004) study provides a particularly striking illustration of the dangers of employing an unreliable or insensitive test of awareness. In the Bechara et al. (1997) study, normal participants were reported to progress from the prehunch (no relevant awareness for discriminating the good and bad decks) to the hunch (some awareness that two of the decks were better than the others) phases at trial 50 on average, with no participant making this transition prior to trial 30. In their replication using the Bechara et al. (1997) awareness questions, but with a more careful algorithm for making the awareness classification, Maia and McClelland located the average transition at about the same point. Yet in their second group of participants, in whom awareness was measured via numerical judgments, participants were clearly aware of the difference between the good and bad decks by the first assessment at trial 20, and the onset of awareness has been located at a similar point in other studies (Evans et al. 2005; Wagar & Dixon 2006). At this point, for example, 80% of Maia and McClelland's participants gave a good deck their highest numerical rating, and 85% of participants indicated one of the good decks when asked which deck they would choose if they could only select from one deck for the rest of the game. Thus on the Maia and McClelland assessment method, most participants had discriminative awareness by trial 20 (and possibly before then), whereas on the Bechara et al. (1997) method, none had such awareness prior to trial 30. The open-ended questions Bechara et al. (1997) used ("tell me all you know about what is going on in this game" and "tell me how you feel about this game"), together with their classification procedure for participants' responses to these questions, clearly did not make a sufficiently reliable and/or sensitive instrument for measuring awareness.

As noted earlier in this article, there has been much discussion about how best to measure awareness. Although they have attracted considerable controversy, alternatives to verbal report have been explored. Here we describe data from one study of decision making in the IGT that attempted to assess awareness without recourse to reports. Persaud et al. (2007) required their participants not only to make a deck selection on each trial, but also to wager on the payoff for that trial. The wager could either be a high (£20) or a low (£10) amount. The reward from the advantageous decks was equal to the amount wagered, while that from the disadvantageous decks was twice the amount wagered, with occasional penalties being larger on the disadvantageous decks. The point of the task is that wagering is assumed to provide a probe of the participant's awareness. If the participant has some awareness that his or her decision is a good one, then he or she should be willing to bet higher on that choice in order to obtain a higher payoff. Thus Persaud et al. speculated that choices from the good decks should tend to be accompanied by high wagers and choices from the bad decks by low wagers, if the participant has some awareness of the difference between the decks.

In a group of participants tested under these circumstances, the good decks began to be reliably selected by around trial 40, but wagering did not begin to show a bias until trial 70. On the basis of this outcome, Persaud et al. (2007) argued that the initial preference for the good decks must be based on unconscious information.

There are, however, some substantial difficulties with this set of conclusions. First, to locate the onset of awareness at around trial 70 in the IGT is to run radically counter to the data obtained in other IGT studies when the first set of test questions is administered at trial 20. Several studies (as noted above) have found that the vast majority of participants give higher numerical estimates for the good compared to the bad decks the first time they are questioned (Persaud et al. (2007) did not report their own results from these awareness questions). Since the onset of a choice preference for the good decks is similar in the Persaud et al. study to that found elsewhere (around trial 40), it seems implausible to argue that the wagering component made the task harder overall and therefore delayed the onset of learning and awareness. Instead, it seems reasonable to speculate that wagering was measuring something other than awareness, or that it was measuring awareness insensitively or unreliably. This latter possibility is consistent with a second problem facing the wagering method of assessing awareness: Participants may have an aversion to risk or loss and hence may choose to make low wagers even when they have some degree of awareness. Evidence that this is not just a theoretical speculation but also an empirical reality has been reported by Dienes and Seth (2010), and Konstantinidis and Shanks (2013) have found that when loss aversion is avoided, wagering very closely matches deck selections.

4.2 Covert emotions in decisions under uncertainty

The review in this section thus far has considered Bechara et al.'s (1997) behavioral evidence concerning unconscious biases in decision making. However, that research is influential for a further reason: Physiological markers of emotion were measured at the same time as card selections. Specifically, Bechara et al. (1996; 1997) measured their participants' skin conductance responses (SCRs) prior to each choice. In normal participants, these responses, commonly assumed to measure bodily states of arousal and emotion, were found to be substantial after both rewards and punishments. Most importantly, though, they began to emerge during the course of the task in anticipation of card choices, in particular becoming larger before selections from bad than from good decks. Bechara et al. (1996; 1997) took these SCRs to be "somatic markers," or covert emotional reactions capable of influencing behavior unconsciously, suggesting that "a negative somatic state as hallmarked by an anticipatory SCR, would nonconsciously "advise" the avoidance of the disadvantageous decks, while helping bring on line, cognitively the reasons for making the avoidance explicit" (Bechara et al. 1996, p. 224).

Of course, the evidence described above that participants' awareness in the IGT is quite extensive raises considerable doubt over the inference that these somatic markers are in any sense covert. On the contrary, they may be the effect rather than the cause of conscious thought, and indeed there is evidence in favor of this viewpoint. Gutbrod et al. (2006) measured SCRs as well as card choices and found that anticipatory SCRs did not begin to discriminate between good and bad decks until about trial 80, yet card selections favored the good decks as early as trial 40. In fact, this sequence is evident in Bechara et al.'s (1997) data too: Whereas significantly more cards

were selected from good than from bad decks in the hunch period, anticipatory SCRs measured during that period were not significantly different for good versus bad decks. As Gutbrod et al. noted, this early development of a behavioral preference for the good decks cannot have been driven by the somatic markers measured in anticipatory SCRs. It could, on the other hand, have been driven by differential awareness which, as discussed above, emerges very early in the task. This temporal sequence – awareness → differential choice → differential SCRs – seems to fit the data across these experiments well, with awareness being evident by around trial 20, advantageous card selections by trial 40, and differential anticipatory SCRs by around trial 80.

The only recent study to provide support for the possibility that anticipatory SCRs precede the development of card selections is that of Wagar and Dixon (2006). These authors obtained the typical finding of advantageous card selections emerging at around trial 40, but in their data differential SCRs were evident by around trial 30. Although these results suggest that more work is needed before we fully understand the relative timing of and causal relationship between anticipatory SCRs and card selections, even Wagar and Dixon themselves did not take any of their results as evidence of unconscious influences on decision making. Their participants showed awareness at least as early as they showed a preference for the good decks.

Moreover, there is a major concern surrounding the interpretation of somatic markers. On Bechara et al.'s (1997) interpretation, they provide anticipatory information about the value of a particular choice option, especially for negative outcomes. Specifically, they are assumed to encode information about the negative emotions that were previously triggered by a stimulus or choice outcome, and then covertly guide subsequent decisions. On this account, whatever the individual's report may state, his or her decision is actually driven at least in part by an emotional marker of the valence of the choice outcome, a marker that is related to previous (especially negative) experiences independently of subjective belief. In contrast to this account, recent findings suggest that SCRs code the uncertainty associated with the participant's decision, not the outcome (Davis et al. 2009; Tomb et al. 2002). For example, Tomb et al. showed that when the IGT was modified so that it was the good rather than the bad decks that were associated with large payoffs and losses, SCRs tended to precede selections from the good decks. This strongly challenges the claim of the somatic marker hypothesis that such markers provide biasing signals for choice, because SCRs precede those choices (of bad decks) that are eventually eliminated in the standard IGT and precede those (of good decks) that eventually dominate in Tomb et al.'s modified version. Although it is possible that there are psychologically distinct somatic markers of positive and negative outcomes, it is plain that they cannot be distinguished by conventional SCR measurement.

4.3 Summary and conclusions

Of all the experimental methods used in recent years to study the role of awareness in decision making, the IGT and its variants have probably been studied more intensively than any others. The task lends itself quite naturally to a variety of awareness assessments and a range of behavioral indices, such as card choices and SCRs. While questions remain about important issues such as the suitability of using wagering as a means of gauging awareness, the evidence (particularly from Maia & McClelland's [2004] major study) is clear in showing that participants acquire detailed conscious knowledge about the payoff structure at an early point during the task. This awareness emerges at least as early as behavioral differentiation itself, and there is little convincing evidence that decision making in the IGT is dissociable from awareness.

5. Primes and primes-to-behavior

In the present section we provide a highly abbreviated assessment of research using a range of priming techniques to influence behavior. In some research fields it has become widely accepted that priming can influence behavior unconsciously.

5.1 Subliminal perception

Subliminal perception is the controversial phenomenon whereby invisible stimuli may influence some aspect of behavior (see Fig. 1, Point C). It is intriguing that in the wake of a comprehensive methodological debate about 25 years ago (see Holender 1986), subliminal processing was afforded a rather modest role in most theoretical debates about the causation of behavior. Yet in recent years there has been a wealth of claims, based on subliminal perception experiments, concerning the importance of the unconscious in behavior including some striking reports of subliminal priming on decision making (e.g., Winkielman et al. 2005). Here we do not attempt to review this extensive literature. We do, however, briefly comment on the pervasive methodological problems that plague interpretation of results in this field (Dixon 1971; Holender 1986; Miller 2000; Pratte & Rouder 2009), and we illustrate these problems with reference to a prominent and typical recent claim about subliminal influences on decision making.

In a striking illustration, Hassin et al. (2007) primed their participants with a brief (16-ms) masked presentation of either the Israeli flag or a scrambled version of the flag, prior to each of several questions about political attitudes (e.g., "Do you support the formation of a Palestinian state?") and voting intentions. Not only did the subliminal primes influence responses to these questions, but they also affected subsequent voting decisions in the Israeli general elections. Key evidence that the primes were invisible came from a test in which participants were shown the masked images and asked directly to indicate for each whether it was a flag or scrambled flag, which revealed chance-level performance.

There are substantial problems with this kind of inference. For instance, the form of awareness check employed by Hassin et al. (2007) is susceptible to bias if the participant's confidence about seeing the flag is low. On some occasions on which they actually see the flag, they may nonetheless respond "scrambled flag" because their judgment is uncertain and they adopt a conservative decision criterion.

Worse still, Pratte and Rouder (2009) have shown that typical tests used to measure awareness in subliminal perception experiments (such as that used by Hassin et al.

2007) may significantly underestimate conscious perception as a result of task difficulty. Because tests assessing perception of near-threshold stimuli are very difficult, participants may lose motivation. In their experiments, Pratte and Rouder maintained participants' motivation by intermixing above-threshold and near-threshold stimuli and found that identification of the near-threshold stimuli increased reliably. Thus brief stimulus presentations that would have been regarded as subliminal in a conventional awareness test were found to be supraliminal in a modified test designed to be more closely equated to the main priming test in terms of difficulty. Until subliminal priming experiments are able to rule out such artifacts, their conclusions will remain in doubt. Recent methodological advances (e.g., Rouder et al. 2007) offer the promise of more clear-cut tests of subliminal perception in the future.

5.2 Primes-to-behavior

Other striking studies, largely emerging from social cognition, describe apparent influence of primes on behavior where the prime, but not its influence, is consciously perceived (Fig. 1, Point D). A number of instances have been reported in recent years, such as that individuals can be induced to act socially or unsocially, walk faster or slower, behave more or less intelligently, or perceive accurately or inaccurately as a result of subtle priming influences of which they are unaware. In Bargh et al.'s (1996) famous experiment, for example, participants read sentences containing words related to the concept old age and, as a consequence, a few minutes later walked more slowly down a corridor. Although few of these studies relate specifically to decision making, they are provocative illustrations of possible unconscious influences on behavior.[6]

Significant question marks exist concerning behavioral priming studies, particularly in regard to their assessment of awareness. The methods used for assessing awareness have generally been weak and fail the criteria described in Table 1. Bargh et al. (1996), for example, reported an experiment specifically designed to evaluate whether their participants were aware of the potential influence of the prime.

> [Participants] were randomly administered either the version of the task containing words relevant to the elderly stereotype or the neutral version containing no stereotype-relevant words. Immediately after completion of the task, participants were asked to complete a version of the contingency awareness funnel debriefing ... [which] contained items concerning the purpose of the study, whether the participant had suspected that the purpose of the experiment was different from what the experimenter had explained, whether the words had any relation to each other, what possible ways the words could have influenced their behavior, whether the participants could predict the direction of an influence if the experimenter had intended one, what the words in the scrambled-sentence task could have related to (if anything), and if the participant had suspected or had noticed any relation between the scrambled-sentence task and the concept of age. (Bargh et al. 1996, p. 237)

Bargh et al. (1996) reported that only 1 of 19 participants showed any awareness of a relationship between the stimulus words and the elderly stereotype.

This experiment leaves a number of questions unresolved. For example, was there any difference between the two groups in their responses to any of the questions? No actual data were reported at all, let alone broken down by group. Why were questions about whether the purpose of the experiment might have been different from what the experimenter had explained, and about whether the words had any relation to one another, included in the awareness test? These issues are irrelevant to the critical issue, namely, whether the participant was conscious of the activation of the age concept. The only relevant question is the final one, whether the participant had noticed any relation between the scrambled sentences and the concept of age. All the other questions are irrelevant, and their inclusion simply adds noise to the overall score. Put differently, the groups may have differed on their answers to this question, but that difference might well have been submerged in the random variance added by the other questions. Worse still, Doyen et al. (2012) used the same walking speed task but with more careful awareness debriefing: Participants were required to choose among four pictures representing categories that could have been used as primes (athletic person, Arabic person, handicapped person, elderly). Doyen et al. found that primed participants had significantly greater awareness of the prime on this test than unprimed participants.

Unfortunately, weak methods are still being employed. In Ackerman et al.'s (2010) recent report that various social judgments can be nonconsciously influenced by haptic sensations, the only supporting evidence regarding awareness was that "Only one participant (in Experiment 5) reported awareness of the hypotheses, and so this person was removed from the analyses" (supplementary materials). How participants were probed about the influence of the primes on their behavior is not described, and whether or not they would have reported awareness if the criteria described in Table 1 had been satisfied (e.g., using sensitive methods such as rating scales) is unknown.

Another major problem is that the replicability of many of these priming effects has yet to be established. Dijksterhuis et al. (1998, study 2), Doyen et al. (2012), and Pashler et al. (2011) all failed to replicate Bargh et al.'s (1996) finding that priming the stereotype of elderly people can affect walking speed. In another priming situation, Bhalla and Proffitt (1999) reported that participants judged a hill as steeper when they were wearing a heavy backpack, but results from Durgin et al. (2009) found evidence that this priming effect is an artifact of compliance by participants to the perceived experimental hypothesis. In yet another example, Zhong and Liljenquist (2006) reported that asking participants to recall an unethical act from their past increased the accessibility of cleansing-related words and the likelihood of taking antiseptic wipes, yet the only published attempt to replicate these findings yielded four failures (Gámez et al. 2011). Until clear replications of these priming effects are reported, using more sophisticated assessments of awareness, it is premature to conclude that these studies provide robust evidence of unconscious influences on behavior.

5.3 Summary and conclusions

Few topics in psychology excite as much attention in the media as research on priming effects with subtle but unnoticed or outright subliminal stimuli. Yet research in this

field yields remarkably few effects that convincingly demonstrate unconscious influences. The claim that briefly presented primes fall outside consciousness is difficult to establish without extremely rigorous methods, but such methods are employed insufficiently often. The primes-to-behavior literature has also largely employed weak methods to assess awareness, there are question marks over the replicability of some of its most prominent findings, and selective publication bias and file drawer effects (Renkewitz et al. 2011) may be clouding the overall picture.

6. Discussion

We have articulated some of the conditions necessary to establish influences of unconscious mental states on decision making and have reviewed a considerable body of evidence in relation to multiple-cue judgment, deliberation without attention, decisions under uncertainty, and priming. From the perspective of our lens model framework, many of the claims for unconscious influences focus on Points B (unawareness of cue–criterion relations), C (unawareness of cues), and D (unawareness of cue utilization) (Fig. 1). However, when paradigm demonstrations are scrutinized, explanations that invoke unconscious processes appear unnecessary. Performance in tasks such as the IGT which is routinely cited as providing evidence for unawareness (at Point B) can be readily explained as mediated by conscious acquisition of deck knowledge (Maia & McClelland 2004); subliminal priming experiments that might be considered optimal for demonstrating unawareness at Point C reveal awareness of primes (Pratte & Rouder 2009); and studies of multiple-cue judgment suggest that people do possess knowledge of cue utilization (Point D; Reilly & Doherty 1992). Moreover, manipulations designed to impact this utilization process unconsciously have limited and potentially artifactual effects (Newell et al. 2009; Payne et al. 2008). In summary, these research areas have so far failed to yield clear, replicable, and unequivocal demonstrations of unconscious influences. On the contrary, many careful experiments have documented consistently high levels of conscious access in people's causal reports on their behavior.

A surprising outcome of the review is that debates and disagreements about the meaning of the terms *consciousness* and *awareness* have (with a few exceptions) played a remarkably minor role in recent research. Whereas issues about how to define and measure awareness were once highly prominent and controversial (e.g., Campion et al. 1983; Reingold & Merikle 1988), it now seems to be generally accepted that awareness should be operationally defined as reportable knowledge, and that such knowledge can only be evaluated by careful and thorough probing. Thus an encouraging conclusion is that the field seems to have generally taken heed of detailed recommendations (e.g., Ericsson & Simon 1980) about suitable methodology in the assessment of awareness, including the requirements noted in Table 1 that awareness assessment must be reliable, relevant, immediate, and sensitive. We concur with Uhlmann et al. (2008) that claims of unconscious influences should ideally depend on more than simply confirming the null hypothesis (that evidence of awareness is not obtained). Null results are always ambiguous because the assessment may not have adequately met the criteria in Table 1. Uhlmann et al. proposed a range of other findings, such as the absence of actor–observer differences, which may avoid these difficulties (though, as previously discussed, these findings have not been obtained under more careful assessments).

6.1 Brief comments on other research areas

We noted in the Introduction that our focus is on those research areas that are most relevant to our overall question about the extent to which the mental processing that leads to the selection of one among several actions can be considered unconscious. To talk of brain systems making decisions is to use the notion of a *decision* very differently, and it is not clear what it would mean to ask whether the visual system's computation of size and distance, for example, is or is not conscious. Even with regard to the main areas reviewed in Sections 2–4, we have of necessity been selective in the studies we have reviewed, and we recognize that our critical viewpoint leaves us at risk of the objection that if we had considered areas X or Y, we would have found more compelling evidence. We maintain that the areas we have selected have been highly influential in bolstering claims for unconscious decision making, so it would be very surprising if the evidence is markedly weaker in these domains than elsewhere. Nevertheless, we briefly comment here on some other well-known areas. Our hope is that we can convey at least a flavor of why the common claims from these fields may be open to challenge.

6.1.1 Automaticity. When we look at the individual's use of low-level brain "decisions," do we see clear evidence of unconscious processing? This is far from obvious. Evidence that such decisions are cognitively impenetrable (in other words, immune from top-down attentional control and conscious knowledge) is very controversial. It is now known, for instance, that even something as low level and apparently automatic as motion processing in area V5 is dramatically attenuated in conditions of high cognitive load (Rees et al. 1997). Similarly, visuo-motor adaptation is influenced by conscious expectancies (Benson et al. 2011).

Supposedly automatic processes like word reading and visual adaptation are frequently cited as examples of unconscious processing. The use of *unconscious* (meaning uncontrollable influences/processes) in this context is rather distinct, however, from what we have been concerned with in this article (unreportable influences or processes). The evidence suggests that very few influences or processes are truly uncontrollable. For example, it is well-known that Stroop interference – which apparently reveals the automaticity of word reading – can be diluted by a range of manipulations of top-down control (Logan & Zbrodoff 1979). Thus these examples have little bearing on the main question addressed in the present article.

6.1.2 Neural precursors of motor responses. Famously, Libet and colleagues (Libet 1985; Libet et al. 1983) reported experiments in which electroencephalographic activity was monitored while participants freely chose when to make a voluntary movement and reported the time point at which they felt the intention to move (Point

E in Fig. 1). Participants observed a spot rotating on a clock and made their timing reports by observing the dot's location at the point of becoming conscious of their urge to move (these are called "will" or W judgments). Libet found that these judgments followed rather than preceded the first neural marker of movement intention, the readiness potential (RP), and indeed the time interval between these could be as much as a second. Libet and many subsequent commentators have taken these results as evidence that conscious intentions do not cause voluntary actions but are instead epiphenomenal effects of the true, unconscious causes of such actions, namely, neural events. Recent research has extended the method using recordings of activity in single neurons in medial frontal cortex (Fried et al. 2011), which show progressive recruitment over several hundred milliseconds prior to participants' reported experience of the urge to move.

Several recent studies, adopting variants of Libet's method, serve if anything to support the intuitive Cartesian view that voluntary movements are caused by conscious decisions to act. Particularly noteworthy is a study by Trevena and Miller (2002) that compared lateralized readiness potentials (LRPs) to psychometrically determined W judgments. The LRP is a more appropriate indicator of hand-specific movement preparation than the RP, which, Trevena and Miller argued, is a marker of very general preparation for a future movement. As well as replicating Libet et al.'s (1983) finding that RPs preceded the mean time of W judgments, Trevena and Miller (2002) also found that the same was true for LRPs, although by a much smaller amount (approximately 180 ms). Crucially, however, Trevena and Miller pointed out that comparing the onset of one measure (LRP) with the mean of another introduces bias. Instead, one onset needs to be compared with another. In their experiments, Trevena and Miller were able to determine the earliest point at which W judgments occurred (i.e., the onset of these judgments) and found evidence that they tended to precede, not follow, the LRPs.

An additional finding confirms that the RP is not – as Libet et al. (1983) supposed – an appropriate measure of preparation for action execution. Miller et al. (2011) reported the striking finding that the RP "signature" of movement preparation was virtually eliminated in conditions where participants made voluntary movements but without a clock or any requirement to report W judgments. The implication of this is that the preparatory neural activity, which Libet took as evidence of unconscious movement preparation, has more to do with dividing attention and preparing to make a clock judgment. As Miller et al. noted, the clock procedure, which was designed to measure mental events, seems in fact to alter the neural activity to which these mental events are related.

6.1.3 Conscious will as an illusion. The folk-psychological view that conscious thoughts cause our decisions and behavior faces a major obstacle in the substantial body of evidence suggesting that our conscious thoughts are often inferred after the fact. Rather than making conscious choices and immediately and passively experiencing those thoughts, an alternative possibility is that the thoughts are constructions created post hoc and that the true causal work is done by unconscious states of mind and brain. This is the essence of the will-as-illusion viewpoint, which emphasizes that experiencing an intention prior to an action is no guarantee that the intention caused the action. In one particular version of this approach, and in contrast to the intuitive view that our decisions and behaviors are caused by conscious intentions, it has been argued (particularly by Wegner 2004) that they are instead caused by unconscious processes that may simultaneously produce illusory experiences of conscious will. Specifically, it is proposed that unconscious states of mind/brain cause two things, both the voluntary action itself and a conscious thought about the action (intention). As a result of the constant conjunction of thought and action, an experience of will is created via illusory inference even though the thought itself is not the true cause of the action. Wegner drew an analogy with a ship's compass. Someone looking at the compass and relating it to the ship's course might form the impression that the compass is actually steering the ship, yet we know that the compass exerts no such control over the ship's movement. The compass reading is an effect, not a cause, of the ship's course, which is in fact caused by a whole raft of separate factors and processes such as the prevailing wind and the position of the ship's wheel and rudder.

Wegner's principal support for this theory comes from demonstrations that illusions of will can be created in which people either experience will when their conscious thoughts are objectively not the cause of their actions or fail to experience will when they objectively are. For example, Wegner et al. (2004) had participants watch themselves in a mirror with their arms out of view by their sides while a confederate stood behind them. The confederate's arms were extended forward to where the participant's arms would normally be, and these arms performed various actions such as giving an OK sign. When the participants heard instructions over headphones previewing each of these actions, they judged that they had greater control over the arms' movements. Wegner has concluded from such demonstrations that the experience of conscious will is an illusion in the same sense that the experience of physical causation is. In both cases, our minds draw inferences when the conditions are appropriate, namely, when constant conjunction is present.

There have been numerous responses to Wegner's radical position on will and the conscious causation of behavior. Nahmias (2005) pointed out that the experiments do not induce anything remotely resembling full-scale experiences of agency. In Wegner et al.'s (2004) study, for example, participants rated their sense of vicarious control on 7-point scales (on which 1 = *not at all* and 7 = *very much*). Although participants reported a significantly enhanced feeling of control when the actions were previewed auditorily, their average ratings were never greater than 3 on this scale. Hence it can hardly be claimed that they reported experiencing a feeling of control over the confederate's actions. Moreover, it has been noted (McClure 2011) that we often experience will even when an intention precedes an action by a long interval (such as a vacation). The analogy with physical causation is curious because the conclusions drawn in the two cases seem very different. In the case of physical causation, even if it is accepted that our knowledge of causation is an inference based on constant conjunction, and that we can in consequence experience illusions of causation, most people do not conclude that physical causation itself

is a fiction or that perception is generally illusory. Rather, we conclude that there are real causal connections in the world but that our knowledge of them is indirect and largely inferential (e.g., Harré & Madden 1975). In contrast, on the basis of illusions of agency and will, Wegner's conclusion is that free will and the conscious causation of behavior are illusions. The illusions per se cannot prove this. They merely show that we lack direct access to linkages between thought and action.

6.1.4 Blindsight. Individuals with the condition known as *blindsight* report being experientially blind in a part of their visual field (scotoma) yet are able to make a variety of discriminations about stimuli presented in that part of the field. Blindsight results from damage to primary visual cortex, and because external space is represented retinotopically in primary visual cortex, there is a tight coupling between the location of the cortical damage and the location of the scotoma. Successful discrimination of location, movement, form, color, and so on, as well as overt actions such as pointing, have been reported in blindsight (Weiskrantz 1986), and it has been proposed that these behaviors must be based on unconscious representations, as blindsight patients deny visual consciousness regarding stimuli falling within their scotomata. In terms of the lens model, the deficit is located at Point C in Figure 1.

For almost as long as blindsight has been investigated, the possibility that the condition is simply degraded (near-threshold) normal vision has been hotly debated (see Campion et al. 1983; Weiskrantz 2009). It is possible that residual visual discriminations with near-threshold stimuli are accompanied by weak, but reliable, levels of visual awareness. In fact, individuals with blindsight often report forms of visual experience (Overgaard 2011). Cowey (2010) recently noted in regard of D.B., the patient whose performance led to the coining of the term blindsight, that "there is still no explanation … for the revelation nearly 30 years after his operation, that he experiences visual after-images when a visual stimulus is turned off.… How ironic if the discovery of blindsight proves to be based on a patient who does not possess it!" (p. 7).

Weiskrantz (2009) and others have argued against the degraded normal vision hypothesis by pointing out (among other things) that individuals with blindsight behave qualitatively differently from normal individuals. Signal detection theory can be used to show, for instance, that forced-choice guessing in blindsight about which interval contained a stimulus yields a higher discrimination measure than yes/no responses about whether a stimulus was presented, while in normal individuals measured discrimination is identical in the two conditions (Azzopardi & Cowey 1997).

Overgaard and colleagues (Overgaard 2011; Overgaard et al. 2008; Ramsøy & Overgaard 2004) have argued, however, that dichotomous measures that ask the individual to report (yes/no) whether a stimulus is visible systematically underestimate the extent of visual awareness (regardless of response bias). These authors have provided evidence that when participants (both normal and blindsight) are given the opportunity to report the clarity of their perceptual experience using a range of categories such as "no experience," "brief glimpse," "almost clear experience," and "clear experience," stronger correlations are observed between awareness and discrimination accuracy than is the case when awareness is measured with binary responses. As with other examples from neuropsychology, much of the evidence can be plausibly explained without recourse to unconscious influences.

6.2 The seduction of the unconscious

Given these conclusions, it is surprising (to us) that there remains a pervasive view in the literature that unconscious processes serve an important explanatory function in theories of decision making. This prominence is most obvious in theories that contrast deliberative with intuitive decision making (see Evans 2008; Kahneman 2011; Keren & Schul 2009). A recent version of this general view advocates two interacting systems with the following qualities:

> System-1 (intuition) is parallel, extracts gist (holistic), and results in affective states, which are *open to phenomenological awareness* (Block 2007) *in their end result but not in their operation (or stages)*. While, in contrast, system-2 (deliberation) is sequential, rule-based (e.g., lexicographic), and *has access to the stages of processing*. (Usher et al. 2011, p. 10, emphasis added)

Our added emphasis highlights that Usher et al. (2011) operationalized the two systems, in large part, via access to phenomenological awareness. In essence, Usher et al.'s interpretation suggests that a decision maker relying purely on system-1 would have awareness only at Point E in Figure 1 (the "end result"), whereas one relying solely on system-2 would be aware at all points (A–E inclusive). Usher et al. emphasized, however, that many decisions will be a product of these two systems interacting. For example, in a multi-attribute judgment task, system-2 is responsible for sequentially inspecting attributes and alternatives (e.g., Does this car have cup holders?), while system-1 generates an "affective integration of the values" (p. 10). This approach is similar to that proposed by Glöckner and Betsch (2008) in their parallel-constraint satisfaction model of multi-attribute judgment and choice (see also Glöckner & Witteman 2010). Our review suggests, however, that when participants are given adequate opportunities to report the knowledge underlying their behavior, there is little, if any, explanatory role played by a phenomenologically inaccessible affective integration process. While knowledge underlying behavior might not always be comprehensive, it is often sufficient to explain observed performance.

Why, then, do explanations that invoke unconscious mental states remain so popular? A superficial answer is that they make good stories that have clear appeal to a wide audience, especially when they involve expert decision making (e.g., Gladwell 2005; Lehrer 2009). A more considered answer acknowledges that as a field of study, the issue of unconscious influences is a challenging one to look at impartially because we all have such strong ex ante beliefs about the causation of our behavior and the circumstances in which we are unaware of its determinants. Consider the following illustration of the grip that our intuitions about the limits of conscious deliberation can hold. In a multiple-choice test, is it wise to change your answer on subsequent reflection? Suppose that you have been asked which city is more populous, Stockholm or Munich? You intuitively choose Stockholm, but then ponder your decision further. Perhaps you retrieve relevant information

from memory such as that Munich has a famous soccer team whereas Stockholm does not. Should you change your answer in such circumstances where intuition and reason diverge? A majority of people believe that the answer is "no," and students often resist (and are advised by their teachers to resist) revising their initial responses, yet decades of research proves the contrary (e.g., Benjamin et al. 1984). In fact, revising initial answers tends to increase their accuracy (Munich is in fact more populous). In the face of such strong but mistaken intuitions about conscious deliberation, and the likely confirmation biases they induce, empirical evidence faces an uphill battle.

Of course there are well-developed and influential frameworks that seek to offer principled accounts of the distinction between conscious and unconscious processing. The well-known global workspace theory of Baars (2002), for instance, roughly divides conscious from unconscious processes in terms of events that are or are not in the spotlight of selective attention. But such models start from the assumption that unconscious drivers of behavior exist, and this is the very assumption we believe is in need of critical scrutiny. We argue that many reports on unconscious biases have been influential in part because the audience has been strongly predisposed to believe them, even when alternative interpretations are available. Thus, claims about the role of unconscious processes have not always been treated quite as critically by the academic community (including journal editors) as claims for which our intuitions are weaker. This can lead to the momentum effects we noted in our review in which (weak) evidence for an "intuitive" result is given undue weight and forms the basis for largely black-box explanations of behavioral phenomena.

This is not to deny that there are differences (phenomenological and otherwise) between a deliberation-based and an intuition-based decision. Nor is it to deny that sometimes deliberated decisions can be bad (e.g., Ariely & Norton 2011; Wilson & Schooler 1991), and fast decisions can be good (e.g., Goldstein & Gigerenzer 2002).

The first of these claims – that too much thinking about a decision can lead to poorer choices than only thinking a little – is not necessarily at odds with our framework. The deleterious effect of *reasons analysis* (conscious reporting of the bases for choice) would be captured by the inclusion of too many inappropriately weighted cues (Point D, Fig. 1). Such an effect does not necessitate unconscious influences but rather the ineffective use of conscious deliberative processes. If choices (or attitudes) change when people are asked to report underlying reasons, this does not necessarily imply that initial choices are the product of unconscious reasons (e.g., Uhlmann et al. 2008). A choice might change because *additional* information to that originally considered consciously might alter (sometimes detrimentally) a final choice. The simple point is that these decisions need not be based on unconscious knowledge – in the sense of lack of awareness of the knowledge and inferences underlying one's behavior.

With regard to the second claim – that fast decisions can be good – Simon's succinct statement that intuition is "nothing more and nothing less than recognition" (Simon 1992, p. 155) is a useful insight here[7] (cf. Kahneman & Klein 2009). Simon's analogy with recognition reminds us that intuition can be thought of as the product of overlearned associations between cues in the environment and our responses. In the same way that firefighters train for many years to recognize cue–outcome associations (e.g., Klein 1993), we all learn to make a multiplicity of mundane everyday decisions (what to wear, eat, watch on TV, etc.). Such decisions may appear subjectively fast and effortless because they are made on the basis of recognition: The situation provides a cue (e.g., portentous clouds), the cue gives us access to information stored in memory (rain is likely), and the information provides an answer (wear a raincoat) (Simon 1992). When such cues are not so readily apparent, or information in memory is either absent or more difficult to access, our decisions shift to become more deliberative (cf. Hammond 1996; Hogarth 2010). The two extremes are associated with different experiences. Whereas deliberative thought yields awareness of intermediate steps in an inferential chain, and of effortful combination of information, intuitive thought lacks awareness of intermediate cognitive steps (because there aren't any) and does not feel effortful (because the cues trigger the response). Intuition is, however, characterized by feelings of familiarity and fluency. Again, the simple point is that in neither situation do we need to posit "magical" unconscious processes producing answers from thin air (cf. Hogarth 2010; Kahneman & Klein 2009). As we have seen, when one undertakes a critical examination of the empirical evidence for genuine unconscious influences on decision making, the evidence is remarkably weak.

6.3 Recommendations for future research

What recommendations can be drawn from past research that might fruitfully guide future explorations? One recommendation concerns the types of task that are studied. It is hard to foresee much progress if the focus is on highly reflective situations such as the IGT or experiments in the deliberation-without-attention framework. These experimental tasks explicitly instruct the participant to make a particular decision and either seek evidence that introspective reports about the decision process are incomplete (IGT) or else that promoting further conscious reflection hinders decision accuracy (deliberation-without-attention studies). Moreover, in these sorts of tasks, participants are fully aware of the independent variables (reward magnitudes in the IGT, positive and negative attributes in deliberation-without-attention studies). It seems unsurprising that when participants are focusing on a particular decision problem, their introspections about their own mental processes and about the influences of the independent variables on their behavior can be quite insightful. Turning to neuroscience and neuropsychology for clear answers also appears problematic given the controversies surrounding many purported demonstrations of unconscious influences (see sect. 6.1).

More promising is to look at situations in which attention is diverted away from the experimenter's hypothesis, such as those that look for subtle priming influences on behavior. The prime-to-behavior literature (sect. 5.2) includes many examples in which participants are unlikely to be aware of the potential influence of a prime on their behavior. Although the interpretation and replicability of many of these findings is in dispute, the basic logic of the experiments seems sound for investigating unconscious influences. A notable example of a very different type is Richardson et al.'s (2009) demonstration that choices can

be influenced by relating the choice to eye movements. Participants in their study considered questions such as "Is murder sometimes justifiable?" and their gaze was monitored as they looked at on-screen *yes* and *no* buttons. They were required to choose as soon as the buttons disappeared. Richardson et al. arranged for the buttons to disappear when the participant's gaze had rested on one of them for 500 ms and found that "yes" responses were about 10% more likely when gaze had been on the *yes* than the *no* button. This and many other such subtle priming effects offer considerable promise for future exploration of insight, awareness, and decision making.

6.4 Conclusion

In summary, evidence for the existence of robust unconscious influences on decision making and related behaviors is weak, and many of the key research findings either demonstrate directly that behavior is under conscious control or can be plausibly explained without recourse to unconscious influences. Few topics in the behavioral sciences are as fundamental as this or run across as many subdisciplines of experimental psychology. Future research must take seriously the experimental and theoretical challenges that our critical review has highlighted.

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NOTES

1. We use the terms *decision making* and *judgment* throughout the article. A decision can be conceptualized as guided by the judgment process, which in turn refers to the evaluation of evidence pertaining to different options (see Baron 2008).

2. Our illustrative use of the lens model departs somewhat from traditional Brunswikian perspectives (e.g., Dhami et al. 2004). For example, in our conceptualization the criterion (Point A) can exert a causal influence on judgment.

3. The terms *proximal* and *distal* here refer to temporal characteristics of the cues and should not be confused with the use of the same terms in the traditional lens model framework.

4. Because this point is so crucial we provide another illustration of our alternative approach to explaining cases where individuals appear unaware of an influence on their behavior. In striking research on racial stereotypes in criminal sentencing, Blair et al. (2004a) found that both black and white prison inmates with more Afrocentric features (e.g., darker skin, wide nose, full lips) received harsher sentences than those with fewer such features, and suggested that this form of stereotyping is outside people's awareness and control. But Blair et al. (2004a) provided no evidence that number of Afrocentric features was the proximal cause of behavior, and it is easy to imagine that some other feature was instead. For instance, suppose that number of Afrocentric features in faces is correlated, in the minds of judges, with some other attribute such as hostility or low intelligence. Use of this correlated attribute might be entirely conscious (though of course deeply unjust). Moreover, it would not be surprising on this alternative hypothesis that participants are unable to control the influence of Afrocentric features on their judgments (Blair et al. 2004b).

5. A more recent and much larger meta-analysis of the unconscious-thought literature by Strick et al. (2011) does not discuss the relationship between *N* and effect size.

6. Some of these effects have been interpreted as arising from direct perception–action links, and if that indeed is their basis, then the involvement of decision making processes would be minimal. However, it has become clear that these effects are highly inferential and almost certainly do recruit aspects of central decision processes (see Loersch & Payne 2011). For example, primes sometimes produce assimilative effects and sometimes contrast effects.

7. In a similar vein, Albert Einstein once noted that "intuition is nothing but the outcome of earlier intellectual experience" (In a letter to Dr. H. L. Gordon on March 5, 1949; *Albert Einstein Archives* 58–217, as cited in Isaacson 2007.)

Open Peer Commentary

Degraded conditions: Confounds in the study of decision making

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Abstract: I raise a consideration complementary to those raised in the target article. Many of the most widely cited studies on decision making involve introspection in degraded conditions, namely, conditions in which agents have no reason for the decisions they reach. But the fact that confabulation occurs in degraded conditions does not impugn the reliability of introspection in non-degraded conditions, that is, in cases in which a subject actually does make a choice for a reason.

An ongoing debate in philosophy of mind concerns the status of our everyday, "folk psychological" explanations of human actions – explanations that advert to the agents' intentions or goals. It is part of this folk picture that in cases where people do act for some particular reason, they know what that reason is. But the work surveyed by Newell & Shanks (N&S) suggests that this assumption is false. Indeed, some of it suggests not only that we may be frequently wrong about what our reasons are, but also that we may be wrong about having reasons at all. To be a reason for performing an action, a mental state must have semantic content, and that content must bear a rational relation to the agent's conception of the action to be performed. Thus, a judgment that stocking sample D is superior to the other samples would rationalize choosing sample D. But if the factor that in fact determines this choice is the spatial position of sample D, there is no rationalizing. Even if I were aware of a rightward bias, the thought that sample D is the rightmost sample would not give me a reason for choosing sample D. If such a factor were in play at all, it would likely be as a mere physical cause: The perceived position of the sample would immediately determine the choice, without any cognitive mediation at all. Unsurprisingly, then, reductivist and eliminativist critics of folk psychology point to work like that of Nisbett and Wilson to

argue that our ordinary attributions of intentions are not only frequently false, but also explanatorily otiose (Churchland 1988).

Some philosophical defenders of folk psychology dismiss such arguments as irrelevant to the probity of the belief-desire framework: Explanation within such a framework, they say, is different from causal explanation, and can be justified independently of any causal account of the production of action (Blackburn 1986; McDowell 2004). I am, however, staunchly naturalistic in my approach to the mind, and so am committed to the continuity of philosophical and empirical work. I therefore recognize the in-principle relevance of the work in question and the seriousness of the challenge it poses. I am very glad, therefore, for the critique N&S offer. I would like to highlight some aspects of their critique that I find particularly germane to the philosophical debate, and then complement the critical points made by the authors with considerations that raise additional questions about the work in question.

N&S point out that Nisbett and Wilson's landmark "stocking study" (Nisbett & Wilson 1977), alluded to earlier, fails to meet at least one of their criteria of adequacy for assessments of awareness, namely, relevance. Although spatial position was correlated with subjects' choices, Nisbett and Wilson illegitimately presume that spatial position per se was causally relevant to their subjects' choices. But this inference neglects the possibility that subjects were running a left-to-right sequential evaluation of the stockings and operating with the rule "if the next one is as good as the previous one, go with the next one." Indeed, Nisbett and Wilson themselves report evidence that suggests that subjects were doing something like this. I find this point especially significant for philosophy, because it underlines the importance of taking seriously cognitive states and processes as independent variables in the production of behavior, variables that must be studied and controlled for. This is as against the strict behaviorist model (which seems to have more vitality in philosophy than in psychology), which only considers publicly available factors – observable stimuli and behavioral responses – and the reductionist/eliminativist model, which says that it is otiose to posit states at any level of abstraction above the neurophysiological level.

But it's one thing to say that the proximal causes of the subjects' choices were *cognitive* and another to say that they were *introspectible*. If N&S are correct about the cognitive procedure the subjects were utilizing, why did the subjects not report that? Why did they insist that their choices were based on the superior quality of the stocking they chose? I have a hypothesis: The set-up of this experiment is a virtual invitation to confabulation. Since there is no good basis for preferring any one sample to any other, subjects will, typically, not be able to cite any such basis. Hence *any* reason proffered by the subject is going to be wrong. But what does a subject's behavior in this sort of circumstance tell us about the accuracy of introspection in cases in which the subject *does* have a reason for acting as he or she does?

What I am suggesting is that Nisbett and Wilson were investigating introspective awareness under *degraded conditions*. In general, it cannot be assumed that the way we solve problems in normal conditions is the same as the way we solve them in degraded conditions. (Consider the very different visual processes activated in daylight and in low light.) Inferences about the unreliability of a certain cognitive process in degraded conditions should not be taken as evidence that the same process is unreliable in normal circumstances. (If we assessed color vision by looking at its operation in low light, we'd conclude that we are terrible at judging colors.) It could well be, therefore, that introspection is highly reliable when our choices and actions are the result of reasons – that is, when there are reasons there to be introspected – but that we have to employ other methods of explaining our own behavior – perhaps, as Nisbett and Wilson suggest, theoretical inference – in cases where introspection finds nothing there. Of course, it would be very difficult to design an experiment to test the accuracy of introspection in what I'm assuming are the circumstances optimal for its operation. We would have to have circumstances in which the agent *has* a reason, and *we* know what it is. And it's hard to see how those conditions could be operationalized; it's much easier to set things up so that the agent *has* to be wrong. But of course, scientists should not be looking under the corner lamppost for watches dropped in the middle of the street.

I called the stocking comparison set-up a case of "degraded conditions." The degradation here is the absence of any reason in the agent's mind for introspection to detect. Other kinds of suboptimality include *hard cases* – cases where there are or might be rational bases for decision, but these bases do not readily determine the best course – and *marginal cases* – cases where there are non-rational factors, such as emotional responses, that feed into the agent's decision. Asking for an agent's reasons in any of these circumstances is likely to provoke a state of mind similar to those that are called cases of *dumbfounding* in the literature on the psychology of moral judgment – cases in which subjects report strong moral judgments for which they offer no compelling moral justification. Accordingly, I would make a similar criticism of work that attempts to draw inferences about our ordinary moral reasoning from the responses subjects make in such cases: It is methodologically unsound to draw conclusions about our ordinary moral decision making from post hoc rationalizations of judgments about hard or marginal cases.

Maybe it helps to be conscious, after all

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Abstract: Psychologists debate whether consciousness or unconsciousness is most central to human behavior. Our goal, instead, is to figure out how they work together. Conscious processes are partly produced by unconscious processes, and much information processing occurs outside of awareness. Yet, consciousness has advantages that the unconscious does not. We discuss how consciousness causes behavior, drawing conclusions from large-scale literature reviews.

Science proceeds by approaching the truth gradually through successive approximations. A generation ago, psychologists began to realize that the conscious control of action had been overestimated, and many began to search for unconscious processes. The pendulum has now swung the other way, as Newell & Shanks (N&S) have shown in their valuable corrective to the excesses of that view. Now it is the unconscious effects that have been overestimated.

We think the way forward for psychological theory is to stop pitting conscious against unconscious and instead figure out how the two work together. Plainly, there is plenty of processing of information that occurs outside of awareness. Likewise as plainly, consciousness has advantages and can accomplish things that the unconscious cannot.

N&S propose their lens model with multiple stages of processing. They rightly criticize the tendency to claim that some outcome is unconscious based on showing that only one of the five steps is unconscious. Still, the fact that some steps are

unconscious is a genuine contribution that will need to be included in the eventual, correct account of human thought and action.

Recently, some theorists have become increasingly bold in asserting that consciousness is an epiphenomenon with no impact on behavior. We have been skeptical that such a complex, advanced phenomenon as human conscious thought would evolve without conferring vital advantages. Inspired by this skepticism, we conducted an extensive review of experimental evidence for the conscious causation of behavior (Baumeister et al. 2011). We searched for experiments in which the independent variable was a conscious thought or other conscious event and the dependent variable was overt behavior. By the logic of experimental design, such studies prove causation. We found a wide assortment, leading to our conclusion that the evidence for conscious causation was extensive, diverse, and undeniable.

Still, none of the evidence we found ruled out important, even essential contributions by unconscious processes. We speculated that there may well be no human behaviors that are produced entirely by consciousness (and likewise few produced entirely by unconscious processes). If all behavior is indeed produced by both conscious and unconscious processes, then it is imperative to understand both types and how they interact.

In fact, we think that conscious processes are themselves produced in part by unconscious processes. Baumeister and Masicampo (2010) concluded that consciousness is best considered a place where the unconscious constructs meaningful sequences of thought. This is linked to evidence that, for example, the unconscious processes single words but not sentences and paragraphs (see Baars 2002). Likewise, logical reasoning deteriorates sharply when consciousness is preoccupied and improves when engaged (DeWall et al. 2008). Logical reasoning requires putting together complex sequences of ideas while ruling out other possible sequences, and that may too big a job to do effectively without consciousness.

What else is consciousness good for? We are wary of making assertions that something absolutely cannot be done unconsciously – but perhaps that is not necessary. After all, the capacity for conscious thought would have been favored by natural selection simply on the basis of doing something better or more thoroughly than unconscious processes, even if the unconscious could occasionally do something along the same lines well enough to produce an experimental finding. For example, one recent paper has proposed that the unconscious can do some arithmetic (Sklar et al. 2012). Even if this finding could measure up to the methodological standards proposed by N&S, we think that is hardly a reason to dismiss the usefulness of conscious thought for mathematical work. Does anyone seriously think that a student could pass a college math test without conscious thought?

Key themes from our survey of experimental findings on conscious causation (Baumeister et al. 2011) included the following: Conscious thoughts integrate across time. That is, conscious thought permits the deliberate combining of past and future into causing present behavior, as well as helping present cognitions to cause future behavior, and probably other combinations. Most animals live largely in the present, whereas the stupendous success of the human race has benefited immensely from integrating across time – for which conscious thought probably deserves much of the credit.

Conscious thought also helps translate abstract principles into specific behaviors. Humankind has benefited from moral principles, legal rules, economic calculations, application of scientific and mathematical principles, and other sorts of general, abstract understandings. The unconscious may be effective at processing highly specific stimuli and responses, but without conscious thought, it may lose most of the benefits of abstract principles for guiding behavior.

We also found that conscious causation of behavior was typically found in situations involving multiple possibilities, such as for deliberating among multiple possible courses of action by considering their likely consequences. Consciousness enables the person to mentally simulate nonpresent realities, including possible sequences of future events. In our view, the jury is still out on whether the act of choosing is conscious or unconscious – but most decisions will be considerably more effective insofar as one uses conscious thought to ponder what each possible action will produce and the desirability of downstream consequences.

Last, and perhaps most important, consciousness is highly useful for communication. We have not heard even the most assertive critics of conscious thought claim that a person could carry on a conversation unconsciously. Indeed, we think that the evolutionarily decisive advantages of conscious thought are not to be found in private, solipsistic ratiocination but rather in its contribution to communication (Baumeister & Masicampo 2010). Humankind's biological strategy for surviving and reproducing has been centrally based on sharing information and coordinating joint performance. Although the principle that thinking is for doing has been widely considered sacrosanct since first asserted by William James (1890), we propose that a viable partial alternative is that conscious thinking is for talking.

In sum, we applaud N&S for pushing the field forward. Conscious thought is a vital part of human life. We think the view that humans could operate effectively without conscious thought will soon be regarded as quaint and naïve.

The problem of consciousness in habitual decision making

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Abstract: Newell & Shanks (N&S) carry out an extremely sharp and static distinction between conscious and unconscious decisions, ignoring a process that dynamically transfers decisions and actions between the conscious and unconscious domains of the mind: habitual decision making. We propose a new categorisation and discuss the main characteristics of this process from a philosophical and neuroscientific perspective.

Newell & Shanks (N&S) establish the elements of a decision by using the lens model (Brunswik 1952). According to their framework, decisions can be *either* conscious or unconscious: In the former, all five stages of the lens model are supervised by consciousness, whereas in the latter at least one of the five elements is unconsciously performed. In our opinion, this is an extremely sharp distinction that leaves out of the picture aspects of a crucial importance in action selection, such as habits or habitual decision making.

Human agents make many decisions every day, some of which are fully unnoticed. Considering the role of consciousness in the course of decision making, we propose three categories in which a decision can be included: (1) conscious decisions, (2) retrospective attributions to unconscious behaviour, and (3) non-conscious but controlled decisions. The first type refers to deliberative decisions, which are made when facing a problem that requires a high cognitive load, especially involving a novel situation. Retrospective attributions are actions performed under low or nonexistent levels of consciousness, and whose meaning is attributed

a posteriori according to its effect; they include the illusion of conscious will (Wegner 2004), whose extreme interpretation suggests that consciousness is just a result of brain function. In our opinion, N&S only consider these two categories throughout their review, skipping the third type: rationally motivated decisions that are unconsciously performed but continuously open to conscious control. This omission disregards the dynamic aspect of decision making, which is contributed by learning. To illustrate the importance the third category of our classification has in human decision making, we will focus on technical habits.

Technical habits such as driving, painting, playing an instrument, or handwriting involve a high number of "decisions" – understood as the selection of a cognitively motivated course of behaviour – in their performance. Considering the lens model, most of them are unconscious in every stage of the process, since the agent does not even realise that a decision has been made. However, when a difficulty or something novel appears, consciousness immediately regains control of the process. At this point, it becomes evident the importance of previous learning and the dynamic aspect of decision making. Through habit learning, the agent transfers some particular actions from a conscious to an unconscious performance, without losing the capacity to consciously intervene at any time. Neuroscientific literature often identifies habits with automatic behaviour, interpreting them as a simple stimulus–response pair (see Seger & Spiering [2011] for a review). As it has been recently proposed (Bernacer & Gimenez-Amaya 2012), we believe that this view considers only the unconscious aspect of habit's performance and ignores the continuous access that consciousness has to regulate the process. In fact, we propose that *habitual decision making* should be considered an overall conscious rather than an unconscious operation, because it is consciously initiated and accessible to conscious control at all times. Another reason to support *habitual decision making* as an overall conscious process can be found in its comparison with instincts (Brigandt 2005; Lorenz 1950). From the point of view of ethology, both – learned habits and innate instincts – include unconscious stages that contribute to a final conscious and cognitive goal. However, there is an important distinctive feature between them: When an instinct is abruptly interrupted, the whole operation ends. By contrary, when a non-conscious but controlled process is suspended, it is substituted by the conscious performance of the action.

We acknowledge new difficulties arise when including habits in decision making. The first of them is the most basic: how to delimitate a decision in this scenario. When a pianist is improvising, is he or she deciding to play each note, each chord of the whole melody? In our opinion, as it happens with actions, a decision has to be defined by its aim (Murillo 2011). Thus, in this particular example, the pianist decides to improvise. However, denying that this conscious decision – improvising – initiates many other non-conscious decisions – each key stroke, which has become non-conscious through habit learning – is a partial view of the process. For that reason, we believe that a more flexible understanding of the role of consciousness in decision making may be beneficial to have a more accurate view of the whole process.

In addition, it should also be considered the experimental difficulties to assess habit learning in the laboratory. The acquisition of a habit is usually measured by the decrease in the number of errors and the reduction of serial reaction times when repeatedly performing a sequence of movements (Aznarez-Sanado et al. 2013). Furthermore, experiments usually include a second task to be performed at the same time as the "automatic behaviour" (Wu et al. 2004). This approach involves the additional difficulty of distinguishing which brain activity pattern corresponds to which task. Although the neural bases of consciousness is a highly debated matter, cognitive cortical and subcortical areas had been associated to conscious performance of actions, whereas motor and premotor regions of the cortex, the posterior striatum, and cerebellum are considered to be in charge of subconscious processes. A recent study assessed early motor learning in the course of a continuous motor task by using functional magnetic resonance imaging. Brain activation progressively decreased in prefrontal cognitive regions and, conversely, increased in motor-related brain areas. Interestingly, an enhanced connectivity between the posterior putamen – a motor-related region – and the hippocampus was found, which supports the hypothesis of interactive cortico-subcortical memory systems in the course of learning (Fernandez-Seara et al. 2009). To the best of our knowledge, a reliable neuroscientific study of technical habits is yet to be achieved. For that reason, we believe it is extremely important to lay solid theoretical foundations for an adequate experimental approach.

To conclude, N&S give an interesting overview about the lack of reliable evidence to demonstrate the role of unconscious drivers in decision making. However, their static framework does not allow the inclusion of habit learning, a fundamental element in decision making that involves a continuous transference of actions between the conscious and unconscious domains of the mind.

Unconscious influences on decision making in blindsight

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Abstract: Newell & Shanks (N&S) argue that an explanation for blindsight need not appeal to unconscious brain processes, citing research indicating that the condition merely reflects degraded visual experience. We reply that other evidence suggests blindsighters' predictive behavior under forced choice reflects cognitive access to low-level visual information that does not correlate with visual consciousness. Therefore, while we grant that visual consciousness may be required for full visual experience, we argue that it may not be needed for decision making and judgment.

Blindsight – the ability that some people with striate cortical lesions have to make solid predictions about visual stimuli in the absence of any reported visual awareness – is a paradigmatic example of unconscious perceptual influence on conscious behavior. Newell & Shanks (N&S) are skeptical about the influence of unconscious processes on decision making in blindsight, given that blindsight seems to have alternative explanations that do not appeal to unconscious processes. To back up their claim, they cite research indicating that blindsight may just be degraded visual experience (Campion et al. 1983; Overgaard 2011; Weiskrantz 2009). A review of further empirical and theoretical work in the area of blindsight reveals that N&S's conclusions primarily based on Overgaard's (2011) findings on blindsight are premature (Brogaard 2011a; 2011b; 2011c; 2012a; 2012b; Cowey 2001; Hardin 1985; Heywood & Kentridge 2003; Stoerig & Cowey 1992).

Using a multipoint awareness measurement (PAS), Overgaard (2011) shows that the reported degree of conscious experience in blindsight correlates with the blindsight subjects' predictive success in visual tasks. These considerations appear to indicate that it is conscious perception, rather than unconscious processes, that is responsible for blindsighters' predictive behavior. For these reasons, N&S conclude that we need not appeal to unconscious processes in explaining blindsighters' success in decision making. However, Overgaard's studies do not completely rule out that the reported awareness that corresponds to predictive

success in blindsight is awareness associated with the higher-order predictive act rather than genuine *visual* awareness. The subjects may not have the ability to distinguish between being aware of thoughts or judgments and being visually aware of a visual stimuli (Brogaard 2011a; 2012b), in which case the PAS studies don't show that unconscious influences are not needed for the predictive behavior.

Further, it's only under forced-choice paradigms that blindsighters are in a position to make predictions about visual stimuli. This suggests that, unlike neurotypical individuals, blindsighters lack full visual awareness in their access to visual information. Even if Overgaard's findings are granted, blindsighters' degraded conscious experience may reflect cognitive access to low-level information deriving from visual, *unconscious* processes taking place in the retina and the lateral geniculate nucleus (LGN) (and perhaps to some extent in V1). Likewise, the correlation between accurate responses and subjective reports of consciousness may only reflect the subject's level of cognitive access to information derived from visual, unconscious processes. If this is the case, then visual processes that do not correlate with visual awareness may well be at work in blindsighters' decision making, even if the information that is unconsciously processed can be cognitively accessed in forced-choice paradigms. In the light of such observations, N&S's conclusion to the effect that blindsighters' predictive behavior is not influenced by unconscious processes does not hold up.

Theories and research about color processing, together with blindsight data, provide additional evidence that blindsighters must be tapping into unconscious processes in order to make successful predictions about visual stimuli (Brogaard 2011a; 2011c). Although blindsight patients have lesions to striate cortex, they can still process information from opponent processes in the retina and the LGN. The Hering–Hurvich–Jameson opponent-process theory is the most popular explanation of how the brain interprets signals from the cones and rods in the retina (Brogaard 2012a; Hardin 1985). Three types of cones (L for long, M for medium, and S for short) are responsible for detecting chromatic (colored) daylight, while rods are responsible for detecting achromatic (black-white) nightlight. Because the three types of cones overlap in the wavelengths of light they record, color is processed via three opponent channels manifested in bipolar cells. These cells measure differences between red (L) and green (M), blue and yellow (the differences between L plus M and S), and black and white (the sum of L and M). For example, when the activity of M exceeds L, the resulting perceived color is green. When the activity of S exceeds the joint activity of L and M, the perceived color is blue.

Blindsighters can detect these outcomes, and yet they have degraded function of the double opponent cells of striate cortex and in areas upstream from the primary visual cortex. As a result, they cannot detect the standard dimensions of color, such as brightness, saturation and hue. Even if damage to V1 does not prevent weak visual experiences, it does preclude full visual experience of colors (Brogaard 2011a; 2011b; 2011c; 2012b; Hardin 1985; Stoerig & Cowey 1992). Likewise, people with achromatopsia, which results from a defect to the V4/V8 color complex, lack conscious color experience of the full range of colors (Brogaard 2011a; Heywood & Kentridge 2003; Heywood et al. 2001).

Despite reporting no or only weak awareness of visual stimuli, blindsighters are able to act reliably in response to wavelengths of light presented to their blind field region, or scotoma. For example, Stoerig and Cowey (1992) showed that under forced choice, three blindsighters were able to discriminate among narrowband wavelength stimuli despite lacking experience of any conscious visual stimuli. A more recent study showed that inhibiting activity in V1 via transcranial magnetic stimulation (TMS) can result in the absence of color awareness in neurotypical individuals despite the retained ability to discriminate among wavelengths in a forced-choice paradigm (Boyer et al. 2005).

Studies have also shown that blindsighters can be trained to detect wavelengths in the absence of conscious color experience (Bridgeman & Staggs 1982; Stoerig & Cowey 1992; Zihl 1980; Zihl & Werth 1984). Stoerig (1993) presented the case of patient F.S., who initially, for several years, showed no statistically significant detection of visual stimuli. However, his performance eventually began to improve. The trainability of blindsighters provides further evidence that blindsight patients do in fact lack conscious visual experience. If blindsighters did have degraded visual perception, we should expect subjective reports made by trained subjects to reflect greater visual awareness in correspondence to their improved ability to accurately respond to visual stimuli. This, however, is not the case. Trained blindsighters consistently report no or only weak conscious visual experiences. Although patients such as F.S. consistently report a lack of conscious visual experience, trainability suggests that these blindsighters learn to report on other information that may be easily available for conscious access. In these cases, blindsighters presumably act on the physical bases of color experience despite lacking normal conscious visual experience.

Thus, while visual consciousness may be needed for full visual perception, certain cases show that visual consciousness may not be needed for decision making and judgment.

Cognitive access to information processed unconsciously appears to suffice for reliable decision making in blindsight. In these cases visual information that does not correlate with visual consciousness influences predictions about features of the visual stimuli present in the subject's blind field.

Unconscious influences on decision making: Neuroimaging and neuroevolutionary perspectives

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Abstract: Newell and Shanks provide a useful critique on unconscious decision making. However, they do not consider an important set of functional brain imaging studies of unconscious processes. Here we review briefly the relevant brain imaging and psychobiological literature and its implications for understanding unconscious decision making.

Newell & Shanks (N&S) argue that priming studies, although promising, are flawed by inadequate self-report measures of awareness. However, functional magnetic resonance imaging (fMRI) subliminal priming studies (which are perhaps more objective than self-report measures) should also be taken into account. In such work, differences in brain activation are observed between stimuli that are consciously versus subliminally perceived. Thus, in a recent meta-analysis by Brooks et al. (2012) of subliminal fMRI studies, it is notable that non-conscious salient stimuli robustly activate the amygdala and hippocampus – brain regions linked to emotional arousal (Costafreda et al. 2008) and memory (Garcia-Lazaro et al. 2012). In the meta-analysis, most studies used highly salient subliminal emotional faces, but subjects reported a lack of awareness of these faces, and there was no activation of the fusiform gyrus, a region of the occipital cortex well-known to be involved in conscious recognition of faces (Weiner & Grill-Spector 2012). Furthermore, when comparing brain responses to the same affective stimulus, presented either with or without awareness, our data indicate that there is a switch from insular cortex (associated with conscious interoceptive awareness) to posterior cingulate cortex activation (associated with default mode network and auto-affective processing), and that the anterior cingulate cortex (ACC) activates in response to both levels of perception (Meneguzzo et al., under review). The

ACC is implicated in decision making, particularly with respect to conflict monitoring and error detection, as well as cognitive control (Carter & van Veen 2007), perhaps especially during high-anxiety states (Ursu et al. 2003). Thus, decision-making processes may be mediated by areas such as the ACC, and they are influenced by non-conscious affective states (Panksepp 2005).

Subliminal fMRI findings are consistent with a view that automatic activation of affective processes probably guides evolutionarily advantageous decision-making mechanisms (Panksepp 2005; 2011a). Such affective processes have evolved to respond efficiently to environmental threats and appetitive stimuli, are mediated by a range of neuroendocrine and neurotransmitter systems, and operate at least partially outside of awareness (Damasio 2010; Kahneman 2011; Le Doux 1996; Panksepp 2005). The involvement of evolutionarily ancient mesolimbic brain regions, such as the amygdala, hippocampus, and striatum, as well as brain stem structures (e.g., the periaqueductal gray) during affective states, underlines their importance in adaptation (Alcaro & Panksepp 2011; Panksepp 2011b, Stein et al. 2006). The activation of these core brain regions presumably occurs with less conscious and less cortical processing in non-human species, and yet it is still meaningful in the decision-making process. Consistent with the findings emerging from the imaging of subliminal processes, neuroimaging work during exposure to threat cues highlights the role of similar brain regions. For example, Mobbs et al. (2007) demonstrated that the imminence of threat shifts brain activation from prefrontal regions to periaqueductal gray, particularly in terms of the degree of dread and lack of confidence in the decision to escape, supporting the notion that automatic brain processes are more prominent under highly arousing affective states.

Most subliminal fMRI studies convincingly assess the lack of awareness with a "forced choice" task post hoc (choosing between a *novel* and a previously subliminal image), which is further corroborated by the participants' inability to recollect verbally any subliminal affective stimulation during the scan (e.g., Brooks et al. 2012). Future fMRI studies using subliminal paradigms must ensure, as N&S emphasize, awareness checks that enable reliable self-report, are relevant to the task, immediately precede the subliminal stimulus, and are sensitive to the subliminal cues. Subliminal fMRI studies may provide an attractive methodology for overcoming some of the discrepancies outlined by N&S in the field of subliminal priming research. In line with N&S's arguments, given that subliminal fMRI studies have not yet probed decision making, this may be a particularly useful component of such work. An evolutionary theoretic framework may be useful in future work to provide an ecologically valid approach to choosing and analyzing relevant cues. Connectivity analyses in subliminal fMRI studies may be useful in probing not only localized brain function, but also in developing network models of the neural circuitry of non-conscious processes. Finally, rigorous studies of different subliminal cues may well be informative in the study of a spectrum of psychopathologies (Stein 1997).

Unconscious influences *of*, not just *on*, decision making

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Abstract: This commentary focuses on the bidirectional links between unconscious influences and decision making. In particular, it examines the extent to which awareness is (not) necessary to the impact of decisions on psychological processes such as preferences. This analysis might help researchers to gain an extended perspective of Newell & Shanks' (N&S's) concerns regarding the role of unconscious influences in theories of decision making.

Newell and Shanks' (N&S's) article covers several major domains of research in psychology in order to question the idea that unconscious influences play a major role in decision-making processes. They do not, however, make any mention of the extent to which decisions could subsequently lead *to* unconscious influences. Nonetheless, it seems important to discuss this aspect, as it echoes the concerns raised by N&S in a directly related matter.

Unconscious influence of decisions – the case of preferences. In principle, decisions may exert unconscious influence on virtually any psychological process. We will here restrict our analysis on the influence of decisions on preferences. This influence has been extensively replicated (e.g., Harmon-Jones & Mills 1999), although the exact nature of the mechanisms at play has recently been debated (e.g., Chen & Risen 2010). Here, we focus on a different aspect: the level of processing (unconscious vs. conscious) that is required for the modulation that decisions can exert on preferences, which is controversial.

The assumption of awareness. The influence of decisions on preferences can be summarized as follows: After a decision between two *similarly liked* alternatives (and only in those instances), the chosen one is rated as more pleasant and the rejected one as less pleasant (Brehm 1956). Classical authors (have argued that the impact of decisions on preferences requires awareness (Festinger & Walster 1964; Wicklund & Brehm 1976). Thus, one is assumed to be aware that one's choice is in conflict with the desirable aspects of the rejected option and with the undesirable aspects of the chosen one, both options being similarly liked. The awareness of this conflict is assumed to lead to the need for cognitive dissonance reduction (Festinger 1957), that is, in this case, readjusting one's preferences to be more in line with one's choice – by devaluing the rejected option and/or valuing the chosen one more positively.

Distraction from awareness. Lyubomirsky and Ross (1999, study 3) have shown that distracting participants reduced postchoice preference modulation. In the same vein, Allen (1965) showed that the modulation of preferences following a difficult choice was *less* pronounced when postchoice time was filled with an extraneous cognitive task. As put by McGregor et al. (1999), "individuals seem to have a remarkable capacity for avoiding awareness of inconsistencies unless their noses are quite vigorously rubbed in them" (p. 331). In these experimental settings, decisions *do not* impact preferences *as much* when awareness of the dissonance (which is assumed to drive this impact) can be avoided. In other words, awareness appears to be required in postchoice preference modulation.

How can this evidence be related to N&S's discussion? Although the design of these experiments is different from the deliberation-without-attention paradigm, the two criteria[1] that need to be met in this paradigm can be argued to also apply here. Criterion 1 was met in both experiments: Distracting participants led to significantly lower postchoice preference modulation than when participants were not distracted. However, just as in the case of the deliberation-without-attention paradigm, criterion 2 was not so well accounted for. In Lyubomirsky and Ross's (1999) experiment, criterion 2 could not be assessed: The second measurement was made 8 minutes after the decision, but no immediate condition was run. In contrast, Allen's (1965) experiment includes four conditions: 2 and 8 minutes of cognitive rest, as well as 2 and 8 minutes of cognitive activity. Preference modulation at 8 minutes in the cognitive activity condition was lower than the one at 2 minutes (independently of the condition), which supports the idea that awareness is a necessary requirement for preference modulation by choice.

Recent evidence against the necessity of awareness. Recent empirical data have, however, questioned the assumption of the necessity of conscious processes in the impact that decisions can

exert on preferences. These experiments have investigated this impact in three ways. First, patients with anterograde amnesia were asked to make decisions, which they were, due to their condition, unable to consciously recall (Lieberman et al. 2001). Second, healthy participants were asked to make several decisions. Their conscious memory for these decisions was measured in an incidental memory task at the end of the experiment. This makes it possible to dissociate the impact of consciously *forgotten* decisions from the impact of consciously *remembered* decisions on preferences (Coppin et al. 2010). Third, participants were presented with decisions that they had *not* in fact made themselves. This third approach has been applied to both rhesus monkeys (Egan et al. 2010) and human participants (Sharot et al. 2010). In all of these three experimental contexts, participants' lack of decision memory makes it highly unlikely that experimental demand effects might be at play. Unconscious influences of decision on subsequent preferences were nonetheless *still* reliably demonstrated.

These experimental settings control the potential pitfalls of experimental demand or social desirability effects (i.e., reliability criteria) by targeting the conscious memory of the decision. Thus, although participants' attention was not, per se, diverted away from the experiment's hypothesis, participants could not be consciously acting in a way that fits the experimenter's hypothesis. As recommended by N&S, the most recent literature on the (potentially unconscious) impact of decisions on preferences has moved away from the deliberation-without-attention framework by replacing it by this type of experimental setting. The similarity between the literature of the unconscious influences on decisions and the literature on the unconscious impact of decisions is striking in this respect.

Conclusion. The debate regarding the extent to which decisions can exert an unconscious influence on preferences echoes the discussion of N&S on the extent to which unconscious influences are at play in decisions. Experiments tailored to investigate unconscious influences *on* or *of* decisions might consequently equally consider N&S's discussion. By adopting this perspective, future experiments might lead to fascinating debates regarding N&S's conclusion that unconscious influences "should not be assigned a prominent role in theories of decision making and related behaviors" (target article, sect. 1).

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NOTE

1. "Demonstration of the benefit of unconscious thought on choice requires two criteria to be satisfied. First, choices following distraction need to be significantly better than those following deliberation, and second, they need to be better than those following an immediate decision" (target article, sect. 3.1). Note that if one assumes that awareness *is* required in postchoice preference modulation, predictions are the exact opposite of the ones quoted. Thus, in the experiments described here, postchoice preference modulation following distraction needs to be significantly *lower* than the one following deliberation (criterion 1), and it needs to be *lower* than the one measured right after the decision (criterion 2).

Newell and Shanks' approach to psychology is a dead end

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Abstract: Newell & Shanks (N&S) criticize theories on decision making that include unconscious processes. To the extent that their own perspective becomes apparent, however, it is dated, implausible, and at odds with the major developments of the past decades. Their conclusions are, at least for research areas we feel entitled to evaluate, based on a biased sampling of the literature.

Although we think that the development of our field benefits from critical discussion, the scientific contribution of the current target article escaped us. It is neither a theoretical article, as it lacks a theory, nor is it a good review article, because it is biased and selective. In our commentary, we first focus on the lack of theory and subsequently on the misleading treatment of the literature.

In our view, the goal to incorporate processes that we are not conscious of in our theories was at least partly sparked by the wish to make our field more mature. Making psychology compatible with philosophy and neuroscience and getting rid of homunculi was, and is, a worthwhile endeavor. This goal led to a burgeoning number of theories and models on unconscious processes – in which there usually is a role for conscious processes, though a modest one – and critical responses from colleagues who maintain that all important psychological processes are guided by consciousness.

Newell & Shanks (N&S) defend an extreme version of the latter position, but fail to provide a reasonable alternative. If conscious thoughts do not have unconscious precursors, as N&S seem to believe, then where do they come from? Unless one believes that consciousness freely hovers in the air, or is in direct contact with the gods, claiming that psychological processes start in consciousness without further ado does not make sense. The house N&S try to build stands on scientific quicksand.

N&S's lack of theory is all the more disappointing in light of the recent scientific progress on the distinction between attention and consciousness, and on the relation between conscious and unconscious processes (Dehaene et al. 2006; Dijksterhuis & Aarts 2010; Koch & Tsuchiya, 2006; Lamme, 2003; Wegner & Bargh, 1998). Unfortunately, they completely ignore this literature. Perhaps needless to say, stating "it's all starting in consciousness" may have been satisfactory to Descartes, but it doesn't work in the twenty-first century.

The target article also falls short of being a comprehensive review. It was mystifying to us why one would criticize the work by Libet (1985) without at least mentioning groundbreaking recent additions (e.g., Soon et al. 2008), or why one would question prime-to-behavior effects on the basis of a few nonreplications without acknowledging the fact that such effects have been reported in well over a 100 papers.

Unavoidably, we read the section on unconscious-thought theory (UTT) attentively (sect. 3.2). We found the reasoning often flawed and the degree of cherry picking too extreme. However, we do agree with some observations of N&S. The strength of the initial evidence for unconscious-thought effects (UTEs) was indeed rather weak. The strong early claims such as the one "to leave decisions to the unconscious" (Dijksterhuis et al. 2006a) were, in retrospect, naïve. Finally, UTEs have been proven far from robust. It is indeed likely that there is a publication bias, but we all know this is a general problem, at least in psychology. Show us a psychological phenomenon studied in over 30 experiments, convince us there is no publication bias, and we will send an expensive bottle of wine.

That being said, the way N&S treat the UT literature does not do justice to the field. To begin with, they pre-emptively formulate some arbitrary inclusion criteria that allow them to discard dozens of experiments supporting UTT. On top of that, they ignore many papers fully compatible with their own criteria that do support UTT (e.g., Ham & van den Bos 2010a; 2010b; 2011; Ham et al. 2009; Handley & Runnion 2011; McMahon et al. 2011; Messner & Wänke 2011). An emphatic reader will understand that for people who have contributed to unconscious-thought research, reading this section was a tad discouraging.

N&S also suggest alternative explanations. They cite Newell et al. (2009), who asked participants to indicate their own attribute weights after they made their choice (instead of weights

predetermined by the experimenter). Using these idiosyncratic a posteriori weights, choices in the conscious thought condition were just as good as in the unconscious thought condition. Obviously, participants are capable of generating post hoc weights that justify their previous choice. Usher et al. (2011) measured participants' idiosyncratic attribute weights before the decision task and found the unconscious thought advantage predicted by UTT. N&S should have concluded that this completely refuted their idiosyncratic weights explanation, but they refrained from doing so because Usher et al.'s study did not satisfy their inclusion criteria (which are obviously irrelevant for his particular conclusion). Furthermore, they mention the possibility that participants make decisions before they can engage in unconscious thought, but fail to say that this explanation has already been ruled out in studies they conveniently disregarded (e.g., Bos et al. 2008).

We are optimistic about unconscious thought research, despite the clear limitations alluded to above. In a recent meta-analysis (Strick et al. 2011), moderators were found that led the UTE to be replicated with greater ease. Furthermore, new additions to the literature, such as a paper integrating UTT with fuzzy trace theory (Abadie et al. 2013), and a paper reporting the first fMRI evidence for UT (Creswell et al. 2013) have appeared recently.

More generally, we strongly argue that consciousness and conscious decisions are best understood by their relation to unconscious processes. The most sensible approach to learn about conscious decisions is thus to consider higher cognitive operations as unconscious, and test what (if anything) consciousness adds rather than the other way around (e.g., Dijksterhuis & Aarts 2010; van Gaal et al. 2011; Zedelius et al. 2012). Although we surely agree that the road to progress in this field is rocky, focusing on consciousness without understanding its unconscious precursors is a dead end.

The presumption of consciousness

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Abstract: Throughout this article the authors presume – without justification – that decision making must be a conscious process unless proved otherwise, and they place an unreasonably strict burden of proof on anyone wishing to claim a role for unconscious processing. In addition, I show that their arguments do not, as implied here, impact upon contemporary dual-process theories of reasoning and decision making.

There are two aspects of this article upon which I would like to comment. The first is the extraordinary *presumption of consciousness* that runs through the entire piece, and the second is the misconceived attack on dual-system theories that appears towards the end.

Newell & Shanks (N&S) hold a strong presumption of consciousness with which they view all evidence. We can understand this by analogy to the presumption of innocence enshrined in those criminal justice systems based upon English common law. A decision process is conscious until proven unconscious; the burden of proof lies with those wishing to argue for unconscious decision making, and they must prove their case beyond reasonable doubt. Take, for example, the work on multicue learning and judgment reviewed early in the article. As the authors acknowledge, there are a number of studies, including those conducted in my own laboratory, which show that people can learn to make such judgments without being able to describe the basis for their choices as explicit knowledge. But using their presumption of consciousness and a very strong set of criteria (N&S Table 1), they nevertheless argue that the case for any of the actual learning or decision making being unconscious is not proven.

I ask the reader for the moment to adopt the opposite presumption: that decision making is unconscious unless proven beyond reasonable doubt to be conscious. How much harder would it be for the advocates of conscious reasoning to prove their case on this evidence than it was for their opponents under the opposite presumption? Even taking the civil law criterion of "balance of probabilities," would the evidence again not clearly favour the advocate of the unconscious? It would obviously be easier for all of us to place a much stronger burden of proof on our theoretical opponents than we apply to ourselves, but we would clearly need to have a very strong justification for so doing. None is provided by the authors. The only basis for their presumption that I can see is common sense or folk psychology, as the everyday belief in conscious decision making is indeed widespread. In support of this, they do in places state or imply a default "intuitive" position of conscious thought.

The definition of conscious decision making that appears implicit in the authors' writing is "that which is accessible to awareness as evidenced by verbal report." On this basis, I would argue for the opposite presumption to theirs. First, it is clear that while the processing capacity of the brain is vast, the thought of which we appear to be aware or able to report is very limited. Second, and despite the authors' attempt to discredit it, there is much evidence that our self-knowledge is poor and our verbal reports of our mental processes most unreliable. Finally, it borders in the mystical (or at least Cartesian dualism) to think of consciousness as some kind of "mind stuff" that has powers of causation. All of our conscious experiences are a product of the brain, because there is nothing else they could be. A conscious decision is one of which we become (at some point) conscious, nothing more nor less (see Evans 2010, Ch. 7).

Not only do the authors believe they have discredited the idea of unconscious thinking, but also that in the process that they have successfully attacked dual-system and dual-process theories of higher cognition. Such theories distinguish between two kinds of processing: Type 1, which is fast, is automatic, and has high processing capacity, and Type 2, which is slow, is deliberative, and has low processing capacity (also known as System 1 and 2; see, e.g., Evans 2007; 2008; Kahneman 2011; Stanovich 2011). It is true that the distinction between conscious and nonconscious processing has been emphasised by some social psychologists (e.g., Wilson 2002), but it is emphatically *not* the foundation for contemporary dual-process theories of reasoning and decision making. As a dual-process theorist, I have argued, in common with others, that the conscious/unconscious decision *cannot* be the basis for the dual-process distinction because it is too vague and fails to define the key central properties of dual processing (Evans & Stanovich 2013). I should also point out that in spite of defending the validity of much of the research that N&S criticise here, I have *in common with them* critiqued unconscious thinking theory and other strong assertions of the powers of intuition (see Evans 2010, Ch. 4). This is because dual-process theory confines powers of reflective reasoning – and with it the ability to deal with novel and difficult problems – to Type 2 processing.

The case for dual process is in fact based not on the conscious/unconscious distinction but on the claim that there are two forms of cognitive processing which have distinctive properties and which reflect the operation of distinct cognitive and neural systems. Most of these properties are merely typical correlates, and few are defining features (Evans & Stanovich 2013). I agree with Stanovich that Type 2 processing is distinguished both by its cognitive resources (central working memory, correlation with measures of cognitive capacity) and by its ability to engage

in cognitive decoupling and hypothetical thinking. The apparent link of dual-process theory with consciousness comes only from the fact that some of the items attended in working memory are available to verbal report. But using broader definitions of consciousness, I have argued in detail that both Type 1 and Type 2 thinking have aspects that are conscious as well as unconscious (Evans 2010, Ch. 7).

In conclusion, not only do I reject the authors' presumption of conscious decision making, which I believe to be shakily founded on folk psychology, but I also contest their implication that the conscious/unconscious distinction is the basis for contemporary theories of dual processing in higher cognition.

Dismissing subliminal perception because of its famous problems is classic "baby with the bathwater"

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Abstract: Newell & Shanks (N&S) appeal to well-known problems in establishing subliminality to argue that there is little convincing evidence that subliminally presented stimuli can affect decision making. We discuss how recent studies have successfully addressed these well-known problems and, in turn, have revealed clear evidence that subliminally presented stimuli can affect decision making.

Newell and Shanks (N&S) argue that there is little convincing evidence that subliminally presented stimuli can affect decision making, because of two artifacts that can influence such experiments: conservatism of response criteria and effects of task difficulty on motivation. Our view is that both artifacts can be avoided and that recent studies that have avoided them have revealed clear evidence that subliminally presented stimuli can affect decision making.

Conservatism of the response criterion. N&S use the study by Hassin et al. (2007) to illustrate the response bias problem. In this particular study, subjects were asked to indicate if a masked stimulus was an Israeli flag or a control stimulus (scrambled flag). In such a "yes/no" task, subjects might adopt a conservative decision criterion and respond "no" even on those occasions in which they had a fleeting glimpse of the real flag. While this is a real concern, it is easily addressed. One solution is to calculate a bias-free measure (d′), which is a standard technique in signal detection theory (Green & Swets 1966). Another solution is to use a two-alternative forced-choice (2AFC) paradigm, where subjects are provided with both possible stimuli simultaneously and their task is to indicate which one of the two had been presented immediately before as the masked stimulus. The advantage of using the 2AFC paradigm is that it (1) greatly discourages response biases and (2) generally provides a more sensitive measure of stimulus detection and/or discriminability (Macmillan & Creelman 2004. There are now several reports of subliminal perception in the literature that have used the 2AFC paradigm to assess subjects' awareness of the masked stimuli (cf. Dell'Acqua & Grainger 1999; Finkbeiner 2011; Finkbeiner & Palermo 2009). Thus, the response-conservatism artifact is not an intractable problem, and so claims of subliminal perception affecting decision making should not be dismissed simply because this is a well-known problem.

Effect of task difficulty on motivation. A somewhat more difficult problem to address is the task-difficulty artifact (Pratte & Rouder 2009). In the standard subliminal perception experiment, subjects are first asked to classify the targets and, subsequently, the masked stimuli. Evidence in favor of subliminal perception depends upon (1) a reliable behavioral effect in the target-classification task and (2) chance-level performance in the prime-classification task. A concern with this two-task design is that the prime-classification task is, by design, very difficult and, hence, poor performance might be due to task difficulty, not subliminality of the primes. If so, then the prime-classification task will underestimate subjects' awareness of the prime stimuli. This is a well-known problem in the subliminal perception literature that has become known as the "task-difficulty artifact" (Pratte & Rouder 2009). But well-known problems are not necessarily intractable problems. In fact, researchers have long known about the task-difficulty artifact and have addressed it in various ways. The most frequently employed solution is to interleave long-duration primes, which are easier for subjects to classify, into the prime-classification task. That serves to make the prime-classification task easier overall and, hence, is thought to encourage subjects to "keep trying" at an otherwise difficult task (cf. Finkbeiner & Caramazza 2008; Finkbeiner et al. 2004; Grainger et al. 2003; Naccache & Dehaene 2001).

Recently, we sought to eliminate the task-difficulty artifact by bringing performance in the prime-classification task up to ceiling levels (>90% accurate), even while maintaining subliminality (Finkbeiner 2011). We did this by presenting the masked prime stimuli (the words *dog* or *may*) in red or green ink. Immediately following presentation of the masked stimulus, we presented subjects with the four possible prime stimuli (formed by crossing the two prime words with the two ink colors) and asked them to point to the correct one. Using this task, we found that subjects were very good at color identification (>90%), but were at chance at word identification (~50%). Thus, the task-difficulty artifact is not an intractable problem, and so, again, claims of subliminal perception should not be dismissed simply because this is a well-known problem.

A third problem: null sensitivity. A far more pernicious problem, and one that N&S do not mention, is the null-sensitivity problem. Here the problem has to do with a lack of sufficient power for the standard null hypothesis significance test (NHST) approach to accurately resolve performance that is only slightly above chance levels. It may seem that the solution would be to increase the power of the experiment, but this is ultimately not feasible. For example, with a sample size of 21 subjects with a mean *true* performance of 52%, one would need approximately 570 prime-classification trials to bring the probability of *wrongly* accepting the null hypothesis down below 5%. With a true performance of 51%, approximately 2,300 trials would be needed. This is the null-sensitivity problem, and trying to resolve it through the addition of more and more trials is not practical for most researchers or their subjects.

Fortunately, the standard NHST approach is not the only way to test for chance-level performance. In a series of recent articles, Rouder et al. (2007) and Morey et al. (2008; 2009) have introduced a hierarchical model within the Bayesian framework that offers researchers a way to resolve the null-sensitivity problem. They have termed this the mass-at-chance (MAC) model. A virtue of MAC is that it penalizes underpowered designs, thereby mitigating the null-sensitivity problem. Small sample sizes yield highly variable posterior estimates of subjects' latent abilities, which makes it more difficult to claim subliminality (Rouder et al. 2007). In one recent study (Finkbeiner 2011), we used the one-parameter MAC model (Morey et al. 2008) and found that, with 9:1 odds in favor of subliminality, our experiment yielded 16:1 odds in favor of priming. Thus, even the most difficult problem in the subliminal perception literature, the null-sensitivity problem, is not without solutions.

Conclusion. We conclude, *contra* N&S, that recent studies have provided clear evidence that subliminally presented stimuli can affect decision making.

How necessary is the unconscious as a predictive, explanatory, or prescriptive construct?

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Abstract: We elucidate the epistemological futility of using concepts such as unconscious thinking in research. Focusing on Newell & Shanks' (N&S's) use of the lens model as a framework, we clarify issues with regard to unconscious-thought theory (UTT) and self-insight studies. We examine these key points: Brunswikian psychology is absent in UTT; research on self-insight did not emerge to explore the unconscious; the accuracy of judgments does not necessitate the unconscious; and the prescriptive claim of UTT is unfounded.

Daryl Bem (1972) foresaw a slippery slope in resorting to unconscious processes as explanatory variables. The point was not to deny that mental activity could occur outside of awareness, but to warn researchers about abandoning sound epistemological practices when explaining phenomena. We add to this a concern about deriving prescriptions from theories that have not been extensively tested; from studies that have not been widely replicated; and from the usage of terms, such as *unconscious*, that have not been consistently defined. In this light, we commend Newell & Shanks (N&S) for their critical review of unconscious influences on decision making and agree with their conclusions. However, we identify areas needing clarification following their use of the lens model (Brunswik 1952; Hammond & Stewart 2001) as an interpretive framework.

Greenwald (1992, p. 775) concluded that unconscious cognition occurs rapidly and is "severely limited in its analytic capability." In contrast, unconscious-thought theory (UTT; Dijksterhuis & Nordgren 2006) assumes a deliberative and temporally extended unconscious that can sift through vast amounts of information to arrive at optimal decisions. UTT experiments, as described by N&S, use a unique multi-attribute evaluation task that presents participants with cue values, sequentially and randomly. We agree with N&S that the evidence supporting the benefits of unconscious thinking is weak. The application of the lens model to research based on UTT, however, is not self-evident. First, N&S identify points within the lens model where *lack of awareness* could take place; however, lack of awareness and UTT's *unconscious processing* do not equate. Second, it is worth adding that UTT is not Brunswikian in spirit. Representative design is absent; most UTT studies use a small set of objects with attributes and their values selected by the experimenters. The cue values are presented in random order across cases in UTT studies, whereas in most judgment situations the unit of information acquisition is organized first by case/object. And in terms of accuracy, UTT uses agreement between judgments and the experimentally defined "best option" rather than by correspondence of judgments with agreed-upon environmental criteria. N&S note that within the lens model, a source of lack of awareness may occur at the weighting of cues stage. We add that this relates to UTT's Principle 4, which claims that unconscious weights the relative importance of attributes in an efficient manner; but the evidence supporting this principle is missing (see González-Vallejo et al. 2008).

From a historical perspective, we note that multiple-cue judgment research did not directly attempt to study unconscious processes, even when considering the topic of self-insight. Hammond (1955) advocated for the use of a quantitative technique to make the judgment process explicit, in the sense of revealing which cues were most influential. The impetus behind this was not rooted in discovering unconscious processes, but simply in the realization that judgments had not been systematically studied and were impacting lives in important domains (e.g., clinical judgments). Because most psychological and physical processes are not easy to verbalize, modern psychological research shifted from relying on verbal reports to using psychometric techniques, and this ensued in judgment research as well. The focus on self-insight evolved from contrasting statistically estimated cue weights with the verbal descriptions of what was important. As N&S show, that agreement is variable, but the goal of the approach was not about understanding unconscious processes but rather about employing statistics to help individuals communicate the basis for their judgments (Hammond & Adelman 1976). More generally, mathematical models of cognition are ubiquitous and use many function forms. The view that individuals may be able to verbalize model parameters, thus showing self-insight, is an interesting but not very useful proposition. Indeed, even if we think mathematical models are about the unconscious, a notion like self-awareness would be unnecessary. We do agree with N&S that the validities of measures of self-insight are questionable, but we add the caveat that both subjective assessments and statistical estimates of parameters depend on a model, so neither has priority over the process they are measuring.

From another perspective, lens model research has yielded a rich body of work (Karelaia & Hogarth 2008). The main results are (a) linear models capture similar and relatively high proportions of variance in environmental outcomes and in human judgments, and (b) judges reach high levels of accuracy when predicting criteria in many domains. Factors that affect accuracy can be safely classified as task/environmental characteristics (see also Stewart et al. 1997). Therefore, on logical grounds, there is little need to resort to unconscious thinking as an explanatory variable of judgments, or as a mechanism for improving accuracy.

Because of Hammond's central role in lens model research, we feel his views on intuition must be mentioned. Cognitive continuum theory (CCT; Hammond 1986; 1996; Hammond et al. 1997) states that both tasks and cognitive processes are located on an intuitive-to-analytic continuum. According to Hammond, most judgment is "quasi-rational," involving a combination of intuition and analysis (Hammond 1996), thus contrasting with dual-process conceptions (Epstein 1994; 2003; Kahneman 2011) and with UTT's first principle of two modes of thought. (We refer the reader to our analysis of this principle in González-Vallejo et al. 2008.) In short, Hammond's notion of quasi-rationality is similar to modern conceptions of cognition. In particular, with the emergence of parallel processing models (e.g., Rumelhart et al. 1986) and more generally connectionist models (Phaf & Wolters 1997), psychologists favor the view that responses reflect a mixture of unconscious and conscious contributions.

We end by revisiting the prescription that complex decisions should be left to unconscious thinking. Many years of research converge on the conclusion that selecting important predictors is best done by experts, but the combination of cues is best left to a statistical tool (Bishop & Trout 2005; Dawes 1979). Imagine a psychiatrist judging the likelihood that a patient will commit suicide; the prescription that she or he should let the unconscious decide is not only wrong, it is also unethical.

Do implicit evaluations reflect unconscious attitudes?

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Abstract: We extend Newell & Shanks' (N&S's) arguments to the question of whether implicit evaluations reflect unconscious attitudes. We argue that correspondence to explicit evaluations fails to meet the criteria of relevance and sensitivity. When awareness is measured adequately and in line with N&S's criteria, there is compelling evidence that people are consciously aware of their implicit evaluations.

Newell & Shanks (N&S) call for a more rigorous study of awareness using reliable, relevant, and sensitive measures that are administered when the relevant mental operation is taking place. In the current commentary, we extend N&S's arguments to implicit evaluations, which can be conceptualized as evaluative responses captured by performance-based measures, such as the Implicit Association Test (Greenwald et al. 1998), evaluative priming (Fazio et al. 1995), and various response interference tasks (for a review, see Gawronski et al. 2011). Implicit evaluations are widely assumed to reflect *unconscious attitudes* that are held outside of awareness (for a review, see Gawronski et al. 2006). Drawing on N&S's conceptual framework, we argue that lack of awareness in the domain of implicit evaluations is inferred from incomplete evidence that does not warrant the conclusion of unawareness.

Characterizations of implicit evaluations as reflecting unconscious attitudes are based on the finding that implicit evaluations typically show rather low correspondence to self-reported explicit evaluations of the same target object (for meta-analyses, see Cameron et al. 2012; Hofmann et al. 2005). However, the conclusion that dissociations between implicit and explicit evaluations indicate unawareness of the former violates N&S's criteria of relevance and sensitivity.

Research and theorizing suggest that encountering an attitude object spontaneously activates evaluative associations in memory (De Houwer 2009; Ferguson & Zayas 2009). Performance-based measures are assumed to capture these associations regardless of whether the person considers them valid. When a person is asked to report an explicit evaluation, activated associations are assessed for their (subjective) validity by propositional processes (Gawronski & Bodenhausen 2006; 2011). To the extent that the evaluation implied by activated associations is consistent with other salient propositions, it is typically regarded as valid and reported on measures of explicit evaluations. However, if the evaluation implied by activated associations is inconsistent with other salient propositions, consistency has to be restored before an explicit evaluation can be reported (Festinger 1957). In such cases, implicit and explicit evaluations often diverge, such that implicit evaluations reflect activated associations regardless of their perceived validity, whereas explicit evaluations reflect activated associations that are regarded as valid (e.g., Gawronski & LeBel 2008; Gawronski & Strack 2004; Gawronski et al. 2008). From this perspective, an explicit evaluation is not a measure of a person's awareness of his or her implicit evaluation. Instead, it reflects the role of propositional processes in assessing the subjective validity of activated associations.

The inference that implicit evaluations reflect unconscious attitudes because they show low correspondence to explicit evaluations thus violates N&S's criteria of relevance and sensitivity. Low correspondence between implicit and explicit evaluations is not relevant for awareness of implicit evaluations, because explicit evaluations may differ from implicit evaluations for reasons other than lack of awareness. Moreover, low correspondence is not sensitive, because measures of explicit evaluation do not ask participants to merely report their evaluative associations, but to report the evaluative associations that they regard as valid.

To overcome these limitations, we have recently started a research project in which we asked participants to predict their implicit evaluations of multiple target groups before completing corresponding measures of implicit evaluation (Hahn et al., in press). We argue that predictions of implicit evaluations are both more relevant and more sensitive for inferences about awareness than correspondence to explicit evaluations. Predictions are more relevant, because they rule out cognitive inconsistency as a potential cause of diverging explicit evaluations. Moreover, predictions are more sensitive, because they directly capture participants' ability to report their implicit evaluations (e.g., "If we ran a computerized test, what would it show?") rather than evaluations that they perceive as valid (e.g., "How much do you agree with the statement that group X is likeable?"). Our studies consistently showed that participants were highly successful in predicting their implicit evaluations, even in cases where they reported distinct explicit evaluations. In line with previous findings (e.g., Blair 2001; Hofmann et al. 2005; Nosek 2005), implicit and explicit evaluations revealed correlations around 0.20. In contrast, participants' predictions showed mean correlations with implicit evaluations higher than 0.50 and median correlations of around 0.65.

Our research also led to some additional discoveries that highlight the benefits of studying awareness more rigorously. For example, high levels of accuracy in predicting implicit evaluations were found primarily when accuracy was determined within subjects (i.e., rank order of evaluations of different target groups for each participant). However, when accuracy was determined between subjects (i.e., rank order of evaluations of the same target group across participants), prediction accuracy was lower. In other words, although participants were able to predict their implicit evaluation of a given target group vis-à-vis other target groups (within-subjects analysis), their predictions were less accurate for identifying their implicit evaluations of a given target group vis-à-vis other participants (between-subjects analysis). Interestingly, participants also predicted lower levels of implicit evaluative bias against outgroups for themselves than for other participants. These findings suggest that, although people are aware of the evaluative quality of their implicit evaluations, they may not be aware of how their implicit evaluations compare to those of other people. That is, people seem to be aware of some aspects of their implicit evaluations (e.g., the fact that they hold more biased implicit evaluations against some groups than others) but not others (e.g., whether these biases are stronger than those of other people), and studying these two "kinds" of awareness requires different methods (i.e., within-subjects analysis vs. between-subjects analysis). Thus, rather than treating awareness as an all-or-none issue, our findings highlight the importance of more fine-grained analyses when studying conscious awareness.

In sum, we agree with N&S's concern that unawareness of psychological processes is often inferred from insufficient evidence. We argue that inferences of unawareness from dissociations between implicit and explicit evaluations violate the criteria of relevance and sensitivity. Research using more adequate measures indicates that implicit evaluations can be predicted with accuracy, suggesting that implicit evaluations do not reflect unconscious attitudes.

But what if the default is defaulting?

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Abstract: We critically consider the default view of consciousness and decision making, and we explore the implications of this view to the authors' argument. We therefore call for rigorous collection of data regarding the role of consciousness in decisions. We also propose that

the section on subliminal effects significantly underestimates existing data and succinctly review relevant findings.

There are many things to like about the target article, and we thank Newell & Shanks (N&S) for their efforts: They will definitely result in a better science, which is what we all want, after all. Our gratitude, however, should not be mistaken for agreement: We widely disagree. For lack of space we will focus on two issues, one theoretical and one empirical.

Imagine the Snamuh, a species with brains and cognition just like ours. Unlike us, however, the Snamuhs are very proud of their unconscious: They believe that it is what sets them apart from the rest of the animal kingdom. Consciousness, they think, does not play a significant role in their lives.

Recently, papers in Snamuh-land's scientific journals suggested that consciousness matters. Curious about these developments, two of Snamuhs' best cognitive scientists examined the evidence in light of strict criteria. Among them are the *relevance* criterion ("assessments should target only information relevant to the behavior," N&S Table 1), and the *sensitivity* criterion ("assessment should be made under optimal retrieval conditions," N&S Table 1).

The scientists were not convinced by the data. After all, conscious information might be "contaminated" (Wilson & Brekke 1994) by non-conscious processes, rendering the task of meeting the relevance criterion difficult. Similarly, assessing sensitivity of conscious measures is not a trivial task, threatening the sensitivity criterion. Accordingly, they concluded "conscious influences – if they exist at all – have limited and narrow effects."

The moral is straightforward: N&S's default is that decisions are conscious. This is their H0. The evidence to the contrary, they suggest, is not convincing enough (we disagree, of course). Hence, H0 is not rejected and consciousness it is. Yet, the Snamuhs used the same scientific logic. But with the opposite H0, their conclusion was diametrically opposed. So which one is it?

We propose that the default view is less likely than it might seem. First, our consciousness is notoriously limited in its capacity (e.g., Baddeley & Hitch 1974; Kahneman 1973). Given the sheer volume of problem solving, goal pursuits, self-regulation, and the like, that we engage with, it seems reasonable to suspect that we benefit from non-conscious progress too. Second, our best theories (to date) suggest that the type of consciousness that we have is relatively new in the evolutionary sense. It seems unlikely that basic functions such as decision making necessitate this "new" invention (see Hassin 2013; Hassin & Sklar, in press; Sklar et al. 2012).

Given this assessment, it will be fruitful to conduct research with the Snamuhs' H0. We urge scientists who argue that consciousness has a role in a cognitive function *F* (whatever *F* might be) to adopt strict criteria and measurements, similar to those adopted by researchers of the unconscious. For example, have them measure *all of the relevant* unconscious effects and contents and devise measures that are *unaffected* by irrelevant unconscious data. To the best of our knowledge, there is little discussion of how one should go about addressing these issues (but see Jacoby 1992) – nothing that is even reminiscent of the debates that allowed the science of the unconscious to improve so much over the decades (with the kind help of the authors of the target article).

In the realm of high-level cognition, a role of consciousness is usually intuitively assumed or inferred from (what N&S call) weak evidence for unconscious processes. We would very much like to see positive, strong evidence of the kind described above. We believe there must be. Until this kind of research blooms, however, we cannot really estimate to what extent conscious processes affect decisions.

Our second point has to do with the literature coverage. For lack of space, we will focus on the subliminal priming section.

We are happy to have been reviewed in this section; we are very proud of this work (see also Carter et al. 2011). But there is a lot of evidence that is not reviewed there. For example, thirsty participants who had been subliminally primed with thirst-related words drank more than non-primed participants (Strahan et al. 2002; see also Veltkamp et al. 2011). Extending these findings, Karremans et al. (2006) showed effects of subliminal brand names (see also Bermeitinger et al. 2009; Verwijmeren et al. 2011). Subliminal primes also affect choices in "free choice" paradigms (Kiesel et al. 2006; Klapp & Haas 2005; Schlaghecken & Eimer 2004), and we recently demonstrated effects of subliminal priming on choice, in a task that used both objective and subjective measures on a trial-by-trial basis (Milyavsky et al. 2012).

Related research examined processes that are likely to affect decisions and has documented subliminal/implicit effects on executive functions and working memory (Hassin et al. 2009; Lau & Passingham 2007; van Gaal et al. 2008), affect (e.g., Monahan et al. 2000), numbers and arithmetic (e.g., Opstal et al. 2011; Sklar et al. 2012), incentives (e.g., Bijleveld et al. 2009), goal pursuit (e.g., Ferguson 2008), information integration (Mudrik et al. 2011), fear (Raio et al. 2012) and fear of death (e.g., Arndt et al. 1997), anchoring (e.g., Mussweiler & Englich 2005), self-evaluation (Mussweiler et al. 2004), and attitudes (e.g., Loersch et al. 2011), to name, really, just a few (see Sklar et al. 2012 for more).

The authors raise a few general worries about these kinds of studies. Yet, the debate about measuring awareness has been with us for decades. Yes, there are justified concerns, but also, yes, there are good answers, which are met by counterarguments, and replies, and the development of new measures, and so on and so forth: scientific dialectics at its best. The question of subliminal semantic processing, for example, has been with us for decades too, and recent reviews suggest that it is possible (Kouider & Dehaene 2007; Van den Bussche et al. 2009).

To conclude, we believe that the data for subliminal effects on various aspects of decisions is much larger, and much stronger, than the data reviewed here. We therefore believe that the conclusions of this section do not adequately represent the state of affairs in this blooming area of the cognitive sciences.

Context, as well as inputs, shape decisions, but are people aware of it?

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Abstract: Even if people are experts at understanding how various input cues landed them at a particular decision (something the authors refer to as *cue utilization*), they may still fail to appreciate how context influences the weight given to those input variables. We review evidence suggesting that people are unaware of contextual influences on their decisions.

Newell & Shanks (N&S) raise important questions about whether people possess self-insight into the factors that shape their decisions. Our critique is motivated not by the evidence that was reviewed in the article, but by a large and essential body of literature that was not – literature suggesting that people are unaware of how contextual factors influence their use of information and the eventual decisions they reach.

Suppose that for any decision two broad types of variables come into play: input variables and context variables. *Input variables* are informational variables that people use in determining what to think or how to act. For example, someone decides to vote for a candidate based on his or her perceptions of that candidate's political leanings, competence, and likability. *Context variables*, by contrast, are "background" variables that affect the way people think about a particular decision or weight relevant pieces of

information. In one context, a voter might weight the candidate's competence over likeability; in another context, the same voter might weight the candidate's likeability over competence.

On our reading, N&S focus their critique of awareness on input variables, making the claim that people have insight into the various inputs that shaped their responses (e.g., Harries et al. 2000). Even if we stipulate this as true, research not reviewed by the authors has shown that people remain unaware of how their use of those inputs is influenced by the context in which the decision was made. People may know which input variables shaped their decision, but they still may lack insight into how context nudged them to rely on those variables.

Imagine someone deciding on Kahneman and Tverksy's classic Asian Disease problem. They have a chance to save the lives of 600 people by choosing which of two drugs to recommend. In one version of this problem, they learn that Drug A will save 200 people with certainty and Drug B has a 1-in-3 chance of saving everyone (otherwise, no one is saved). Most people in this situation recommend Drug A. Let's assume they know why: They value the certainty of saving 200 over the uncertainty of Drug B. However, in another version of this problem, the same question is framed in terms of losses, such that Drug A will result in the death of 400 people with certainty and Drug B carries the 2-in-3 chance that everyone will die (with a 1-in-3 chance that no one dies). Asked with this framing, people now prefer Drug B, and again can articulate why – it's better to take a chance on saving everyone than kill 400 for sure. Thus, depending on the question asked, people arrive at two very different answers, and they can describe accurately why they decided as they did. To our minds, though, the interesting self-insight question still remains: Do people know how the *context* of the decision affected them? Do they know that their use of the information and eventual decision was shaped in large part by the question framing?

Emerging evidence reveals that people tend to have inadequate insight into the impact of significant context variables on their decisions. In this work, people are asked how their preferences or decisions would change if the circumstances surrounding their decisions were different. For example, they are asked how likely they would be to help another person if placed in a group that passively did nothing versus in a room alone with the other person—the classic bystander intervention effect. People claim that being in a group would do nothing to their tendency to help, but in reality people are much less likely to help in those circumstances (Balcetis & Dunning 2013; see Epley & Dunning 2000, for conceptually similar results).

Similarly, people fail to understand how emotion changes their preferences (Van Boven et al. 2013). Many people will say, when asked hypothetically, that they would be willing to dance in front of a classroom full of peers for $5; a substantially smaller number actually accept this opportunity when faced with the real choice. What may explain this difference between hypothetical and real decisions is that people fail to understand how the context of the decision – real versus hypothetical – changes their decision-making process. In the former case, people weight the $5 compensation over their fear of social evaluation. In the latter, that weighting flips such that the fear of social evaluation trumps the lure of compensation (Van Boven et al. 2012).

A range of contextual variables known by social psychologists to affect decision making appear to go largely undetected by decision makers themselves. People do not recognize how sensitive their decisions are to social norms (Nolan et al. 2008). They believe that they are more immune to conformity pressures than they really are (Pronin et al. 2007). And they similarly overestimate their resistance to media influence (Davidson 1983; Douglas & Sutton 2008; 2010; Perloff 1993; 1999).

Or, consider the following: We (Helzer & Dunning 2013) have asked people to make a decision between X and Y, with knowledge that most of their peers think X. The opinions of their peers have an effect on the participants' ultimate decision, but do the participants know this? After they reach a decision, we ask them what their decision would have been if, instead, their peers had favored Y. As in the studies cited above, people consistently underappreciate the impact this shift will have on their decisions, thinking that their decisions are insensitive to this changing context, when, in fact, they are quite sensitive.

Thus, even if people are experts at understanding how various input cues landed them at a particular decision (something N&S refer to as *cue utilization*), we assert on the basis of relevant empirical findings that they fail to appreciate how context influences the weight given to various decisional inputs. This leaves them with some recognition of *how* they arrived at their ultimate decision, but not necessarily *why* the decision unfolded as it did.

Automatic processes, emotions, and the causal field

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Abstract: Newell & Shanks (N&S) provide a welcome examination of many claims about unconscious influences on decision making. I emphasize two issues that they do not consider fully: the roles of automatic processes and emotions. I further raise an important conceptual problem in assigning causes to potential unconscious influences. Which "causal field" is relevant: that of the investigator or the experimental participants?

As noted by Newell & Shanks (N&S), recent years have seen numerous authors extolling the virtues of unconscious processes in decision making. From some accounts, it would appear that we would all do better if we were just to "let our unconscious do the thinking."

N&S question several claims for the influence of unconscious influences, and their findings give pause for solid *conscious* thought. What precisely are the influences of unconscious processes in decision making? How can these be reliably detected? These are difficult questions, and my goal here is to add some elements to the debate.

My first point is to express surprise that N&S do not explore more the topic of *automatic* processes and the extent to which these do or do not involve unconscious influences. It is clear that in learning physical skills (imagine riding a bicycle), people go through a process whereby, at the outset, they are conscious of their movements, but once skilled, they can control what they do without paying much, if any, conscious attention. It is difficult to prove or disprove the role of unconscious influences in these kinds of situations, but an analogy can clearly be made with judgments or decisions. Is the use of an automatic process conscious or, on the contrary, an unconscious reaction to a process that has already been initiated?

One interesting phenomenon lies in decisions that have been taken automatically but for which there is no longer a conscious memory. (Does this mean they were subject to unconscious influences?) For example, like many other people I am supposed to swallow a pill every morning. Occasionally, I cannot remember if I have done this. Should I then deliberately take – perhaps – another pill? Fortunately, my pill container indicates days of the week. Thus, when I wonder whether I have taken my pill, I look to see if the pill for that day is still there. If it is, I didn't take my pill; if it isn't, I did. Parenthetically, this example does not satisfy N&S's criteria for detecting an unconscious influence because, if I had been asked just after taking the pill whether or not I had done so, my answer would undoubtedly be that I had – it is the delay that appears to erase this automatic event from memory.

A second topic that N&S do not highlight is the role of emotions in decision making and whether this involves unconscious influences. There is a considerable literature that illustrates how emotional states affect judgments of risk and even risky decision making (Andrade & Ariely 2009; Slovic & Peters 2006). For example, in one research program, my colleagues and I used experience sampling to collect judgments of mood and emotion as well as assessments of risk (Hogarth et al. 2011). We found that emotional states explained variability in risk judgments over and above rational factors of probabilities and magnitudes of potential losses. We did not attempt to determine whether participants were aware that their emotional state was impacting their risk judgments. However, from an N&S perspective, future studies could clearly do this. My hypothesis is that people are not always aware of how emotions influence their decisions in the same way that these might be affected by, for example, relative states of hunger (Danziger et al. 2011).

A third point deals with a difficulty in interpreting the differences that researchers and participants in experiments have concerning whether a variable has had a *causal* influence on a decision. An example given in a seminar some 30 years ago by Richard Nisbett illustrates the point. (Incidentally, although I like and remember the scenario, I do not recall the specific point that Nisbett was illustrating!)

Imagine that a social psychologist is conducting a study on the influence of lighting in restaurants on romantic attachment. Couples are recruited for blind dates involving a meal at a restaurant, and there are two experimental conditions to which couples are randomly assigned. In one, the restaurant is fully illuminated; in the other, the lights have been dimmed. The dependent variable is the proportion of couples who decide to meet again after the meal. Now imagine that this variable is significantly greater for couples in the dimmed lighting condition. What does this mean? For the social psychologist, the inference is that dimmed lighting fosters romantic attachment. After all, this was the variable that was manipulated experimentally, and there was an effect.

Now imagine that you ask the couples whether the lighting in the restaurant influenced their decisions to meet again. Almost certainly, they would deny that this had played any role.

So who is "correct" – the social psychologist or the couples? It is possible to make an argument that both are correct. What differs between the two is the definition of the causal background – or "field" – against which the causal inference is made (Einhorn & Hogarth 1986; Mackie 1965; 1974). For the social psychologist, the causal field involves both experimental groups (with and without dimmed lighting), and the difference in the levels of lighting is a "difference-in-the-field" and thus a potential causal factor. The causal fields of the experimental participants, however, contain no such difference. The experience for each couple consists entirely of dimmed or full lighting, and they never experience the differences between the two conditions. For the couples, therefore, there is no way that they can assign cause to the level of lighting. For each couple, lighting is a constant and thus not causally relevant.

Advocates of influences of unconscious effects on decisions would undoubtedly agree with the social psychologist. However, this conclusion only holds at one level of analysis (i.e., causal field). In general, we should be clear at which levels we wish to draw conclusions.

Is the unconscious, if it exists, a superior decision maker?

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Abstract: Newell & Shanks (N&S) show that there is no convincing evidence that processes assumed to be unconscious and superior are indeed unconscious. We take their argument one step further by showing that there is also no convincing evidence that these processes are superior. We review alternative paradigms that may provide more convincing tests of the superiority of (presumed) unconscious processes.

In their short abstract, Newell & Shanks (N&S) state: "Recommendations to 'stop thinking' and rely on 'gut instincts' reflect widely held beliefs that our decisions can be influenced by unconscious processes." (N&S) predominantly focus on the second part of this phrase and show that there is no convincing evidence these processes are indeed unconscious. We take their argument one step further by addressing the first part of their phrase. That is, we discuss whether there is evidence that these decisions, presumably based on the unconscious, are superior to those based on thinking.

To determine whether presumed unconscious decisions are superior to conscious ones, we first need to define what constitutes a good decision. To this end, we use the distinction between compensatory and non-compensatory decisions. In compensatory decisions, options are compared on their probability weighted sum of all attributes, in which probability and attributes are evaluated objectively or subjectively (e.g., Tversky & Kahneman 1992). Non-compensatory decisions, however, are not based on a weighted sum of all attributes. For example, in Dawes' strategy (e.g., Bröder & Schiffer 2003a) decisions are based on the number of positive attributes, and in a lexicographic strategy (e.g., Tversky & Slovic 1988), decisions are based on a sequential comparison of attributes, in which a decision is made if options differ sufficiently on an attribute under consideration. There seems to be general consensus that compensatory decisions are superior to non-compensatory ones, as all attributes are taken into account (yet see Payne et al. 1988 for an interesting counterexample).

Dual-process theories (e.g., Kahneman 2011; Stanovich & West 2000) posit that non-deliberative processes often yield non-compensatory decisions, whereas deliberative processes generate compensatory ones. This hypothesis is supported by evidence showing that non-compensatory decisions are common in case of mental overload, which is assumed to hinder full reliance on the deliberative system (Bröder & Schiffer 2003b; cf. Pohl et al. 2013). Interestingly, proponents of unconscious decision making argue the opposite: They state that the non-deliberative system facilitates compensatory decisions, whereas the deliberative system facilitates non-compensatory ones (e.g., Dijksterhuis et al. 2006b). In the following we determine whether the two decision-making paradigms discussed by (N&S), the Iowa Gambling Task (IGT) and the paradigm of Unconscious Thought Theory, the Unconscious Thought Paradigm (UTP), offer the possibility to test this alternative claim.

In the IGT, decision makers presumably relying on unconscious processes would opt for the two options (C & D) with the highest expected value (Bechara et al. 1994); that is, they would use an objective compensatory strategy. However, IGT studies often do not allow for a test of this claim, as choices for specific options

are generally not reported. The few studies that did include an analysis of specific options support a different conclusion (e.g., Duijvenvoorde et al. 2010; Horstmann et al. 2012; Lin et al. 2012). That is, decision makers generally prefer options with low probability of losses (B & D), and some, but certainly not all, decision makers gradually develop a preference of D (low losses, low gains) over B (high losses, high gains) (Huizenga et al. 2007). It is not very likely that the latter decision makers adopted a compensatory strategy, as they did not prefer both optimal options (C & D). It is more likely that these decision makers adopted a non-compensatory lexicographic strategy, in which they first considered probability of losses and then losses themselves. These findings show that in the IGT, participants using non-compensatory and compensatory strategies may arrive at similar decisions. We therefore conclude that the IGT is not suitable to differentiate decision strategies.

According to Unconscious-Thought Theory (Dijksterhuis et al. 2006b), decision makers who presumably rely on unconscious processes would prefer the option with the highest compensatory value over all attributes. However, using importance ratings of attributes, it was shown that the compensatory strategy, Dawes's strategy, and a lexicographic strategy all converged on the same choice (Huizenga et al. 2012). Therefore we conclude that the UTP also does not allow for a differentiation of decision strategies.

The evidence reviewed above suggests that the IGT and UTP are not suited to identify decision strategies and therefore are not suited to test whether presumably unconscious decision processes facilitate compensatory decision making. To test this claim of compensatory decision making, the field requires new paradigms that allow assessment of decision strategies, namely, paradigms in which compensatory and non-compensatory strategies result in different decisions. Fortunately, both within, as well as outside, the IGT and UTP literature, paradigms are being developed that suit this purpose. In the IGT-related field there exists a paradigm that allows a further study of lexicographic versus compensatory strategies (Lin et al. 2009). In the UTP literature, there are paradigms to delineate Dawes and compensatory strategies (Payne et al. 2008; Usher et al. 2011) and to delineate lexicographic and compensatory strategies (Huizenga et al. 2012). Outside these fields it has been shown that process-tracing techniques (Bröder & Schiffer 2003a; Payne et al. 1988) provide valuable tools to study decision strategies. In addition, it has been shown that modern statistical techniques like mixture analyses offer the possibility to differentiate decision strategies (Duijvenvoorde et al. 2010; Jansen et al. 2012).

To conclude, the evidence in favor of the superiority of unconscious decisions is not convincing, as paradigms like the IGT and UTP do not allow for an assessment of decision strategies. However, there do exist new paradigms, experimental approaches, and statistical techniques that provide a detailed assessment of decision strategies and therefore allow for a more convincing test of the superiority of – presumed– unconscious processes.

Neuroscientific evidence for contextual effects in decision making

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Abstract: Both internal and external states can cause inconsistencies in decision behavior. I present examples from behavioral decision-making literature and review neuroscientific knowledge on two contextual influences: framing effects and social conformity. The brain mechanisms underlying these behavioral adjustments comply with the dual-process account and simple learning mechanisms, and are weak indicators for unintentionality in decision-making processes.

Newell & Shanks (N&S) criticize prior work on unconscious influences in decision making for providing insufficient assessment of awareness, leading the authors to question whether unconscious influences should be incorporated as prominent factors in decision theories. While I appreciate their methodological concerns, I am cautious to refute a large body of literature on automatic processes in decision making (Chaiken & Trope 1999; Kahneman 2011; Sloman 1996). I will explore the possible role of unconscious processing in decision making by discussing contextual influences in judgment and choice.

There is a discrepancy between rational decision making, as described by economic theory, and actual choices (Thaler 1980). Both internal and external states (such as visceral factors, framing, and social context) can induce inconsistencies in choice behavior (Cialdini & Goldstein 2004; Loewenstein 1996; Tversky & Kahneman 1981). Danziger et al. (2011a) report that, prior to food breaks, judges in parole boards less frequently give favorable decisions than after food breaks. The framing effect is manifested, for instance, in the behavior of a majority of consumers who prefer a "75% lean" ground beef product over one having 25% fat, even though there is no difference in the actual product (Levin et al. 1985). Finally, related to the primes-to-behavior literature reviewed in the target article, descriptive social norms are so powerful in directing behavior that people are even willing to increase their own energy consumption to match the consumption level of their neighbors (Schultz et al. 2007).

These examples raise many questions about the awareness and intentionality of the decision maker. Why is consumer preference affected by the positive or negative presentation of a piece of information? Why would one use more energy than needed – and pay for it – just because others use a lot of energy? And can judges sleep at night peacefully knowing that someone else is behind bars because they were hungry when they made their parole decision? Economically, these choice biases do not make sense, and based on the discussion following the publication by Danziger et al. (2011a), the legal community objects to the idea that meal breaks influence judicial decisions (Danziger et al. 2011b; Weinshall-Margel & Shapard 2011).

Recent neuroscience literature has shed light on the underlying mechanisms of framing effects in situations where subjects choose between a positively or negatively framed risky lottery versus a sure outcome. This research suggests that framing effects are mediated by emotional brain areas (amygdala), whereas resisting these effects co-occurs with activation in the anterior cingulate cortex (ACC), a brain region related to conflict detection (De Martino et al. 2006). These findings are consistent with the expectations of dual-process theories, as they suggest an interplay between initial emotional reactions (System 1) and suppressing control processes (System 2) in the formation and resistance of framing effects, respectively (Kahneman & Frederick 2007). Two further experiments have strengthened these claims. First, individuals with a certain gene variant have a stronger coupling between the ACC and amygdala and are able to resist framing effects better than other individuals (Roiser et al. 2009). Second, people with autism spectrum disorder do not show the same pattern of emotional (skin conductance) responses to positive and negative frames compared with control subjects; they also exhibit weaker susceptibility to framing effects (De Martino et al. 2008). Taken together, this research indicates that largely inborn characteristics can influence the strength of framing effects.

The tendency to follow the behavior of others has been proposed to be driven by error detection and subsequent adjustment (Montague & Lohrenz 2007). Klucharev et al. (2009) tested this hypothesis with functional magnetic resonance imaging in the context of facial attractiveness estimation and found that

deviations from a stated general group opinion was associated with activation in brain regions that also activate during erroneous responses in simple trial-and-error tasks. The strength of the "error response" was indicative of the subsequent behavioral adjustment toward the group opinion. Intentional adaptation of the reported attractiveness ratings is highly unlikely for two reasons. First, due to extensive requirements for memory of faces and attractiveness ratings, and second, because the behavioral adaptation is also reflected in the neural representation of the stimulus value, suggesting a true modification of opinion beyond mere social gratification (Zaki et al. 2011). Social context also modifies the activation of the reward network for targets other than faces and adjusts the neuronal representation of long-term memories (Campbell-Meiklejohn et al. 2010; Edelson et al. 2011). Together, these findings suggest that social influence in decision making is mediated by adapted value estimates and memories.

The literature reviewed here unfortunately cannot give conclusive information about the presence or absence of unconscious influence in the framing effect and social conformity, because the experimental procedures did not include rigorous assessments of awareness. Regardless, the gained knowledge gives many weak indicators for unintentionality, if not unawareness. First, the neuroscientific findings of framing effects comply with the expectations of dual-process theories and show that inborn features may influence the strength of behavioral framing effects, indicating that the decision process is systematically different between groups of people in a simple and reasonably neutral decision task. Second, even a single exposure to a descriptive social norm can modify the value of an item possibly through basic and automatic reinforcement learning mechanisms. One noteworthy aspect is that the dual-process accounts do not necessitate that System 1 influence is uncontrollable in a top-down fashion (Chaiken & Trope 1999). While in some conditions there might be an unconscious effect, in other situations the influence of framing or social norms can be intentionally acknowledged and controlled by the decision maker.

A logical next step is to conduct further tests that measure a decision maker's awareness of the effect of framing and social norms. N&S give many good pointers for designing methodologically sound experiments, but one should be careful not to influence the decision-making process with the awareness assessment. Highlighting aspects of the decision-making task can change the course of the decision-making process by increasing attention and top-down control.

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Restrictive and dynamic conceptions of the unconscious: Perspectives from moral and developmental psychology

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Abstract: Newell & Shanks' (N&S's) conceptualization of the unconscious is overly restrictive, compared to standard social psychological accounts. The dichotomy between distal and proximal cues is a weak point in their argument and does not circumvent the existence of unconscious influences on decision making. Evidence from moral and developmental psychology indicates that decision making results from a dynamic mixture of conscious and unconscious processes.

Newell & Shanks (N&S) perform a valuable service in critically reviewing some of the burgeoning literature on unconscious decision making, and exposing some of the methodological weaknesses of these studies. Nevertheless, there are three related aspects of their thesis that we would like to question: their conceptualization of the unconscious, their dichotomy between proximal and distal cues, and their lack of consideration of any developmental evidence.

First, N&S's treatment of "the unconscious" is conceptually very limited, in that they appear to restrict unconscious decision making to processes that are "cognitively impenetrable" (sect. 6.1.1) – that is, that are not accessible to conscious awareness – without foregrounding this limitation on their definition. This is far from the everyday and classical (e.g., Freudian) meanings of the unconscious as something that is *potentially* accessible to awareness, but which *usually* occurs automatically and beneath the level of conscious processing (Bargh & Morsella 2008). Indeed, the goal of psychoanalysis is to make hidden or suppressed (temporarily inaccessible) thoughts available once again to conscious awareness.

There are many examples from recent studies of moral reasoning and moral intuition that fit better with this classical understanding of the unconscious. For Haidt (2007, p. 998), for instance, "Moral intuition refers to fast, automatic, and (usually) affect-laden processes in which an evaluative feeling of good-bad or like-dislike (about the actions or character of a person) appears in consciousness without any awareness of having gone through steps of search, weighing evidence, or inferring a conclusion." Note that this does not imply that someone cannot, on reflection, come to an awareness of some of the steps that have led him or her to this evaluative feeling. This paints a much more dynamic picture of the unconscious than that presented by N&S. And it is a picture that is shared with a researcher whom the authors criticize, John Bargh, who has explicitly stated that he does not view the unconscious in terms of a lack of awareness of certain (subliminal) stimuli, but rather in terms of a lack of awareness of the effects that certain stimuli have on decision making (Bargh & Morsella 2008). So we may have a familiar case of authors from two different, but related, disciplines (cognitive and social psychology) arguing across one another because they are using the same word ("unconscious") to refer to two different but related phenomena (what is subliminal and inaccessible to consciousness vs. what is merely overlooked or forgotten by consciousness).

This suspicion is reinforced by N&S's reliance on a dichotomy between "proximal" and "distal" cues (when assessing the relevance of a piece of information for decision making; sect. 1.2). They claim an agent might be unaware of a distal cue (e.g., *Mother always told me spinach was good for me*) and its influence on a current decision (to eat spinach), but still may be able to justify her decision in terms of a proximal cue (the belief *spinach is healthy*). It is hard to see the difference between a neglected distal cue and an unconscious influence on behavior, in the naturalistic social psychological sense of Bargh and Morsella (2008). Nor do N&S elaborate on what makes a distal cue "irrelevant" to decision making. Even long-past and long-forgotten cues can be highly relevant: for example, a jury selection panel is unlikely to look favorably on any history of interaction between a potential juror and a defendant, whether the juror can recall the interaction or not. Social psychologists of like mind to Haidt and Bargh would claim the authors confuse an agent's ability to give reasons for her own decision with her awareness of all the factors that significantly influenced her decision. That can be thrown into sharp relief by consideration of Haidt's famous cases of "moral dumbfounding" (e.g., when participants are asked why they condemn a case of incest that has no harmful consequences): In such cases, individuals are unable to give either a distal or a proximal cue for their behavior (Haidt 2001; cf. Pizarro & Bloom 2003).

N&S's other example of the relation between proximal and distal cues (in an adjacent endnote) is even less satisfactory. We

are asked to consider a judge who sentences people with Afrocentric features more severely (without being aware of this bias) because he perceives them as less intelligent. Yet this time, any conscious justification given by judges cannot be the same as the "proximal" cue, since the judges in these cases would presumably not rationalize their decisions in terms of any aspect of the suspects' appearance whatsoever: They would simply not be aware that the perception of a face as either Afrocentric or unintelligent would influence their judgment. In such cases there is clearly a disconnect between the conscious justification made by an agent and causes of their behavior. In this context, it is interesting that a recent mock-jury study found that when given a chance to deliberate, jurors were more likely to find an attractive defendant guilty, whereas without deliberation they were more likely to find a non-attractive defendant guilty (Patry 2008). This finding is in accord with a more dynamic picture of the unconscious than the one that N&S paint.

Finally, N&S omit any discussion of the extensive developmental literature on the ontogeny of children's decision making. Yet that literature is highly relevant to the conceptual limitations of their article, in that there are many experimental tasks (reviewed by Karmiloff-Smith 1992) for which younger children are unable to articulate why they have a preference for a particular behavioral choice, but for which older children are able to explain the conscious reasoning behind their choices. Because of this type of transition, developmental research currently represents a growing point in dual-process accounts of decision making (e.g., Stanovich et al. 2011). Taking a developmental perspective leads us again to emphasize the dynamic relationship between conscious and unconscious influences on decision making, because observing how children solve certain tasks makes it clear that conscious thought processes can come to modulate decision making that was previously performed automatically.

Why decision making may not require awareness

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Abstract: Newell & Shanks (N&S) argue against the idea that any significant role for unconscious influences on decision making has been established by research to date. Inasmuch as this conclusion applies to the idea of an "intelligent cognitive unconscious," we would agree. Our concern is that the article could lead the unwary to conclude that there are no unconscious influences on decision making – and never could be. We give reasons why this may not be the case.

We begin by raising some general methodological issues regarding the assessment of insight, and then we move to considering other examples from our own work that also bear on the thesis of the article. The first methodological issue we wish to raise regards the possible knock on effects of measuring insight in the stringent way that Newell & Shanks (N&S) recommend. Although we agree that the immediacy criterion is well-motivated in principle, the concurrent measurement of awareness with performance could predispose participants to use a conscious decision strategy in a situation where they may otherwise use an unconscious strategy. Indeed, this criterion seems fundamentally at odds with N&S's recommendation that highly reflective situations should be avoided in the study of unconscious decision making. The authors argue that online judgments do not alter judgment strategies by citing a study which showed that the inclusion of an online awareness measure made no difference to performance (Lagnado et al. 2006), but in reaching this conclusion N&S are relying on a null result (an approach they criticise when it provides evidence in support of unconscious processes). Furthermore, the absence of performance differences does not rule out the possibility that different processing strategies are being used to obtain a similar level of performance in the two versions of the task.

The second methodological issue pertains to the narrative rather than the systematic review approach that appears to have been adopted in the article. We agree with N&S that a focus on particular influential domains in such a review is entirely appropriate, but we feel that a systematic search strategy for identifying studies in each domain should have been articulated. For example, work we have conducted has found some evidence for unconscious influences on a variant of the Iowa Gambling Task (IGT) (Dunn et al. 2011) that we feel offers some support for the unconscious account and would have been relevant here. In particular, using the stringent insight criterion outlined by Maia and McClelland (2004) that meet the reliability, relevance, immediacy, and sensitivity criteria, we found that participants behaviourally acquired a modified IGT task prior to being able to articulate conscious awareness. Although the methodology of this study can also be criticised (on the basis of low power), this nevertheless is some evidence for unconscious decision-making influences. Therefore, the review can be critiqued on the grounds that its coverage of each domain is in parts selective.

The third methodological issue is that the insight literature has generally neglected a potentially prominent role for individual differences – namely, that individuals' performance may be more or less driven by unconscious influences. Consistent with this position, verbal reports indicate that the degree to which performance on the IGT is driven by conscious awareness varies between individuals (e.g., Guillaume et al. 2009, although we acknowledge the limitations of the way awareness was indexed in this study). Similarly, individual differences exist in the extent to which anticipatory bodily signals (arguably a measure of unconscious influence) are associated with task acquisition on the IGT and its variants (Dunn et al. 2011; Guillaume et al. 2009).

If marked individual differences do exist, this means that attempts to characterise behaviour at the population level are likely to be doomed to failure. In other words, the question should shift from "is behaviour driven by unconscious influences?" to "in which individuals and contexts is behaviour most driven by unconscious influences?"

Turning now to examples taken from our own research that are also relevant to this debate, our position is that there are other types of unconscious influence on decision making, in particular the influence of automatic, associative processes on behaviour. The case is slightly complicated by the fact that associative processes do not have to proceed in the absence of awareness, but equally they do not require it either (McLaren et al. 1994), which immediately raises the possibility that there can be instances of unconscious influences on decision making involving processing of this type. We will focus on the demonstrations of peak-shift in humans by Jones and McLaren (1999) and Livesey and McLaren (2009), though we could equally appeal to demonstrations of implicit sequence learning by Jones and McLaren (2009) and Spiegel and McLaren (2006), which make the point that the decisions made by participants are quite different when they are aware (a monotonic function consistent with rule use) or unaware (a non-monotonic function consistent with peak-shift) of the contingencies in play. Participants had to classify green squares by pressing one of two keys. The participants were not informed that the squares varied in either brightness (1999) or hue (2009), and so the correct response had to be learned by trial and error (they were given feedback). During a subsequent test phase (without feedback) they were shown

stimuli that varied over a much wider range of brightness or hue. At this point those participants that were unable to specify that the correct attribute to guide their decisions exhibited the typical "peak-shift" pattern of responding seen in similar experiments with pigeons (e.g., Hanson 1957). Other participants who became aware of the attributes relevant to responding (either during training or testing) showed a different pattern, with performance improving monotonically as they moved from the training stimuli to more extreme values.

The awareness test used in this experiment clearly fails the sensitivity criterion that the authors would apply, and yet our point is that there is actually a strong case to be made for this being an example of unconscious influences on decision making. The key here is the correlation between verbal report and the pattern of performance. If participants say they are aware of the critical attribute's role in the task, then they show one pattern. If they are not aware of it, then they show a different pattern similar to that seen in pigeons. N&S may still argue that both patterns of performance are due to conscious cognitive processes; however, this would lead to an entirely new interpretation of peak-shift in pigeons. If the explanation in terms of conscious cognitive processes is taken to apply only to humans, then we must ask why such an unparsimonious position is being adopted, with one explanation for humans and another for infra-humans. Either way, this type of evidence poses a considerable challenge for the analysis offered in this article.

Better tests of consciousness are needed, but skepticism about unconscious processes is unwarranted

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Abstract: What people report is, at times, the best evidence we have for what they experience. Newell & Shanks (N&S) do a service for debates regarding the role of unconscious influences on decision making by offering some sound methodological recommendations. We doubt, however, that those recommendations go far enough. For even if people have knowledge of the factors that influence their decisions, it does not follow that such knowledge is conscious, and plays a causal role, at the time the decision is made. Moreover, N&S fail to demonstrate that unconscious thought plays no role at all in decision making. Indeed, such a claim is quite implausible. In making these points we comment on their discussion of the literature on expertise acquisition and the Iowa Gambling Task.

Newell & Shanks (N&S) argue that there is little reason to think that unconscious thought plays a significant role in decision making. But they cast their net of evidence too narrowly. In particular, we worry that the research they marshal in support of their claim is either (a) consistent with competing interpretations that are supported by other lines of research or (b) fails to show that all elements that go into reaching a decision are conscious. While the data that N&S cite show that we have more knowledge of the factors that underwrite our decisions than was previously thought, they do not show that this knowledge informs our decisions or is conscious at the time the decision is made.

To begin, many of the studies that N&S cite demonstrate that, at best, people have *post facto* knowledge of the factors that figure in their decision making, not that those factors are conscious during the decision-making process itself. Consider, for example, N&S's discussion of studies of expert decision making that purport to find a discrepancy between explicit and implicit policies, or between explicit and implicit knowledge of the environmental cues that influence one's decisions. Previous studies had asked people to estimate their reliance on each cue, finding little correlation between those judgments and actual decision-making practice, thus suggesting that their reliance on those cues was unconscious. But if people are presented, instead, with a variety of sets of cue weightings and are asked to select which most closely resembles the strategy they use, then they prove quite accurate. N&S take this to show that people follow a conscious decision strategy. However, that one has a capacity to *recognize* one's policy does not begin to show that one consciously employs that policy. For the display may trigger an *implicit* memory of the previously deployed, but an unconscious decision strategy, which then primes the person's selection. One reason to prefer this explanation is that it is a familiar finding in the perception literature that masked stimuli produce implicit memories, which can then modify behavior in future tasks (Leuthold & Kopp 1998; Schacter 1992).

Of course, we grant that this hardly settles the matter and that further experimentation is required. In agreement with N&S's "immediacy" criterion, we suggest that what is needed in this type of case is *introspection sampling*, where people are cued at irregular intervals to report the contents of their conscious awareness (Hurlburt & Akhter 2006). Post facto measurements of conscious awareness not only run the risk of participants tapping into implicit memories or accessing knowledge that played no active part in the decision-making process, but they also run the risk of participants forgetting what they had in fact been conscious of.

Similar points hold in connection with N&S's discussion of the Iowa Gambling Task. They point out that when Maia and McClelland (2004) use a more explicit and less open-ended set of probe questions than had previously been employed, people show awareness of which decks are the good ones, and of the approximate long-term payoffs of the decks, as soon as they start to choose appropriately. N&S take this to show that it is conscious knowledge of payoffs that drives people's choices. Yet it may be (as Maia & McClelland themselves note) that in their online selections people rely on their affective responses toward the various options, without conscious judgments of relative goodness or approximate payoffs playing any causal role in the process. Indeed, when asked, people may base their judgments of goodness on their concurrent affective reaction while they contemplate making a selection from each deck. Moreover, they may either be able to reconstruct a rough estimate of the payoffs of each deck from memory, or else they may have constructed such a model in an ongoing manner following each trial.

Not only is this alternative construal of the data possible, but it is preferable. For it can smoothly accommodate the findings from patients with damage to ventromedial prefrontal cortex (VMPFC) (which is widely accepted to be the primary site of cortical representations of affect; Rolls 1999). Such patients continue to make bad choices in the Iowa Gambling Task, despite having good knowledge of the expected payoffs from each deck (Bechara et al. 2000). This finding makes good sense if people base their selections on their affective responses (which are absent or attenuated in VMPFC patients) while at the same time building a conceptual model of the task contingencies. To accommodate these data N&S will need to claim that in the normal case it is conscious judgments of comparative goodness that drive one's affective reactions. We know, however, that affective responses occur quite swiftly. It is implausible to claim that in every case they are preceded by conscious conceptual appraisals of the situation.

Even if we set aside these concerns about N&S's treatment of the data, however, they will need to posit some mechanism that can maintain an approximate running total of the net winnings from each deck. Otherwise the judgments of comparative goodness and likely payoffs from each deck that they appeal to will appear magical. But it is quite implausible that participants are aware of calculating these approximate running totals during the gambling task, in the way that one might be aware of calculating

the tip on a restaurant check. Much more likely is that participants rely on an implicit system that operates unconsciously, perhaps along the lines of Dehaene's (1997) approximate number system.

In conclusion, N&S demonstrate, at best, that in normal instances of decision making *some* components of the decision-making process are conscious. This is not surprising, given that attentional resources are likely directed toward the task at hand, and given the connections between attention, working memory, and consciousness (Engle 2002; Knudsen 2007; Prinz 2012). But it is now well established that working memory is a very limited channel (Cowan 2000). It therefore beggars belief that *all* of the factors that influence decision making could be conscious, if decision making occurs in real time.

Demonstrations of subconscious processing with the binary exclusion task

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Abstract: The binary exclusion task involves "subtle priming effects" and a measure of awareness that is reliable, relevant, immediate, and sensitive. This task, which meets the criteria outlined in the target article, has been used to demonstrate subconscious processing.

The target article recommends that future research on subconscious processing "should focus on tasks in which participants' attention is diverted away from the experimenter's hypothesis, rather than the highly reflective tasks that are currently often employed" (Abstract). The authors also suggest that: "subtle priming effects offer considerable promise for future exploration of insight, awareness, and decision making" (sect. 6.3) and outline four criteria for a measure of awareness: reliability, relevance, immediacy, and sensitivity. The binary exclusion task meets both of these recommendations and fulfills the four criteria for a measure of awareness, but it is not mentioned in the target article.

In each trial of the binary exclusion task one of two known stimuli appears. Participants are required to respond with the stimulus that was *not* shown (Debner & Jacoby 1994). If the stimulus is presented for long enough, participants are aware of which one was shown and respond correctly with the other one. But at brief stimulus durations, participants are more likely than chance to respond incorrectly, with the stimulus that *was* shown (Persaud & McLeod 2007). The briefly presented stimulus must have been processed because it affected the decision about which response to make. But if it had been available to conscious processes, the participant would have responded correctly with the other stimulus. Thus the binary exclusion task with briefly presented stimuli demonstrates unconscious processing influencing decision making.

The assessment of awareness in the binary exclusion task meets all four of the criteria outlined in the target article. Since the response used to assess awareness is the same as the behavioral response, the assessment of awareness is reliable, relevant, and immediate. Using the definition of sensitivity in the target article ("same cues are provided for measuring awareness as for eliciting behavior" in Table 1), the binary exclusion task is also sensitive because only one cue is presented.

Persaud and Cowey (2008) used a binary exclusion task to compare the processing in the blind and sighted fields of the blindsight patient, GY. A square wave grating was presented to either the upper or lower quadrant of his blind or sighted field. He had to reply with an exclusion response, saying "upper" when it was in the lower field and "lower" when it was in the upper field. He claimed to see the stimuli presented to his sighted field and followed the exclusion instructions correctly. But when the stimulus was presented to his blind field, he reported that he was guessing, and his responses were significantly more often than chance incorrect. That is, he responded that the stimulus was in the quadrant in which it had been presented, not in the opposite one. When the stimuli were made clearer (the contrast between light and dark bars of the grating increased) the discrepancy between blind and sighted fields became more marked. He continued (unsurprisingly) to respond correctly to stimuli presented to his sighted field. But the probability of making an error in the blind field (replying with the quadrant in which the stimulus had been presented) increased. This is a clear demonstration of a difference between conscious and subconscious processing. Increasing the stimulus contrast *decreased* the error rate for consciously processed stimuli, but increasing the contrast *increased* the error rate for subconsciously processed stimuli.

Just as with the normal participants tested with brief stimuli by Persaud and McLeod, the experiment with GY demonstrates a clear difference between conscious and unconscious processing. Consciously processed stimuli lead to what James (1890) described as "the pursuance of future ends," correctly following the experimenter's instructions to respond with the stimulus that was not shown. But subconsciously processed information can lead to responses that are contrary to a person's goals (Chalmers 1996; Searle 1992), erroneously responding with the stimulus that was shown.

Self-insight research as (double) model recovery

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Abstract: Self-insight assessment compares outcomes from two model-recovery exercises: a statistical exercise to infer a judge's (implicit) policy and an elicitation exercise whereby the judge describes his or her (explicit) policy. When these policies are mismatched, limited self-insight is not necessarily implied: Shortcomings in either exercise could be implicated, whereby Newell & Shanks' (N&S's) *relevance* or *sensitivity* criteria for assessing awareness may not be met. Appropriate self-insight assessment requires that both exercises allow the original processes to be captured.

Slovic and Lichtenstein's (1971) extensive review of research on policy capturing for multiple-cue judgment (see Newell & Shanks [N&S], sect. 2.2) was one of the first papers that I read on human judgment; so one of the first things I learned about human judgment was that people exhibit poor insight into their cue use, overestimating the number of cues used and misestimating the relative weights applied to different cues. N&S have usefully reminded us that this conclusion is dependent upon a particular choice of methods, and that the picture changes if alternative methods for investigating self-insight are employed (e.g., Reilly & Doherty 1989; 1992). When considering methods for assessing self-insight for multiple-cue judgment, it is worth noting that such investigations are an exercise in model recovery. In fact, two model recoveries are required: (1) statistical techniques (typically regression) are used in an attempt to recover the judge's policy for making the original case judgments (the implicit policy); and (2) the judge is also asked to recover his or her strategy for making the original judgments (the explicit

policy) – often by assigning a points value to indicate each cue's weight. Conceptualising self-insight research as "double model recovery" emphasises some limitations in previous work that bear on N&S's *relevance* and *sensitivity* criteria for the adequate assessment of awareness (target article, Table 1), and points to avenues for developing better methods for assessing self-insight.

First, this double-model-recovery framework highlights a critical question: why – as seems standard – instantiate the implicit policy (from statistical model recovery) as the "correct" model, and therefore assume that any discrepancy between implicit and explicit policies represents the judge's failure to recover the "true" model? Model-recovery exercises in cognitive science usually consider multiple "families" of candidate model. Typically, lens model research considers a single family of models: compensatory linear rules that integrate a fixed number of cues – though it does consider different family members, which differ according to the number of cues used. Alternative families of non-linear (configural) or non-compensatory judgment models are less frequently considered in the multiple-cue judgment literature, even though several alternatives can be modelled, such as judgments made according to the similarity of each case to a prototype, judgments made following a non-exhaustive lexicographic search through cues, and judgments where cues are selected probabilistically and therefore different cues are used for different cases. In contrast, some research on multi-attribute *choice* does consider different families of models: for instance, comparing alternative models reflecting whether a compensatory or lexicographic decision rule is being applied (e.g., Bröder 2003). Additionally, this research on recovering choice processes highlights that different models reflecting quite distinct processes often fit the data similarly well. Therefore, even when a compensatory linear model fits the data, the judge may nonetheless have followed a quite different process in making his or her judgments. In such cases, any elicitation procedure that presupposes the compensatory linear combination of a fixed number of cues fails N&S's *relevance* criterion because the behaviours being probed are not those that drove the judgment. This is liable to generate a poor match between the implicit and explicit policies. Thus, by following a restricted approach to modelling the judge to dictate the constraints of that judge's self-description, we create an insensitive assessment of awareness and may misattribute poor modelling as poor self-insight.

Second, a double-model-recovery framework emphasises the potential for mis-recovery of the original judgment process by *either* recovery technique (statistical or human). As many others have done, I have pitted human judges against statistical rules in multiple-cue judgments and – as is typical – have found that "statistical judges" outperform their human competitors (Dawes et al. 1989). However, in one investigation (see Rakow et al. 2003), our statistical judge showed the same apparent lack of self-insight as its human counterparts. A seven-cue predictive model derived using logistic regression generated predicted probabilities (that an applicant would be offered a place at a given university) for a series of cases, each defined by multiple cues. Human judges also provided the same set of judgments. Using the same linear regression analysis applied to the human participants, the implicit policy for the statistical judge declared only five cues to be used reliably (i.e., significant). Thus the statistical judge showed the typical pattern of limited self-insight that human judges display, apparently overestimating the number of cues that it used! Thus, just as assessments of awareness may fail N&S's *sensitivity* criterion, so too, insufficiently sensitive model recovery via linear regression could contribute to an inappropriate conclusion of "limited self-insight" (for a technical discussion of this problem, see Beckstead 2007).

Third, we can consider strategies for assisting human judges in recovering (describing) their judgment policies, which may, also, influence the candidate models for the statistical element of the double recovery exercise. In a recent study, we asked mental health practitioners to self-identify with descriptions of alternative families of judgment models – (non-)compensatory and (non-) exhaustive – which drew on analogies to common decision aids such as "balance sheets" and "trouble-shooting guides." Many of our assessors selected those options that implied contingent information search or non-compensatory information integration in their own (triage) judgments. Thus, if required to describe themselves in terms of a compensatory model always using a fixed number of cues (as per most self-insight research – though arguably failing the *relevance* criterion), inevitably some participants were forced to misrepresent their policy. It would therefore be unsurprising if judges displayed "poor self-insight." Much work has been done on alternative strategies for eliciting the subjective weights for compensatory linear judgment policies (e.g., Cook & Stewart 1975). However, we need improved (i.e., *relevant* and *sensitive*) elicitation methods that allow for a wider range of information search and integration processes to be identified when judges are asked to describe their judgment policies. Fair assessment of a judge's self-insight requires that *both* the statistical exercise of deriving the implicit judgment policy *and* the elicitation exercise whereby the judge describes his or her own judgments allow – as far as possible – recovery of the processes by which the original judgments were made.

What we (don't) know about what we know

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Abstract: The hypothesis of unconscious influences on complex behavior is observationally equivalent to the dissociability of cognition and metacognition (reportability). The target article convincingly argues that evidence for unconscious influence is limited by the quality of the metacognitive measure used. However, it understates the empirical evidence for unconscious influences and overlooks considerations of cognitive architecture that make cognitive/metacognitive dissociations likely.

In their target article, Newell & Shanks (N&S) identify methodological problems in the study of unconscious influences on decision making. Because awareness is indexed by subjects' reports about what they know and how they know it, such studies seek, in effect, to demonstrate dissociations of cognition and metacognition: One component of the design shows that information of some kind is influencing behavior in some way; a second component elicits subjects' reports about the information they possess and the manner in which they are using it. Evidence for unconscious influence is obtained when the (relatively indirect) cognitive measures and the (relatively direct) metacognitive measures paint inconsistent pictures of the underlying mental process.

As the authors note, such studies are only as compelling as the metacognitive measures they use – and measures lacking in reliability, relevance, immediacy, and sensitivity are often employed. Indeed, research on unconscious influence suffers from its own distinctive array of perverse incentives. As in other areas of psychology, the researcher is driven to obtain evidence for a clear effect on the cognitive measure. This incentive fosters practices that make Type I errors more likely (Simmons et al. 2011). In the study of unconscious influences, the researcher typically has a second incentive – to *fail* to find evidence of a significant effect on the metacognitive measure. This incentive may foster practices that make *Type II* errors more likely in the

assessment of awareness. One effective way of failing to detect awareness is the use of unreliable, irrelevant, insensitive, and/or belated probes. (Ironically, such bias in the choice of probes might itself be unconscious.)

Complicating matters, it is not always easy to formulate, let alone satisfy, the central criterion of relevance – that "assessments should target only information relevant to the behavior" (target article, Table 1). What is relevant to a behavior depends on what causes it. As a result, subtly flawed or imprecise causal theories of behavior can lead even the well-meaning and careful researcher to misidentify relevance in designing a measure of awareness.

Although these methodological problems are important, and although they challenge some influential findings, we believe that the target article understates the full empirical and theoretical case for unconscious influences on complex behavior. To make the empirical case adequately would require a counter-review rather than a commentary. Recent reviews of unconscious cognition that are more comprehensive and, in our view, also more balanced are provided by Kouider and Dehaene (2007) and by Simons et al. (2007). The empirical study of unconscious cognition has its share of murky bathwater, but we believe the outlines of a baby are distinctly discernible within it.

Critically, the target article also understates the *theoretical* case for unconscious influences in complex behavior. N&S suggest that such influences make for "good stories," and that they confirm "strong ex ante beliefs" about mental causation that soften the critical judgment of researchers and journal editors. The explanatory role of unconscious influences is otherwise dismissed, as when the authors state that we do not "need to posit 'magical' unconscious processes producing answers from thin air" (sect. 6.2). Are unconscious processes mere explanatory magic?

As we noted above, the hypothesis of unconscious influence is observationally equivalent to the claim that cognition and metacognition are imperfectly coupled and sometimes strongly dissociate (because "conscious awareness" is measured by metacognitive report). In this regard, unconscious processes are no more "magical" than any other functional dissociation in cognition. Such processes are predicted by any cognitive architecture that represents metacognition as a limited subset or partial aspect of the mind.

For example, consider Baars's (2005) global workspace theory (GWT). Contrary to the target article's cursory account of it, this model is motivated by basic computational problems in cognition. Behavioral and neurophysiological investigations suggest the existence of multiple semi-independent "modules" specialized for different facets of information processing. This division of cognitive labor solves some problems, but it also *creates* a problem. Specifically, information from different modules needs to be integrated to represent arbitrary perceptual combinations, solve unfamiliar problems not handled by any one module, organize motor programs around a coherent action plan, and build an internal model of "the self." To address this problem, GWT proposes that only a small subset of relevant information is selected for "broadcasting" across the network. Integration is thus obtained, but it is incomplete and comes at the expense of reduced information bandwidth and processing speed. The theory makes sense of the *local* patterns of neural activity (with relative *inactivity* in globally connected association areas) that are observed in subliminal priming experiments and in the behavioral automatisms of sleepwalking, epilepsy, and the vegetative state (Baars 2005). This architecture implies that non-selected information can bias behavior, but without flexible integration or accessibility to report.

Similar predictions are made by other models that, in principle, distinguish the process of metacognitive report from other processes. For example, well-known models of learning and memory distinguish between procedural and declarative systems (Squire 1992). While the systems are thought to interact in the control of complex behavior, declarative knowledge of procedural mechanisms is at best indirect. Other models highlight constraints on the (coarse-grained) format of metacognitive representations. These constraints may limit the kinds of information that are available to report (Winkielman & Schooler 2011). Notably, dissociations are even possible within metacognition, as when we overtly report that certain states are ineffable – we experience more than we can overtly describe or express.

In any event, the claim that some cognitive operations are inaccessible to metacognition is not magical, but conceptually coherent and consistent with current knowledge. It predicts systematic mismatches between cognitive processes and subjects' overt reports about those processes – even when probes of awareness are reliable, relevant, immediate, and sensitive. Indeed, we would be interested to see the authors propose a principled sketch of a cognitive architecture in which cognition and metacognition are inseparable. To us, such a panpsychic architecture sounds like magic.

Extremely rigorous subliminal paradigms demonstrate unconscious influences on simple decisions

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Abstract: While showing unconscious influences on complex decisions is indeed difficult, relevant awareness in relatively simpler subliminal paradigms is more easily assessed. Utilizing objective *detection* (vs. more typical identification or classification) tasks to assess awareness overcomes longstanding residual methodological problems, and prior work using such methods (e.g., Snodgrass & Shevrin 2006) clearly shows unconscious influences on simple decisions.

Newell and Shanks (N&S) marshal impressive evidence that claims for unconscious influences on decision making are likely premature in the three areas they primarily discuss. Especially in such complex paradigms (e.g., multiple-cue judgment), we agree that it is very difficult to adequately assess relevant awareness, and hence that the jury is (or should be) still out. In contrast, however, subliminal paradigms are simpler, making assessing relevant awareness easier. Of course, such paradigms also face methodological hurdles, and we agree that much subliminal work does not overcome these difficulties. Still, contra N&S, we argue that subliminal paradigms can demonstrate unconscious influences on simple decisions under certain conditions. We first summarize our methodological analysis (cf. Snodgrass et al. 2004a, pp. 849–53), and then briefly describe some prior work that meets these extremely stringent methodological criteria. We focus on objective threshold paradigms, wherein performance on awareness assessment tasks does not exceed chance (i.e., $d'=0$). Skeptical interpretations are more plausible in subjective threshold paradigms, wherein performance exceeds chance and/or awareness assessment is often weak (e.g., post-experimental inquiries).

How should relevant awareness be assessed? All stimulus-related effects (e.g., semantic priming), whether conscious or unconscious, require at least partial stimulus identification. Accordingly, forced-choice prime identification tasks (e.g., "Was it word A or word B that was just presented?") adequately assess awareness in principle, because any conscious partial identification will raise performance above chance. For example, given "happy" and "terror" as response alternatives, perceiving the letter "t" would favor the latter response. Consequently, demonstrating

null identification awareness warrants claims for unconscious effects on other (e.g., priming) tasks.

Perhaps surprisingly, however, widely used *categorization* tasks (e.g., "Was the just-presented positive or negative?") may not be adequate because they frequently require more extensive identification. Here, for example, perceiving "t" alone would be useless. Given this, partial identification could conceivably activate related versus unrelated prime words, yet be insufficient to allow conscious categorization. Lovibond and Shanks (2002, p. 9) made related arguments, but failed to recognize this critical difference between identification versus categorization, instead lumping them together as "recognition" (cf. Wong et al. 2004, p. 239).

Unfortunately, however, even given observed chance identification, intrinsic measurement error makes definitively ruling out relevant awareness difficult (cf. the *null sensitivity problem*), because true identification might exceed chance. While there are various potential solutions, here we suggest a simple yet underutilized alternative: Use true detection tasks (e.g., "Was a word or a blank field just presented?") instead, arranging conditions such that detection $d' \approx 0$. Signal detection theory (Green & Swets 1966) provides strong reasons to believe that such tasks exhaustively assess even partial identification (cf. Macmillan 1986). Even more important, much evidence (Snodgrass et al. 2004a, p. 853) shows that objective *detection* thresholds (ODTs) are well below objective *identification* thresholds (OITs), and are hence extremely conservative. To illustrate, Fisk and Haase (2011) obtained both detection and identification for masked words under various exposure durations. See Fig. 1.

As Fig. 1 shows, given Fisk and Haase's masking conditions, detection $d' \approx 2$ at the OIT (i.e., identification $d' \approx 0$ with 25 ms exposures) and remains well above chance even at below-OIT durations. Critically, then, if the ODT is approximated, we can be very confident that extremely stringent OIT conditions are also satisfied, even given measurement error in detection d' – thus solving the null sensitivity problem outright regarding ruling out conscious partial identification.

But what about other possible artifacts cited by N&S, such as Pratte and Rouder's (2009) claim that standard prime discrimination tasks underestimate their visibility in the priming phase? While we disagree with their fundamental reasoning, here we simply note that their ostensibly improved awareness assessment procedure only increased identification from 54% to 60%, a d' increase of about 0.3. Thus, even if they are correct, approximating the ODT would still guarantee that extremely stringent OIT conditions were simultaneously met.

ODT effects are large and reliable. Although most grant that ODT conditions are extremely stringent, they are rarely utilized in recent years, in part because they are difficult to achieve using typical computer monitors. Perhaps more importantly, many investigators believe that all effects will disappear given the extremely brief exposures necessary for ODT conditions. Refuting such intuitions, however, our meta-analysis (Snodgrass et al. 2004b) shows that ODT effects are both large (Cohen's $d = 0.88$) and reliable ($p \approx 10^{-9}$).

But what about unconscious effects on decision making proper? In recent years subliminal investigations of cognitive control processes have increased markedly, obtaining positive results with clearly decision-relevant paradigms such as go/no go (cf van Gaal et al. 2012 review). However, because virtually all of these studies used identification or classification tasks to assess awareness, they do not conclusively rule out conscious partial identification.

In a series of ODT studies, however, we (Snodgrass et al. 1993a; 1993b; Snodgrass & Shevrin 2006) investigated unconscious influences on forced-choice identification itself, which clearly requires simple decision making. For the current purposes, the most striking result was that under certain conditions identification was reliably *below* chance. This requires that the stimuli were unconsciously identified, yet rejected as a response (i.e., *excluded* – cf. Jacoby 1991). Otherwise, only chance performance would result. But could this effect be conscious? No, because (1) ODT conditions rule out conscious partial identification; (2) conscious exclusion requires much stronger stimuli (i.e., exceeding the subjective threshold; Debner & Jacoby 1994); and (3) instructions requested correct responses (i.e., *inclusion*, not exclusion). Further, these effects have been repeatedly replicated, both by skeptical investigators (Van Selst & Merikle 1993) and including critical tests for possible artifacts. Accordingly, these effects reflect unconscious, involuntary exclusion. While still relatively simple, this result is notable indeed, given that response inhibition (i.e., exclusion) is a core decision process long thought to require relevant awareness.

It may be that only relatively simple decisions can be unconsciously influenced. Further subliminal work using more complex paradigms (cf. van Gaal et al. 2012) under extremely rigorous ODT conditions, however, are essential before firm conclusions about unconscious influences on complex decision making can be drawn.

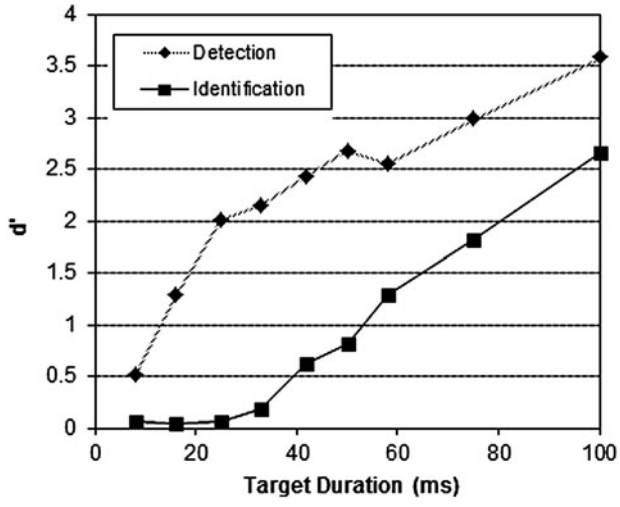

Figure 1 (Snodgrass et al.). Sensitivity (d') of detection and identification as a function of masked word (target) exposure duration. Reprinted by permission from Fisk and Haase (2011).

Even "unconscious thought" is influenced by attentional mechanisms

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Abstract: In this commentary, we focus on the role of attentional mechanisms in unconscious thought. We argue that even distracted or unconscious thought is capacity limited and differences in scope of attention influence processing during unconscious thought. Attention also would influence processes at different stages in the proposed lens model. We conclude that there is a clear need to understand the role of attention to better understand conscious or unconscious thought.

Recently multiple attempts have been made to argue in favor of powerful unconscious processes affecting decision making,

including recommendations to let the unconscious guide one's decisions (Dijksterhuis & Nordgren 2006). Newell and Shanks (N&S) have done a commendable job questioning the efficacy of seductive claims regarding unconscious processing. We focus on the Unconscious Thought Theory (UTT) and paradigms used to argue for deliberation-without-attention. Although we agree with the broad claims made in the target article against UTT, N&S do not directly address the role of attentional mechanisms involved in distracted or supposedly unconscious thought. The role of attentional processes in the lens model discussed by N&S is also not clear, although they point to attentional or top-down mechanisms influencing processes such as motion perception. We think the role of attention is extremely critical for the debate on conscious and unconscious thought, and that it requires further elaboration. We suggest rethinking the core assumptions of UTT, the very definition of unconscious thought and the nature of processing during distraction.

A critical assumption of UTT is that the powerful unconscious is not constrained by limited capacity attentional processes (Dijksterhuis & Nordgren 2006). We have questioned the unlimited capacity and optimal weighing assumptions of UTT using simulations that were performed on data sets employed in the UTT paradigms (Srinivasan & Mukherjee 2010). The simulations clearly showed that a small subset of information is sufficient to produce performance that is seen in UTT tasks. Experimental results (Ashby et al. 2011) confirm our concern with the fundamental assumptions of UTT (the capacity and weighting principles). The use of a generic "sub-sampling" heuristic can enable people to "select" a small set of dominant attributes during distracted thought (hypothesized to elicit "unconscious thought") and can partly explain other related findings based on consideration sets even during conscious thought (Mukherjee & Srinivasan 2013). This is consistent with suggestions made by N&S to explain earlier findings on decision making (Wilson & Nisbett 1978). Even intuitive or affective processing (Usher et al. 2011; Kahneman 2011) could be utilizing a subset of attribute information along with quickly recovered cues from memory that would result in decently good solutions because many choice scenarios require attending only to a subset of the information. For example, in Usher et al.'s (2011) data set consisting of 12 attributes and four alternatives, choice based on the two best attributes creates a tie between the best and second best option, and selecting 7 out of the possible 12 attributes results in the selection of the best alternative. These results indicate that attention plays an important role in selecting specific attributes based on prior experience to make satisfying decisions.

A critical problem in many decision making studies is the lack of proper treatment of attentional processes, possibly linked to graded differences in consciousness. For example, attention is used to operationalize "unconscious thought," which we believe conflates attention and consciousness and treats attention as a dichotomous variable (Mukherjee & Srinivasan 2013; Srinivasan & Mukherjee 2010), thereby limiting the construct of attention. Attention can vary as a resource (more versus less) and perceptual scope (focused versus distributed) that involves differences in selection resulting in differences in perception, memory, and awareness (Baijal & Srinivasan 2009; Srinivasan et al. 2013).

Given that people are performing a distractor task during "unconscious thought," the nature of the distractor task – and more specifically the attentional mechanisms employed during distraction – can potentially influence processing either during or after distraction. The changes in (perceptual or conceptual) scope of attention under different situations enable us to sample and process information differently leading to differences in processes involved in memory and decision making. Using the UTT paradigm, we manipulated the distraction task using global or local processing (associated with changes in scope) at low and high levels of cognitive or working memory load (Srinivasan et al. 2013). We found that global processing during distraction resulted in stronger preference for the chosen item irrespective of cognitive load. In addition, we found better incidental memory for attributes with global compared to local processing during distraction only when the distractor was an easy low load task.

Therefore we propose that the putative "unconscious thought" is constrained by differences in the attentional processes employed during distraction (Mukherjee & Srinivasan 2013; Srinivasan et al. 2013) and to differences in selection (e.g., information sampling; Srinivasan & Mukherjee 2010). Theorizing about the causal effects of conscious versus unconscious processes is critically dependent on a proper treatment of attention (like the global workspace theory discussed in the target article). Conflating both attention and consciousness would add more confusion to this critical debate on the role of consciousness in decision making.

More generally, attention could influence judgment and decision making at multiple points such as cues and their utilization – points C and D in the lens model. Selective attention mechanisms (e.g., subsampling) can affect the number of cues selected for processing depending on the weights of the cues and past experience of their validity. Sometimes not attending to part of the information or relying on small samples can prove useful (Gigerenzer & Gaissmaier 2011). The differences in selection (changes in scope of attention) could also affect utilization of the cues and would be consistent with results showing that changes in scope of attention can affect preference strengths and memory (Srinivasan et al. 2013).

The information that we attend to gets privileged access in working memory (McElree 2006) and the access can be related to graded levels of consciousness as attention and working memory interact (Baars & Franklin 2003). A clear understanding about the role of different attentional processes is crucial for debates on the role of consciousness in decision making including the current analysis about causally effective unconscious processes. Much of the published literature in UTT and other areas of decision making (see Mukherjee & Srinivasan 2013) need to be reevaluated through the lens of attentional mechanisms and their role in conscious or unconscious thought.

Performance and awareness in the Iowa Gambling Task

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Abstract: Newell & Shanks (N&S) conclude that healthy participants learn to differentiate between the good and bad decks of the Iowa Gambling Task, and that healthy participants even have conscious knowledge about the task's payoff structure. Improved methods of analysis and new behavioral findings suggest that this conclusion is premature.

Newell & Shanks (N&S) convincingly argue that past research has severely overstated the importance of conscious processes in decision making. We agree with N&S on many counts, but here we focus on what is perhaps our sole source of dissention. N&S conclude that healthy participants who perform the Iowa Gambling Task (IGT) learn to differentiate between the good and bad decks, and that this behavioral differentiation is even reflected in conscious knowledge about the payoff structure. We believe this conclusion may be premature: Several pitfalls in IGT data analysis methods frustrate a fair interpretation of IGT data, and several behavioral findings go against the authors' conclusion.

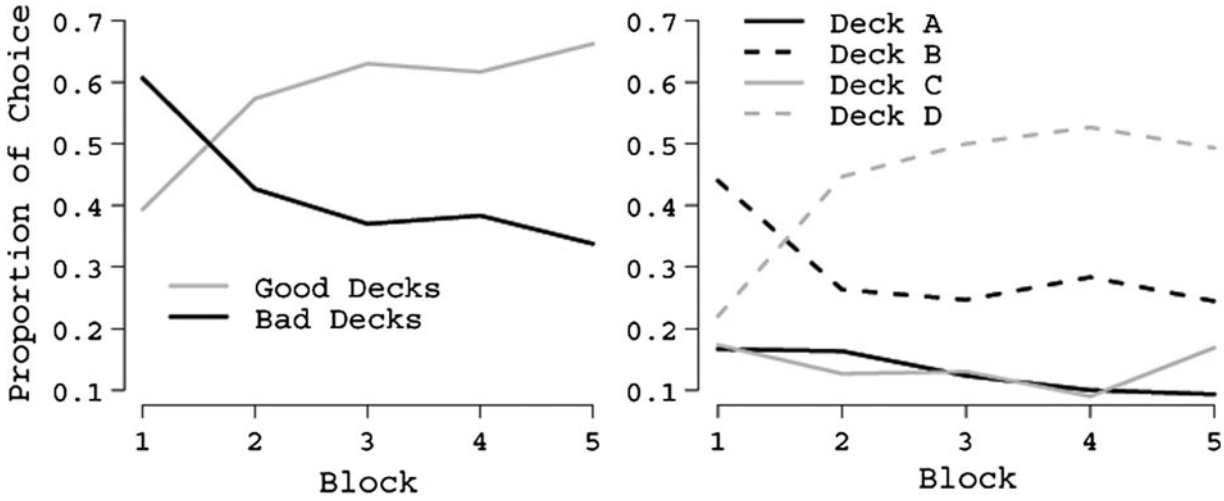

Figure 1 (Steingroever & Wagenmakers). Choice behavior of healthy participants in Fridberg et al. (2010), once for the good and bad decks (left panel) and once for each deck separately (right panel). Each block contains 20 trials, except the last block (15 trials).

The first pitfall is that the traditional way of analyzing IGT data is incomplete and potentially misleading because it collapses choice behavior over the two good decks and over the two bad decks. This procedure hides the impact of the frequency of losses (bad deck B and good deck D yield rare losses, whereas bad deck A and good deck C yield frequent losses) and potentially obscures diagnostic information. For example, consider the data of Fridberg et al.'s (2010) healthy participants. Fridberg et al. plot the mean proportion of choices from the good and bad decks as a function of trial number, replotted here in the left panel of Figure 1. This panel suggests that participants learn to prefer the good decks. However, Fridberg et al. also plot the mean proportion of choices from each deck separately, replotted here in the right panel of Figure 1. This panel shows that, across all trials, participants prefer the decks with infrequent losses (B & D).

A similar problem is evident in work that assesses conscious knowledge about the IGT either with subjective experience ratings (C+D) – (A+B) (Bowman et al. 2005; Cella et al. 2007), or by determining whether participants have conscious knowledge that would encourage them to choose *one* of the two best decks (Maia & McClelland 2004). However, participants who consider "*one* of the best decks as the best deck" do not necessarily understand that there are two best decks and that both bad decks should be avoided. To investigate whether participants understand that there are two good decks, participants should identify the best and second-best deck on each trial.

The final pitfall concerns the way in which IGT studies typically assess the learning process, namely by applying an analysis of variance to assess whether participants' preference for the good decks (i.e., (C+D) – (A+B)) increases over blocks of trials (main effect of block). A significant effect of block is typically taken as evidence that participants learned to discriminate between the good and bad decks. However, when the main effect of block is significant, this does not imply it is also substantial. For example, consider the data of Bowman et al. (2005), who tested three groups of healthy participants that differed in whether they obtained a manual or computerized IGT combined with or without a 6-second delay. The only significant effect was a main effect of block. However, even in the last block (i.e., the final 20 trials), the three groups showed at most a weak preference for the good decks, as (C+D) – (A+B) ranged from about 3 to about 6.5. A value of 3 corresponds to an average of 11.5 out of 20 choices from the good decks, and a value of 6.5 corresponds to an average of 13.25 out of 20 choices from the good decks. Similar unconvincing results were evident from subjective ratings of how positive each deck was experienced. These findings suggest that neither participants' behavioral preference for the good decks nor their conscious preference for the good decks is substantial. Cella et al. (2007) reported similar findings.

Next to the above mentioned pitfalls, several behavioral findings contradict the conclusion from N&S. First, a detailed reanalysis of eight data sets showed that healthy participants learn to prefer the good decks in only one data set (see Steingroever et al. 2013, and references therein). In the remaining seven data sets, participants either only learn to avoid bad deck A (frequent losses) or prefer the decks with infrequent losses (decks B & D). Such a preference for the decks with infrequent losses – the frequency-of-losses effect – has been reported by many studies. The empirical evidence for the frequency-of-losses effect contradicts the assumption that healthy participants learn to prefer the good decks.

Second, Steingroever et al. (2013) showed that participants have a tendency to switch frequently throughout the entire task. This is counterintuitive because one expects a strong decrease in the mean number of switches once participants learned to prefer the good decks. The frequent switches suggest that participants do not learn to systematically differentiate between the good and bad decks, a suggestion that is illustrated by deck selection profiles of 394 participants (Steingroever et al. 2013; see https://dl.dropbox.com/u/12798592/DeckSelectionProfiles.zip for the deck selection profiles); each participant has a highly idiosyncratic choice pattern, and for most participants it is impossible to identify a point where they realized that the good decks should be preferred.

In sum, detailed analyses of IGT data have shown that even healthy participants are unable to discriminate the good decks from the bad decks, a finding that suggests a lack of both conscious and unconscious knowledge in this task.

The problem of the null in the verification of unconscious cognition

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Abstract: Newell & Shanks (N&S) argue that when awareness measures are more reliable and valid, greater evidence of awareness of supposedly

unconscious influences is revealed. A related issue is that unconsciousness is typically the null hypothesis that evidence of awareness will *not* emerge. As it is difficult to conclude the null, it is also difficult to conclude a lack of conscious awareness.

Traditional theories hold that human beings make decisions consciously and intentionally. In contemporary cognitive science, this traditional perspective has been challenged by research pointing to an important role for unconscious influences in decision making. Newell & Shanks (N&S) provide a methodological critique of some of the major bodies of literature on unconscious cognition. As they argue, when awareness probes are more reliable, relevant, immediate, and sensitive, greater evidence of conscious awareness is sometimes revealed. Thus, at least some findings used to argue for unconscious influences on decision making may result from shortcomings of commonly used measures of conscious awareness.

This point also applies to some areas of research on implicit and automatic cognition not addressed by N&S. Uhlmann et al. (2008) raised similar concerns about methodological limitations potentially shrouding evidence of awareness of the automatic associations measured by tasks like the Implicit Association Test (IAT; Greenwald et al. 1998). Early studies finding negligible correlations between self-reported attitudes and IAT scores led to the conclusion that the latter measured attitudes of which the person was not consciously aware. However, subsequent studies reveal robust implicit-explicit correlations after correcting for random measurement error (Cunningham et al. 2001; Cunningham et al. 2004) and when more relevant self-report measures are used (e.g., asking the person to report their automatic gut feelings rather than their explicit attitudes; Ranganath et al. 2008; Smith & Nosek 2011). Moreover, correlations between self-report and implicit measures are higher in domains that are less socially sensitive (e.g., consumer as opposed to racial attitudes; Nosek 2005), for participants unmotivated to conceal their true attitudes (Banse et al. 2001; Dunton & Fazio 1997; Fazio et al. 1995; Payne 2001; Payne et al. 2005), and when respondents are encouraged to be honest in their self-reports (Olson et al. 2007). This suggests that people are at least partly aware of their automatic associations, but that insufficiently reliable, sensitive, and relevant measures often obscure this fact (Uhlmann et al. 2008).

This reflects not just methodological limitations of the measures involved, but also the broader problem with operationalizing unconsciousness as a null effect (as is done in most research on unconscious cognition). When post hoc debriefings do not uncover evidence of awareness, or a correlation between a self-report measure and implicit measure fails to emerge, such null effects are used to conclude a lack of conscious awareness. This would be less problematic if we knew a priori that the measure of awareness were perfectly valid. However, how does one really know whether an awareness measure is reliable, relevant, sensitive, or immediate enough? Such measures are most self-evidently valid when they uncover some evidence of conscious awareness. But when they do not, should we then conclude the null (i.e., a lack of conscious awareness), or worry that the measures involved are not good enough? Equating unconsciousness with the null also leaves the findings vulnerable to criticism. A skeptic can always argue (in some cases post hoc) that the awareness measure was insufficiently relevant, reliable, immediate, or sensitive.

Importantly, there is considerable evidence of unconscious influences on decision making that is *not* dependent on null effects. For instance, research on the effects of "reasons analyses" shows that asking people to provide reasons for their attitudes leads them to report different attitudes, suggesting that they do not actually know what the real reasons for their attitudes are (Wilson & LaFleur 1995; Wilson et al. 1984; 1989). N&S argue that reasons analyses may lead participants to incorporate additional information they had not considered before and therefore change their attitudes, but they offer no evidence that this actually occurs. Moreover, it is unclear why consciously incorporating previously unconsidered information would reduce attitude-behavior consistency and post-choice satisfaction if the influence of the new information (and resulting attitude change) is genuine. Thus, the effects of reasons analyses are more consistent with a lack of full introspective access into the true influences on one's attitudes.

In addition, the effects of unobtrusively presented primes (e.g., words related to competition) on relevant judgments and actions (e.g., competitive behavior) have been replicated in scores of studies (for reviews, see Bargh 2006; Bargh et al. 2012; DeCoster & Claypool 2004; Wheeler & DeMarree 2009). Indicating that such influences occur primarily when participants are unable to consciously resist them, priming effects have been shown to attenuate or even reverse when study participants suspect they are being influenced (Lombardi et al. 1987; Newman & Uleman 1990) or their awareness of the primes is experimentally increased (Erb et al. 2002; Newman & Uleman 1990; Strack et al. 1993). If increased awareness reduces priming effects, then assimilation to primes is almost certainly unconscious. The case that people are unaware of the influences of primes on their judgments and behaviors does not rest solely on null effects.

As highlighted by N&S, the criteria currently used to demonstrate unconscious cognition are worth critiquing and debating. However, it is worth discussing not only the criteria for concluding an influence on decision making is unconscious, but also for concluding it is conscious. When strong evidence of unconscious cognition is unavailable, researchers should not assume conscious awareness by default. Rather, awareness should be demonstrated empirically. A liberal criterion is a statistically significant relationship between an awareness probe and the phenomenon of interest. A conservative criterion is that an effect only emerges among participants who report being consciously aware of it. Regardless of what criteria the field ultimately settles on, it is critical that the burden of proof for concluding consciousness and unconsciousness be equally difficult to meet.

What makes a conscious process conscious?

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Abstract: Newell & Shanks' (N&S's) critical review considers only a very limited sense in which mental processes can be thought of as either conscious or unconscious and consequently gives a misleading analysis of the role of consciousness in human information processing. This commentary provides an expanded analysis of conscious processing that also reveals the various ways in which mental processes are unconscious.

According to Newell & Shanks (N&S), it now seems to be generally accepted that whether a process is conscious should be operationally defined in terms of whether one has reportable knowledge of it. Consequently, in their critical review of unconscious processing, this is the criterion that they apply. However, as I have noted in the pages of this journal and elsewhere (see Velmans 1991a; 1991b; 1993; 1996; 2009), the psychological and philosophical literature often confounds three distinct senses in which a process might be said to be conscious. It might be conscious:

a. in the sense that one is conscious *of* the process,
b. in the sense that the operation of the process is *accompanied* by consciousness (of its *results*), and
c. in the sense that consciousness *enters into* or *causally influences* the process.

In these publications I have also considered how these different forms of "conscious processing" apply to every stage of human information processing, although I only have space in this brief commentary to deal with a few examples. Ask yourself what's conscious about "conscious verbal thought." We do not have introspective access to how the preconscious cognitive processes that enable thinking produce individual, conscious thoughts in the form of "inner speech." However, the content of such thoughts and the sequence in which they appear does give some insight into the way the cognitive processes (of which they are manifestations) operate over time in problem solving, thinking, planning and so on. Consequently such cognitive processes are partly conscious in sense (a), but only in so far as their detailed operation is made explicit in conscious thoughts, thereby becoming accessible to introspection and consequent report. As noted above, being conscious in sense (a) is the criterion that N&S adopt.

However, many psychological processes are conscious in sense (b), but not in sense (a) – that is, we are not conscious of how the processes operate, but we are conscious of their *results*. This applies to perception in all sense modalities. When consciously reading this sentence, for example, you become aware of the printed text on the page, accompanied perhaps by inner speech (phonemic imagery) and a feeling of understanding (or not), but you have no introspective access to the processes which enable you to read. Nor does one have introspective access to the *details* of most other forms of cognitive functioning, for example, to the detailed operations that enable "conscious" learning, remembering, engaging in conversations with others, and so on.

Crucially, having an experience that gives some introspective access to a given process, or having the results of that process manifest in an experience, says nothing about whether that experience *carries out* or *controls* that process. That is, whether a process is "conscious" in sense (a) or (b) needs to distinguished from whether it is conscious in sense (c). Indeed, it is not easy to envisage how the experience that makes a process conscious in sense (a) or (b) *could* make it conscious in sense (c). Consciousness *of* a physical process does not make consciousness responsible for the operation of that process (watching paint dry does not actually make it dry on the wall). So, how could consciousness *of* a mental process carry out the functions of that process? Alternatively, if conscious experience *results* from a mental process, it arrives *too late* to carry out the functions of that process. For example, try reading the following sentence and note what you experience:

If we don't increase the dustmen's wages, they will refuse to take the refuse.

Note that on its first occurrence in your phonemic imagery or "inner speech," the word "refuse" was (silently) pronounced with the stress on the second syllable (re*fuse*) while on its second occurrence the stress was on the first syllable (*re*fuse). But how and when did this allocation of stress patterns take place? Clearly, the syntactic and semantic analysis required to determine the appropriate meanings of the word "refuse" must have taken place prior to the allocation of the stress patterns; and this, in turn, must have taken place *prior* to the phonemic images entering awareness.

Note too, that while reading, one is not conscious of any of the visual processing or pattern recognition that is required to identify individual words, or of any syntactic or semantic analysis being applied to the sentence. Nor is one aware of the processing responsible for the resulting inner speech (with the appropriate stress patterns on the word "refuse"). The same may be said of the paragraph you are now reading, or of the entire text of this commentary. You are conscious *of* what is written, but not conscious of the complex input analyses involved. And if you are not conscious of how these processes operate, in what sense can they be said to be under "conscious control"?

The same may also be said about the detailed operation of nearly every other form of human information processing (see reviews cited above). According to N&S, "evidence for the existence of robust unconscious influences on decision making and related behaviors is weak, and many of the key research findings either demonstrate directly that behavior is under conscious control or can be plausibly explained without recourse to unconscious influences" (sect. 6.4). On the contrary, evidence for the influence of unconscious mental processes on human behavior is ubiquitous. Indeed, if these complex processes *were* conscious in the sense that N&S intend, they should be directly available to first-person introspection, in which case there would be no need to discover their operation by means of laborious, third-person, cognitive psychological research!

The effect of the cognitive demands of the distraction task on unconscious thought

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Abstract: The unconscious-thought effect occurs when distraction improves complex decision making. Recent studies suggest that this effect is more likely to occur with low- than high-demanding distraction tasks. We discuss implications of these findings for Newell & Shanks' (N&S's) claim that evidence is lacking for the intervention of unconscious processes in complex decision making.

Recent studies suggest that performing a distraction task concurrently with a complex decision paradoxically improves the quality of the decision (e.g., Dijksterhuis et al. 2006b). This finding, referred to as the unconscious-thought effect (e.g., Strick et al. 2011) or as the deliberation-without-attention effect (see below), has been interpreted as evidence that complex decisions are best made through "unconscious thought."

In early theoretical accounts, Dijksterhuis and colleagues defined unconscious thought as thought processes occurring outside conscious awareness and proposed that unconscious thought is capacity-unlimited (Dijksterhuis 2004; see also Dijksterhuis & Nordgren 2006). Thus, unconscious thought is allegedly capable of handling a large amount of information without requiring attention or cognitive resources.

We agree with Newell & Shanks (N&S) that the unconscious-thought effect, like many others purporting to demonstrate the capacity of unconscious processes, does not mandate the existence of a powerful unconscious system that works just like the conscious system, only minus consciousness (Cleeremans & Jiménez 2002). We also confirm that the effect is difficult to replicate (Waroquier et al. 2009; see also Klein et al. 2012). However, in contrast to N&S's position, we have to admit that the results of the most recent meta-analysis (Strick et al. 2011) support the existence of the effect, and even more importantly, that it can be replicated under specified conditions. One of the important moderators we identified is the difficulty of the distraction task: The effect is more likely to occur with easy distraction tasks.

Two independent sets of experiments that directly manipulated the difficulty of the distraction task now provide evidence that low-demanding distraction improves complex decision making compared with deliberation, high-demanding distraction, or immediate choices (Abadie et al. 2013; McMahon et al. 2011). Similarly, a recent study suggests that low-demanding distraction improves creativity as well (Baird et al. 2012). Abadie et al. (2013) also provide evidence that the effect is accompanied by a better organization of the information conveyed by decision cues, as shown by an increase in gist memory (see Reyna 2012).

Do such findings confirm the existence of unconscious thought, or on the contrary, do they support N&S's claim that evidence for the intervention of unconscious processes in the utilization of decision cues is lacking? As it is often the case with interesting research topics, things are not so simple.

First, we note that neither unconscious-thought theory (UTT) in its original formulation (Dijksterhuis & Nordgren 2006) nor the position taken by N&S in the target article suffice to account for these recent results. Indeed, UTT assumes that unconscious thought, unlike conscious thought, is not capacity-limited. It is precisely this greater, potentially unlimited capacity that would explain why people make better decisions after distraction. A straightforward prediction of UTT is therefore that performance should increase as distraction increases, for the more conscious attention is otherwise engaged, the more unconscious thought should be able to solve the problem. However, several studies have shown exactly the opposite: People indeed make better decisions after low-demanding distraction than after deliberation, but performance after high-demanding distraction is worse than after low-demanding distraction.

Turning now to N&S's proposal, we likewise run into an impasse, for they make the exact opposite – but likewise monotonic – prediction about the effects of distraction on decision making: The more conscious attention people can dedicate to a decision-making process, the better the decision should be. However, this is again not what the most recent studies show.

A solution to this dilemma comes from the important consideration that consciousness (i.e., the ability of being aware of the processes) and attention (i.e., the extent to which cognitive resources are allocated to process some specific information) are not identical to each other. Several studies have now documented the fact that the two can be wholly dissociated (Dehaene et al. 2006; Koch & Tsuchiya 2006; Dijksterhuis & Aarts 2010). A recent experiment even adopted a clear 2 × 2 design (Watanabe et al. 2011) to show that consciousness (as assessed by reportability) and attention are subtended by distinct neural correlates.

Based on this distinction, Strick and colleagues (2011) maintained that the processes involved in the unconscious-thought effect occur outside conscious awareness but conceded that the term "deliberation without attention" (e.g., target article; Dijksterhuis et al. 2006b) is a misnomer. They thus suggest that the integration of decision cues is unconscious but needs attentional resources. According to this view, unconscious thought can not only perform the same functions (e.g., mathematical calculations; for evidence, see Ric & Muller 2012) as conscious thought but also is subject to the same constraints (i.e., limited capacity).

However, Strick et al. (2011) do not show any evidence that decision cues are indeed used unconsciously (e.g., cues utilization cannot be reported) during low-demanding distraction (e.g., while listening to music). Moreover, since the decision goal is given explicitly before distraction in the paradigm at hand, it is likely that some decision-relevant processes occur inside conscious awareness. If, as N&S do, we endorse the null hypothesis that complex decisions are made consciously (for evidence, see Baumeister et al. 2011), it seems both safe and parsimonious to assume that integration of decision cues occurs inside conscious awareness but is modulated by attentional factors. Congruently with Waroquier et al.'s (2010) conclusions, conscious thought may enhance decision making; however, while a certain amount of attention is necessary, too much attention may sometimes be detrimental.

Authors' Response

The primacy of conscious decision making

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Abstract: The target article sought to question the common belief that our decisions are often biased by unconscious influences. While many commentators offer additional support for this perspective, others question our theoretical assumptions, empirical evaluations, and methodological criteria. We rebut in particular the starting assumption that all decision making is unconscious, and that the onus should be on researchers to prove conscious influences. Further evidence is evaluated in relation to the core topics we reviewed (multiple-cue judgment, deliberation without attention, and decisions under uncertainty), as well as priming effects. We reiterate a key conclusion from the target article, namely, that it now seems to be generally accepted that awareness should be operationally defined as reportable knowledge, and that such knowledge can only be evaluated by careful and thorough probing. We call for future research to pay heed to the different ways in which awareness can intervene in decision making (as identified in our lens model analysis) and to employ suitable methodology in the assessment of awareness, including the requirements that awareness assessment must be reliable, relevant, immediate, and sensitive.

In our target article we proposed that unconscious influences have been ascribed inflated and erroneous explanatory power in theories of decision making. Many of the commentators agreed with our basic position, noting that more critical treatment of these issues was welcome and a debate overdue (**Baumeister, Vohs, & Masicampo** [**Baumeister et al.**]; **González-Vallejo, Stewart, Lassiter, & Weindhardt** [**González-Vallejo et al.**]; **Huizenga, van Duijvenvoorde, van Ravenzwaaij, Wetzels, & Jansen** [**Huizenga et al.**]; **Rakow**; **Steingroever & Wagenmakers**; **Waroquier, Abadie, Klein, & Cleeremans** [**Waroquier et al.**]). However, several other commentators strongly disagreed both with our principal claim and with a perceived selective review of the relevant literature (**Brooks & Stein**; **Dijksterhuis, van Knippenberg, Holland, & Veling** [**Dijksterhuis et al.**]; **Evans**; **Hassin & Milyavsky**; **McLaren, Dunn, Lawrence, Milton, Verbruggen, Stevens, McAndrew, & Yeates** [**McLaren et al.**]). This clear divergence of opinion confirms that researchers remain divided on the role of consciousness in decision making and emphasizes the continued need for open discussion. We thank all the commentators, both those generally sympathetic to our analysis and those more critical, for their thoughtful and constructive remarks.

The structure of our reply mirrors that of the target article. First, in light of the critiques challenging our

theoretical conceptualizations of consciousness and decision making, in section R1 we clarify what we mean by a "decision" and by an (un)conscious influence, and why we argue for the primacy of *conscious* rather than unconscious decision making. We then go on to consider commentators' challenges (and/or extensions) to the conclusions we drew in the main topic areas we reviewed. Thus section R2 considers multiple-cue learning; R3, the unconscious thought paradigm; and R4, the Iowa Gambling Task (IGT). Section R5 elaborates on the additional paradigms that we briefly reviewed – subliminal priming, blindsight, and primes-to-behavior. In section R6 we address issues that we did not cover in the original article – in particular the intriguing claim that the *context* in which decisions occur can exert unconscious influences (e.g., **Helzer & Dunning**). We conclude in section R7 by suggesting areas in which further study of the potential for unconscious influences on decision making could be particularly informative against the backdrop of current gaps in our knowledge and understanding.

R1. Defining the consciousness of a decision

Dijksterhuis et al., **Evans**, and **Hassin & Milyavsky** all question, in various ways, why we presume that in the absence of evidence to the contrary, decision making is a conscious process. These commentators all appear to advocate the opposite position of proposing that all decision making (all of cognition?) is unconscious, and that the onus should be on researchers to provide evidence of conscious influences. We find this line of argument ill-conceived and ill-defined.

Dijksterhuis et al. and **Evans** both suggest (incorrectly) that our position forces us to endorse a form of Cartesian dualism in which conscious "mind stuff" has powers of causation in the brain. But neither explain how unconscious "mind stuff" – that they argue plays such a central role in cognition – exerts its influence. Simply arguing that all conscious thought must have unconscious precursors begs the question of where these precursors come from.

For the avoidance of doubt, we emphasize that our position does not force us to assume that "consciousness freely hovers in the air" (**Dijksterhuis et al.**) nor is it remotely correct to state that "it borders in the mystical (or at least Cartesian dualism) to think of consciousness as some kind of 'mind stuff' that has powers of causation" (**Evans**). Claiming that all or most decisions have conscious precursors does not force us to embrace dualism or abandon materialism. We assume that all mental states *are* brain states. Software states in computers are equivalent to, or realized by, hardware states, yet it is still perfectly meaningful to say that a line of software code caused the printer to start working. Likewise, by any of the usual standards for judging what a cause is, consciously reportable mental processes cause behavior. This is not a dualistic claim – it is perfectly consistent with materialism. To say that report X caused behavior Y means, for example, that Y counterfactually would not have occurred if X had been absent.

A good example is the relationship between conditioning and awareness. In experiments on this topic, independent variables are employed to manipulate awareness levels, with conditioned responding as the dependent variable. Meeting **Uhlmann**'s criterion, numerous studies demonstrate covariation between reportable awareness and conditioning (Lovibond & Shanks 2002), such that in the absence of awareness, conditioned responding is absent. **Baumeister et al.** make the excellent point that "by the logic of experimental design, such studies prove causation." No one can seriously doubt that such inferences are valid. Reportable mental states correlate with behavior (my belief that light switches cause lights to come on correlates with my pressing the light switch); behaviors are prevented when the relevant mental state is absent (when I don't believe that pressing the light switch will cause the light to come on – it's been disconnected – I don't press the light switch); and interventions on those states cause or prevent the behavior (you telling me that you've disconnected the light switch will stop me believing that pressing will cause the light to come on and will stop me pressing the light switch). No such commonsense case can be made for unconscious states playing a causal role in behavior. There are no clear-cut and agreed instances in which an unreportable state causes a behavior that would not have occurred in the absence of that state. As the target article argues, it has not even been unequivocally proven that there are any unreportable states that cause behavior. And as Baumeister et al. say, "Does anyone seriously think that a student could pass a college math test without conscious thought?"

Evans argues that we have conflated the System or Type 1 versus System or Type 2 distinction with unconscious versus conscious. We acknowledge that consciousness is but one aspect by which the proposed different modes of thinking can be distinguished, and that for at least some authors it is not the primary one. Nonetheless, the particular instantiation of dual-process theorizing we focused on in the article (Usher et al. 2011) did use awareness of the stages of processing as a key defining feature of the difference between System 1 and System 2 (as illustrated in the quotation we took from that article). Appeals to other defining features, such as involvement of working memory in System 2 but not System 1 (Evans), are also fraught because of the difficulties inherent in interpreting "dissociations" (e.g., Newell & Dunn 2008), and because there have been repeated demonstrations of the necessity of working memory for tasks that are purportedly under System 1 control (e.g., Lewandowsky et al. 2012; Newell et al. 2007a; 2010). In our view discussion about what kinds of processes should and should not be included "in" System 1 and System 2 is exactly the kind of hair-splitting and unproductive debate that appears to handicap the development of dual-process theories. In this regard we agree with Keren and Schul (2009) that "two-system models currently provide little scientific advance" (p. 533).

Ogilvie & Carruthers contend that even though individuals may be able to give informative reports about their decision processes, this provides no guarantee that these reports accurately reflect knowledge that was both conscious and causal at the time the decision was made. In relation to the IGT, for instance, the accurate ratings given by Maia and McClelland's (2004) participants may have been based on their affective reactions to the decks, and not at all causal in regard to deck selection choices. We commented on this possibility in the target article (sect. 4.2) and cited some of the extensive evidence against it in the context of the IGT. But we acknowledge the more general points that (a) many awareness

assessments probe *post facto* knowledge that may have been constructed after the decision itself, and (b) even for knowledge assessed contiguously with a decision, it is a challenge to establish that such knowledge was causal in relation to the decision. One general strategy is to ask whether verbal reports correlate better with choices than do affective reactions or somatic markers; Gutbrod et al.'s (2006) data suggest this is highly likely, though more research is needed on this issue. To that extent, it is plausible to attribute a causal role to conscious knowledge.

Several commentators (**Bernacer, Balderas, Martinez-Valbuena, Pastor, & Murillo** [**Bernacer et al.**]; **Hogarth**; **Srinivasan & Mukherjee**) raise the issues of attention, automaticity, and habitual behavior. We agree that attention is distinct from awareness and that attention is required for virtually all decisions. Hogarth expresses surprise that we did not explore the topic of automatic processes in more detail. We do not dispute that the acquisition of many physical or perceptual-motor skills involves a period in which people are acutely aware of their movements, and that when such skills are mastered, they are executed with very shallow phenomenological experience. However, just because we allocate very little attention to and engage in minimal monitoring of the mental operations involved in performing perceptual-motor skills, it does not follow that such skills are controlled and executed unconsciously. A relevant example comes from studies of ball catching. Although this ability is often highlighted as a paradigmatic case of a skill outside conscious control, detailed analyses of what people know about the cues they use to decide whether to advance or retreat to intercept and catch a ball reveal surprisingly rich and accurate information (e.g., Reed et al. 2010). Thus while we agree with Hogarth that it can be difficult to prove or disprove the role of unconscious influences in such skills, those studies that have tried to do so provide evidence that falls far short of demonstrating independence from conscious control.

Bernacer et al. suggest that habits are a distinct form of behavior characterized by unconscious triggering alongside conscious monitoring. Thus consciousness can reclaim control of behavior when a difficulty arises. We are not convinced that it is meaningful to say that habits involve any decisions at all. A pianist is not deciding to play each note, and as evidence for this we would point to the fact that true habits run on independently of their consequences: They are "pushed" by the eliciting cues rather than "pulled" toward a goal. Dickinson (1985) has shown that habitual responses (such a lever pressing by a hungry rat) continue even if their outcomes (food pellets) have been devalued (e.g., by being paired with poison). A defining characteristic of a decision is that it involves the weighing of different outcomes, which is precisely what is absent in habitual behavior.

In the target article we employed a lens model analysis to explicate the ways in which unconscious influences on behavior might be realized. An elegant redescription of the issue is provided by **Sher & Winkielman**, who frame it in terms of the relationship between cognition and metacognition. We would certainly not want to take up the challenge they put to us of proposing a cognitive architecture in which cognition and metacognition are inseparable. However, we stress that their cognition/metacognition view does not align with our own conception. We do not believe that a prominent place in the human cognitive architecture needs to be assigned to mental states that may (or may not) become the object of other, metacognitive, states. Instead, we believe that awareness and reportability are intrinsic properties of many mental states. States become reportable not because other states pick them up and move them to the consciousness box, but because reportability is part of (or an affordance of) what they are as states in the first place. How much hinges on this conceptual disagreement we leave for others to judge. Our principal claim is an empirical one, namely, that the coupling between cognition and metacognition, if that is how one wishes to frame it, is far tighter than many have assumed, although we certainly do not deny the theoretical possibility that they can be dissociated. Sher & Winkielman offer the distinction between procedural and declarative knowledge as an empirical example, the former being the "cognitive" part and the latter the "metacognitive" part. We have analyzed this distinction in considerable depth elsewhere (Berry et al. 2012) and maintain that the evidence does not support the view that people can only "declare" a subset of their procedural knowledge. Last, we agree wholeheartedly with the point Sher & Winkielman make about the incentives in place that might induce researchers to make Type I errors in their observations of the behavior of interest but Type II errors concerning their observations about participants' reports about those behaviors.

Ingram & Prochownik quote from Haidt (2007) concerning fast and automatic moral intuitions "in which an evaluative feeling of good-bad or like-dislike … appears in consciousness without any awareness of having gone through steps of search, weighing evidence, or inferring a conclusion," to which we reply, what's the evidence that these intuitive responses went through such steps? Perhaps they were based on one-reason decision making? We also suggest that Ingram & Prochownik are muddled in two further respects. First, we certainly do not (as they imply) confuse awareness of stimuli with awareness of their influence: The lens model framework incorporates this distinction very clearly. Second, they misinterpret the proximal–distal distinction so as to effectively equate a forgotten or neglected distal cue with an unconscious influence. These are quite different things. Our argument is that forgotten distal cues (e.g., Mother always told me that spinach was good for me) are irrelevant to understanding decision making if they causally triggered a chain of events that eventuates in a reportable proximal cue (the current belief that spinach is healthy).

Velmans asks us to consider distinct ways in which a process might be conscious and suggests that adopting a broader perspective leads to the conclusion that evidence for unconscious mental processes is "ubiquitous." To illustrate his point, Velmans considers the phenomenological experience of reading the sentence: *If we don't increase the dustmen's wages, they will refuse to take the refuse*. He argues that the syntactic and semantic processing required to assess meaning and assign appropriate stress to "refuse" in the two instances in which it appears must occur outside awareness. This conclusion, however, appears to be at odds with our (and others', based on an informal survey) phenomenological experience: Encountering the second instance of "refuse" provokes hesitation in readers *precisely because* there is an awareness of the

need to correct an initial temptation to pronounce it using the same stress as in the first instance. The correction appears to be a clear instance of "conscious control" over our behavior: An action was initiated (i.e., saying "re*fuse*"), but we "selected" an alternative (i.e., saying "*re*fuse"). Many of us could probably also (correctly) introspect that the inappropriate pronunciation was triggered on the second encounter because we were primed by the initial, alternative pronunciation.

In the target article we made it clear that we do not consider it useful to ask whether, for example, area V5's computation of motion is or is not conscious because we view consciousness as a property of individuals. Thus **Velmans**'s claim that because we are "not conscious of the complex input analyses" involved in reading text on a page, such processes must occur outside conscious control is, we would argue, a category mistake (Ryle 1949). In contrast, it is perfectly reasonable to ask whether an individual is conscious of hesitation in reading sentences containing heteronyms.

R2. Multiple-cue judgment: Challenges and extensions

Rakow and **González-Vallejo et al.** make the very important point that the validity of self-insight measures is dependent on assumptions about the model underlying judgment. We noted this issue briefly in the target article (sect. 2.4) and agree that judges may often use other models such as similarity to exemplars or sequential heuristics in their judgments. We welcome Rakow's concept of "double-model recovery" and think it could be used very profitably in future research on policy capturing and self-insight. Both commentaries reinforce the point that an inappropriate approach to modeling the judge's implicit policy may lead us incorrectly to misattribute poor self-insight.

R3. Deliberation without attention: Challenges and extensions

We note that of the commentaries which discussed unconscious-thought theory (UTT) and deliberation without attention (DWA), all except one agreed with our general conclusion that such studies fail to provide unequivocal evidence for the involvement of active unconscious processes (**González-Vallejo et al.**; **Huizenga et al.**; **Srinivasan & Mukherjee**; **Waroquier et al.**). Even those who disagreed with almost everything else in our article agreed that the claims made for the powers of unconscious thought are too strong (**Evans**).

The exception was **Dijksterhuis et al.**, who criticize us for (among other things) "cherry picking" the studies we reviewed in regard to the DWA effect. Our review was necessarily selective, bearing in mind the burgeoning literature on this topic, and our inclusion criterion was firmly based on discussing the strongest evidence, whether for or against unconscious influences. Dijksterhuis et al. refer to their recent meta-analysis (Strick et al. 2011), which they claim now allows the unconscious thought effect to be replicated with greater ease. What happens when all the moderators of the effect that are identified in this meta-analysis are set to the values most conducive to obtaining it? Nieuwenstein and van Rijn (2012) provide the answer to this question: It is not obtained. These authors carefully set up a DWA experiment so as to optimize the likelihood of a benefit from unconscious thought, but they had no success whatsoever. For example, they ensured that pictorial information was presented with the choice options together with a relatively short presentation time, factors identified in the meta-analysis as being important moderators. Their results suggest that the Strick et al. (2011) meta-analysis should be treated with considerable caution.

An additional moderator adhered to (in vain) by Nieuwenstein and van Rijn was the use of a moderately difficult distractor task in the unconscious thought condition. **Waroquier et al.** discuss recent findings suggesting that DWA effects are strongest when "low-effort" distractor tasks are used (Abadie et al. 2013; McMahon et al. 2011). As an initial comment, we note that only the latter study includes an experiment that satisfies our (non-arbitrary) criteria for demonstrating a DWA effect (see target article sect. 3.1), and that experiment (McMahon et al. 2011, Experiment 1) failed to counterbalance the presentation order of different choice options, leading to the possibility that the DWA advantage was simply a result of a recency bias (cf. Newell et al. 2009). (We also note that the mode of thought effect in their second experiment – which did not include an immediate thought condition – failed to reach conventional levels of statistical significance.)

The results of the Abadie et al. (2013) study are intriguing, and we welcome further replications using the modified procedure that they adopted in their experiment. However, the more general point made by **Waroquier et al.** – that "too much attention may sometimes be detrimental" is not at odds with our conclusions. Contrary to Waroquier et al.'s claim, we do not propose a monotonic "more conscious attention=better decision making" view (see sect. 6.2 of the target article). Indeed, one of us (Shanks 2006) was quick to point out that the Dijksterhuis et al. (2006b) result may well have been due to the detrimental effect of inappropriate conscious thinking rather than any advantage of unconscious thinking (cf., Mamede et al. 2010; Payne et al. 2008). We agree that some of these issues can be clarified by demarcating the differences between attention and awareness (cf. **Srinivasan & Mukherjee**), but simply suggesting that the term "deliberation without attention" could be replaced with "deliberation without consciousness" (see Strick et al. 2011) is not going to help matters. In our view, and it seems that of many commentators, evidence of active processing occurring "outside" conscious awareness in this paradigm is lacking.

In this regard we concur with **Huizenga et al.**, who make the insightful point that the unconscious thought paradigm is ill-suited to test claims about the superiority of different modes of decision making (cf. **Srinivasan & Mukherjee**; Newell et al. 2009). The strategy-convergence issue raised by Huizenga et al. is an important one to tackle if we are to obtain clear evidence about the purported abilities of unconscious thought. Progress is already being made in this regard, as noted by Huizenga et al., and to their list we add another recent study by Pachur and Forer (2013) that sheds light on the use of different decision strategies (e.g., LEX, WADD, EQW) following different modes of thought. Pachur and Forer find a

slight (and statistically nonsignificant) tendency for participants in an unconscious thought condition to use a compensatory equal-weights strategy (EQW) more than those in a conscious thought condition, but find no difference in the use of a weighted-additive strategy (WADD) across conditions. This latter finding is clearly contrary to the weighting principle of UTT (Dijksterhuis & Nordgren 2006), which states that unconscious thought leads to more efficient and accurate weighting of attribute values. On a related point, we were also somewhat surprised by **Dijksterhuis et al.**'s statement that "Obviously, participants are capable of generating post hoc weights that justify their previous choice." While we agree, we thought the key claim was that choices following unconscious thought would be more consistent with these weights than those following conscious and immediate thought (e.g., Dijksterhuis 2004). In line with the conclusions of **González-Vallejo et al**., we see little evidence in the literature to support this claim.

In a somewhat related vein, **Uhlmann** questions our interpretation of research on "reasons analyses," arguing that such effects are consistent with people lacking conscious introspective access into the "true" bases for their attitudes and subsequent choices (e.g., Wilson & Schooler 1991). The key feature of these studies is that participants who are invited to provide reasons to support their choices end up making objectively poorer decisions, and sometimes exhibit greater post-choice regret, than those who make "unexamined" choices. While such studies support the idea that preferences are constructed, labile, and influenced (sometimes detrimentally) by deliberation, we fail to see why they force the conclusion that some influences on choice lie outside awareness. Both sorts of choice – those made intuitively and ones accompanied by an analysis of reasons – are, we contend, accompanied by awareness of the *proximal* basis for that choice. The fact that this proximal basis might not be the same in the two cases does not imply that the unexamined choice was mediated via an unconscious process.

R4. Iowa Gambling Task: Challenges and extensions

We argued that participants are able to learn to make advantageous choices in the IGT but concurrently acquire considerable levels of awareness and insight into the payoff structure of the decks and of the optimal decision-making strategy. **Steingroever & Wagenmakers** argue that in one important respect our conclusion is incorrect: Participants do not learn to discriminate the good from the bad decks at all (**Huizenga et al.** make a similar point). It must be emphasized, however, that although Steingroever & Wagenmakers dispute our analysis, their viewpoint does not challenge our general conclusion about the role of awareness in decision making: If, as they claim, there is minimal discrimination in the IGT, then it also provides no evidence of unconscious influences on decision making.

It is important to note that the conclusions of **Steingroever & Wagenmakers** may be overly strong, in two respects. First, their statement that there is "a lack of both conscious and unconscious knowledge in this task" is contradicted by their own results, which show that participants learn a great deal about the decks – albeit about their associated loss frequencies rather than long-run payoffs. In principle, this loss-frequency learning could be unconscious.

Second, while we agree with them that participants in the IGT often show a prominent frequency-of-losses effect (a result we ourselves have obtained), this does not mean that they fail to show discrimination between good and bad decks. In our own studies (Konstantinidis & Shanks 2013), such discrimination has invariably been statistically significant. We suspect that one or more methodological factors to do with the payoff schedule or the level of performance-related reward or indeed the inclusion of awareness measures may account for this difference, though clearly more work on this issue is called for. But we reiterate that whether or not participants can discriminate good from bad decks in the IGT, **Steingroever & Wagenmakers** agree with us that the IGT provides minimal evidence for unconscious influences.

In a related comment, **McLaren et al.** suggest that some studies on the IGT (and variants thereof) that we omitted from our review do show evidence for unconscious influences. However, McLaren et al. themselves note that one of these studies (Guillaume et al. 2009) adopted a less than ideal method for indexing awareness. We share this reservation. Guillaume et al. found that explicit knowledge and differential skin conductance response (SCR) magnitude can be uncorrelated. These researchers presented their participants with a standard 100-trial IGT, measuring SCRs concurrently with card selections. Awareness was only assessed at the end of the task, and Guillaume et al. used responses to the awareness questions to classify participants as having no awareness, partial awareness (conscious knowledge of which decks were good or bad), or complete awareness (knowledge of the relative payoffs of the decks). Whereas participants classified as having no awareness performed at chance on the task, higher levels of awareness were associated with increasing proportions of selections from the good decks. Thus awareness correlated with card selections. Likewise, Guillaume et al. found that the extent to which SCRs differed in anticipation of bad versus good deck selections correlated with choice behavior. Yet awareness was not correlated with differential anticipatory SCRs.

While Guillaume et al. (2009) speculated that such a finding is consistent with awareness and somatic markers having independent influences on decision making, they also acknowledged that the nonsignificant correlation (reported as reaching $p = 0.1$) could simply be the result of low statistical power. We would add to this that their awareness classification was less than ideal as it was presented only once at the end of the task (raising problems of lack of immediacy) and did not include any questions requiring numerical estimates. Instead, the questions required very coarse-grained responses (e.g., "suppose you select 10 new cards from the deck, will you on average win or lose money?"). Since other studies show a gradual development of differential anticipatory SCRs (Gutbrod et al. 2006) and a gradual development of differential awareness (Bowman et al. 2005; Cella et al. 2007; Evans et al. 2005), it seems likely that a positive relationship between awareness and SCR differentiation would be observed if the former were measured more sensitively and immediately.

A further study is cited by **McLaren et al.** as providing evidence for unconscious influences in an IGT-like task. In this study (Dunn et al. 2011), participants in one group were probed by the Maia and McClelland (2004) awareness questions. For another group, decision making (deck selections) was related to bodily signals (i.e., somatic markers) based on electrodermal responses and heart rate, with the latter two measures being combined into an index of "bodily differentiation," which assessed for each participant his or her bodily reaction to the good versus the bad decks. Dunn et al. also measured these participants' sensitivity to their own heart rate. The main and highly intriguing finding was that in those individuals who showed high sensitivity to their own heart rate, deck selections were correlated with bodily differentiation, whereas this was not the case for those who showed poor sensitivity. This pattern suggests that bodily signals play an important role in decision making, but only to the extent that they are accurately perceived. Although this is an impressive finding, there are two reasons why it is more consistent with a primary role for conscious processes in decision making than with a causal role for somatic markers. First, sensitivity to heart rate was assessed via a consciously reportable measure, namely, participants' accuracy in reporting the number of beats in a specified time interval. Second, in the group of participants who were administered awareness probes, above-chance levels of awareness entirely in line with those reported by Maia and McClelland (2004) were observed. Hence awareness was, at the very least, strongly correlated with the variables assumed to be causally related to deck selections. A promising avenue for future research would be to collect all of the relevant data within a single group of participants to allow analytic techniques such as structural equation modeling to be brought to bear to untangle the causal pathways.

McLaren et al. also refer to research on the relationship between rules and the "peak-shift" effect, which demonstrates striking qualitative differences in patterns of behavior between individuals who can versus those who cannot report a categorization rule. We acknowledge that such effects, although reliant on retrospective reports, provide impressive evidence for unconscious influences. Future studies employing online awareness assessments would be very valuable.

R5. Subliminal priming, primes-to-behavior, and blindsight: Challenges and extensions

In our view, the points of disagreement highlighted by **Finkbeiner & Coltheart** and **Snodgrass, Shevrin, & Abelson** (**Snodgrass et al.**) are vastly overshadowed by the common ground we share with them. These commentators review in detail some of the factors that might lead unwary researchers to draw erroneous conclusions from subliminal priming experiments, such as using inappropriate awareness discriminations (e.g., prime categorization), response biases, task difficulty, and null sensitivity. As Finkbeiner & Coltheart explain, the latter problem alone renders virtually all work conducted within the null hypothesis significance-testing framework uninterpretable. Similarly, on the basis of the doubts they raise over the use of identification and categorization tasks to assess prime awareness, Snodgrass et al. conclude that virtually all recent studies of "subliminal investigations of cognitive control processes … do not conclusively rule out conscious partial identification."

We thoroughly applaud the careful methods employed in the impressive studies **Finkbeiner & Coltheart** and **Snodgrass et al.** describe, which appear convincingly to demonstrate subliminal effects (e.g., Finkbeiner 2011) – and we very much hope that future explorations expand these research programs into more mainstream decision-making tasks – and evaluate priming effects over considerably longer time intervals than a few tens of milliseconds. But the most important point is that almost all decision-making research reported in the past few years using subliminal priming methods has fallen far short of the methodological requirements described by Finkbeiner & Coltheart and Snodgrass et al., and until this is recognized, inferences about unconscious influences must remain in doubt.

We imagine that **Finkbeiner & Coltheart** and **Snodgrass et al.** will view **Hassin & Milyavsky**'s and **Brooks & Stein**'s conclusions in much the way that we do, namely, as considerably overestimating the implications of recent research and underestimating the viability of alternative explanations. To give just one example, Hassin & Milyavsky refer to research using continuous flash suppression by Sklar et al. (2012), which appears to show that reading and doing arithmetic can be achieved unconsciously. Yet by their own awareness tests, and putting aside issues such as task difficulty and null sensitivity in the awareness check, the majority of Sklar et al.'s participants were conscious (i.e., performed above chance in a forced-choice discrimination). Sklar et al. only obtained evidence of unconscious processing by eliminating participants *post hoc* who performed above chance on the awareness test. As we have argued at length elsewhere (Shanks & Berry 2012), this introduces a statistical artifact (regression to the mean) that renders the apparent evidence of unconscious processing almost meaningless. At the very least, these experiments need to be done in such a way that each subject is rendered categorically unconscious of the prime, rather than it being left to individual perceptual variability. Brooks & Stein describe subliminal fMRI studies that purportedly demonstrate activation of neural systems involved in emotion and memory such as the amygdala and hippocampus. This is undoubtedly an important research topic, but until due attention is devoted to the methodological issues described by Finkbeiner & Coltheart and Snodgrass et al., interpretation must remain uncertain.

Persaud & McLeod describe data from a binary exclusion task in which participants see a briefly presented letter ("b" or "h") on each trial and are asked simply to report the letter that was not shown. Their experiments with this task (e.g., Persaud & McLeod 2007) reveal that when the stimuli are presented for 15 ms, participants follow the instructions without undue difficulty and tend to respond "h" when "b" is presented and vice versa. However, at shorter presentation durations (5–10 ms) a striking reversal is found, whereby participants tend to report the stimulus that was presented, counter to the instructions. Persaud & McLeod argue that this must be an unconscious influence on responding because if information about the stimulus was consciously represented, participants would follow instructions and respond with the identity of the stimulus not shown.

We acknowledge the elegant simplicity of this demonstration and urge researchers to explore it further (see Table R1). Other studies using this basic task have not obtained the same result (Fisk & Haase 2006; 2007), so its basis and boundary conditions require further exploration. We also note the peculiarly contradictory position that **Persaud & McLeod** inevitably find themselves in regarding their definition of unconscious perception. In their studies, they found that at very short presentation durations participants could not make the correct exclusion response, and instead reported the identity of the presented letter. Persaud & McLeod take this to be an unconscious effect. At the same presentation duration, however, participants successfully reported the identity of the presented letter when explicitly instructed to do so (inclusion instructions – i.e., report "b" when "b" is present). The latter would, of course, normally be taken as direct evidence of conscious, not unconscious, processing.

Taking a similar line, **Uhlmann** cites studies in which priming effects from unobtrusive stimuli attenuate or even reverse when participants become aware of the stimulus. But there are many reasons why a change in cognitive state might modulate priming, even for conscious primes (Higham & Vokey 2000). From the fact that altered levels of awareness (e.g., from weak to strong) may reduce priming effects, it does not follow that priming can occur unconsciously.

The data surrounding blindsight are extensive and complex, but the idea that blindsight is little more than degraded conscious vision has proven extremely difficult to refute. In the target article we reviewed Overgaard's (2011) findings that when individuals with blindsight are asked to report whether they have "no experience," a "brief glimpse," or an "almost clear experience" of a stimulus, correlations are observed between awareness and discrimination accuracy. **Brogaard, Marlow, & Rice** (**Brogaard et al.**) object that such correlations do not prove that the reports are indicative of visual awareness, and could instead reflect "awareness associated with the higher-order predictive act," that is, awareness of being able to make a judgment. We do not see the force of this objection. Whichever construal is correct, it would remain the case that in the absence of awareness (either visual or judgmental), discrimination would be at chance.

Dijksterhuis et al. found it "mystifying" that we did not discuss a study by Soon et al. (2008). In a modern neuroimaging adaptation of the Libet task, Soon et al. presented their participants with a stream of letters (1 every 500 ms) and asked them to make a left or right button-press at a freely chosen time point. Participants then reported the letter that had been on the display at the moment they felt they formed their conscious choice. Using advanced methods for decoding neural activity, Soon et al. found that several seconds before the choice was made, and long before it was conscious, two brain regions (frontopolar and precuneus/posterior cingulate) contained information that predicted that choice.

Soon et al. (2008) concluded from these findings that there is a significant contribution of unconscious processes to decision making. But this conclusion rests on adopting the assumption that participants go instantaneously from a state of no bias (i.e., 50:50 right/left) to a state in which they have sufficient bias to commit to a response. It is surely the case that the process of forming a decision takes time. Suppose that a threshold degree of bias or preference (100:0) is required before a participant makes a voluntary movement of the left or right hand. Then the accumulation of bias prior to reaching this threshold could be entirely conscious and neurally measurable for tens or hundreds of milliseconds, even before it compels the button-press. When individuals report the time at which they consciously made their decision, perhaps they (perfectly reasonably) report the point at which their bias reached, say, 70:30, rather than the point it first drifted away from 50:50. The key point is that the threshold for detecting neural activity does not have to be the same as the threshold for reporting a state of awareness.

The notion of information accumulation is more than just a vague possibility. Numerous theories of decision making have developed precise formalizations of the accumulation idea. For example, random walk models conceive of decision making in terms of time-steps during which evidence moves in one direction or another by small amounts. When the total evidence reaches a threshold, a choice is made. Although they have not usually considered whether accumulated information is conscious or unconscious, these models have been very successful in explaining response time distributions and other aspects of choice (e.g., Newell & Lee 2011). Soon et al.'s (2008) findings provide important evidence about the high-level brain structures involved in the development of decisions, but they seem entirely consistent with the idea that consciousness is a necessary component of, and precursor to, our choices.

Table R1. *Suggested studies where further research could address major outstanding questions.*

Primary citation	Issue to be addressed
Dunn et al. (2011)	Measuring awareness, bodily differentiation (somatic markers), sensitivity to bodily signals, and payoff knowledge within subjects in variants of the IGT
Finkbeiner (2011)	Subliminal priming applied to more typical decision-making tasks and over longer time intervals
Huizenga et al.	Strategy classification in the UTT paradigm to identify if/how decisions change following distraction
McLaren et al.	Peak-shift and verbalizable rules employing online awareness assessments
Overgaard et al. (2008)	Use of a new awareness instrument in blindsight and normal vision
Persaud & McLeod (2007)	Binary exclusion task
Richardson et al. (2009)	Unobtrusive priming techniques such as using eye-tracking to "prompt" decisions

R6. Additional perspectives: Context, causal fields, and emotions

Hogarth makes the interesting point that mismatches may occur between verbal reports about causal influences and the reality of those influences as a result of experimenters and participants adopting different perspectives on the "causal field." In Hogarth's example, a couple enjoying a romantic meal in a restaurant might deny that the level of lighting influenced their behavior, whereas an experimenter able to compare behavior between-subjects in conditions of low or high lighting might conclude that lighting level did influence behavior. Such differences in conceptualization of the causal field might lead to erroneous conclusions, as the two people are surely right that (from their perspective) they only experienced one level of lighting and therefore do not have the evidence necessary to assign it a causal role.

A related issue is raised by **Hytönen** and **Helzer & Dunning**. It is well-known that formally equivalent decision problems can lead to different decisions depending on the way they are framed. For instance, people may prefer "75% lean" ground beef to "25% fat" beef. Hytönen's view is that such effects result from unconscious emotional signals arising from System 1, which may in some circumstances be suppressed by conscious System 2 control processes. Hytönen describes neuroscientific evidence that she takes to provide support for this two-system view. We, in contrast, find this explanation both unparsimonious and ill-specified. A more plausible explanation is that a typical person does not necessarily believe her interlocutor is saying quite the same thing when he says "75% lean" and "25% fat," or when he says "the glass is half full" and "the glass is half empty," and that is why she may behave differently (Sher & McKenzie 2006; 2011). Helzer & Dunning, commenting on the same sort of framing effect, suggest that people are likely to have poor insight into the impact of context variables on their decisions. We disagree. "Information leakage" studies (Sher & McKenzie 2006; 2011) provide evidence that people are sensitive to the implications of the chosen frame.

Helzer & Dunning describe evidence that, for example, many more people will agree that they would hypothetically dance in front of an audience for a small amount of money than will actually do so when faced with the same choice for real. This seems to suggest a lack of awareness of how a future emotional state (embarrassment) would influence behavior. Similarly, being sated as opposed to hungry decreases the likelihood of choosing a high-calorie food to eat at a future time point, as if people are not always fully aware of how their future bodily states will affect their preferences. These examples of lack of insight are striking, but we do not see that they in any way demonstrate unconscious influences on behavior. Rather, they are consistent with a much simpler explanation, namely, that imagined cues or contexts are often weaker than the real thing. When I contemplate a future time point at which I will have to dance in front of an audience, my imagination fails adequately to represent how embarrassing the situation will be. Both the hypothetical decision and the real one are based on conscious influences and cues. Where they differ is in terms of the cues themselves.

Still on the theme of the contexts in which decisions are made, **Antony** argues that many influential studies appearing to demonstrate unconscious influences in decision making involve asking participants to introspect in "degraded" conditions in which they have no reasons for their decisions. We fully endorse Antony's point that it is often inappropriate to assume that how we solve problems in normal conditions is similar to how we solve them in degraded conditions. In both cases, a full characterization of the decision process is required before questions can be meaningfully asked about the individual's awareness. We are less convinced that people "confabulate" in degraded conditions. We argued that in Nisbett and Wilson's (1977) stockings example, participants may have employed a sequential comparison rule such as "if the next one is as good as the previous one, go with the next one." Antony wonders why participants did not report that they were using this rule. We contend that (a) the "rule" is as much in the environment as in participants' heads, in the sense that the situation offers behavioral affordances including left-to-right choice, and in any case (b) they *did* report the crucial component of the rule, namely, that it involved a comparison of items in terms of their quality ("…as good as…").

There is evidence that the relationship between preferences and choices is bidirectional. That is, in addition to preferences influencing the choices one makes, choices seem to retrospectively alter preferences. **Coppin** reviews evidence on this issue, with a particular focus on whether the latter effect is modulated by awareness. As Coppin notes, a considerable body of evidence suggests that awareness is necessary for choice-induced preference changes. However, she cites recent studies pointing to the opposite conclusion. We find the latter evidence weak. As an example, Sharot et al. (2010) reported evidence for post-decision preference changes but collected no conscious reports from their participants and made no claim that the effects they observed were unconsciously mediated. Coppin et al. (2010) reported similar data for choices between pairs of odors, although in this case awareness was assessed via a post-choice explicit recognition test. Their procedure involved initial liking ratings for single odors, and then choices between pairs of odors; and finally the individual odors were re-rated, and participants indicated whether each was new or old. Choice again affected preferences (chosen odors became more liked and rejected ones more disliked) and did so even for odors that were later forgotten. But it is easy to explain such patterns on the basis of a single, conscious, knowledge state, as we have shown in regard to classic dissociations between implicit and explicit memory (see Berry et al. 2012; Shanks & Berry 2012). Post hoc selection of forgotten versus remembered items introduces the same statistical artifact that we highlighted in regard to the Sklar et al. (2012) subliminal priming data. Much more compelling would be a demonstration of a preference change across an entire participant group performing at chance in odor recognition (e.g., as a result of a delayed test).

We thoroughly concur with **Uhlmann** and **Hahn & Gawronski** that the role of unconscious processes in tasks like the Implicit Association Test (IAT) has been substantially exaggerated and that when sensitive tests are employed, implicit and explicit attitudes tend to show reliable levels of correlation. For instance, Hahn & Gawronski review evidence showing that asking participants to report their *predictions* of implicit evaluations

(conscious reports) yields stronger correlations with actual implicit evaluations than is observed when standard explicit evaluations are compared to implicit ones. Such a pattern suggests that low implicit–explicit correlations may arise in the IAT and similar tasks because standard explicit evaluations are not fully valid indicators of awareness.

R7. Conclusions

We reiterate our view that the unconscious has been afforded an unwarranted degree of explanatory power in models of cognition. Although it is convenient to think of our main question (are there unconscious influences on decision making?) in binary terms, ultimately this question will inevitably turn out to require a more complex and nuanced answer than a simple *yes* or *no*. In all likelihood unconscious influences will be established in certain conditions, although it remains to be seen whether it plays a trivial or a more significant role in these conditions. Our argument, however, is that (a) the evidence available thus far falls significantly short of establishing the importance of such influences, and (b) future research should take careful heed of the methodological issues that have been raised. Awareness can only be evaluated using careful methods. We call for future research to acknowledge the different ways in which consciousness can be involved in decision making (as highlighted in our lens model analysis) and to employ suitable methodology in the measurement of awareness, including awareness assessments that are reliable, relevant, immediate, and sensitive.

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[The letters "a" and "r" before author's initials stand for target article and response references, respectively]

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