

**On the other side of the mirror:
Priming in cognitive and social psychology**

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Abstract

Over the past several years, two largely separate traditions have collided, leading to controversy over claims about priming. We describe and contrast the main accounts of priming effects in cognitive and social psychology, focusing especially on the role of awareness. In so doing, we consider one of the core points of contention, claims about the effects of subliminal priming. Whereas cognitive psychologists often are interested in exploring how priming operates with and without awareness, social psychologists more commonly assume subliminality in order to bolster claims about the automaticity of priming. We discuss the criteria necessary to claim that a stimulus was processed entirely without awareness, noting the challenges in meeting those criteria. Finally, we identify three sources of conflict between the fields: awareness, replicability, and the nature of the underlying processes. We close by proposing resolutions for each of them.

Introduction

Priming is fundamental in both cognitive and social psychology because it reveals the powerful ways in which our past experiences can influence our present and future behavior. Priming takes many forms, from more efficient processing the second time we encounter a stimulus (repetition priming) to activation of other related concepts (semantic priming) to triggering an associated goal (goal priming). Priming contributes to most human behavior, including perception, memory, decision making, and action.

Priming has been studied extensively by both cognitive and social psychologists. Both fields use similar tasks to prime behavior, both assess whether those influences are automatic, and both posit mechanisms to explain their influence. But they use priming for different purposes. Social psychologists typically use priming as a tool to study the influence of mental representations (e.g., stereotypes, personality traits, or values) on real-world judgments, beliefs, and actions. Cognitive psychologists typically use priming as a tool to study the structure of knowledge representations.

One question looms large over most extant research: Can primes influence behavior in the absence of awareness? This is both the most important question and the most controversial one. Whether our behavior is influenced by events occurring outside of awareness has considerable implications for our concept of free-will. It raises issues of personal responsibility (Gazzaniga, 2011; Wegner, 2002) and strikes at the heart of the mind-body problem. Claims about non-conscious priming remain controversial because establishing the absence of awareness is fraught with epistemological and methodological complications.

Social and cognitive psychologists have approached priming without awareness from different perspectives and with different agendas. In social psychology, demonstrating that a prime is processed without awareness is a means to an end (Bargh, 1992). Non-conscious primes presumably influence behavior unintentionally and automatically. For cognitive psychologists, measuring awareness in priming situations is an end in and of itself. One branch of cognitive psychology has focused extensively on the sorts of priming that operate

with and without awareness, debating the criteria needed to claim that a stimulus was processed subliminally (Kouider & Dehaene, 2007; Van den Bussche, Van den Noortgate, & Reynvoet, 2009).

Despite the use of similar methods to induce priming, for the better part of their respective histories, these traditions have proceeded apace, without extensive cross-fertilization. Recently, though, some cognitive psychologists have begun applying the conclusions drawn from cognitive psychology priming research to social psychology priming research, leading to a clash of claims and traditions.

In this paper, we consider differences in how priming is used in cognitive and social psychology in an attempt to deflate the animosity and miscommunication that often spring from a collision of traditions. Specifically, we focus on differences in how cognitive and social psychologists measure and evaluate the role of awareness in priming. We first review the methodological challenges associated with measuring awareness. We then review the sorts of claims about priming and awareness that have been put forward within each field. We conclude by describing three sources of conflict arising from the consideration of priming in social and cognitive psychology, and suggest potential ways to overcome them.

Although priming takes many forms, we focus on a type of study common to both cognitive and social psychology:

- (a) experimenters present a prime stimulus, either on a computer display or as part of a task that a participant completes;
- (b) the prime activates an internal representation;
- (c) the activated representation influences other representations;
- (d) those other activated representations lead to behavioral changes.

This scope excludes cases of repetition priming, those in which a briefly presented stimulus affects the ability to process *the same stimulus* later. Instead, we focus on what is known as semantic or associative priming in cognitive psychology (and sometimes in social psychology), as well on what social psychologists have sometimes called “goal priming” or

“behavioral priming.” We include cases in which multiple primes affect a single response as well as studies in which a single experience affects a single behavior.

The challenge of measuring awareness

Studies adopting the contrastive approach to assessing awareness (Baars, 1998) typically include two measures, one of the consequences of a prime and one of awareness of that prime. For instance, a subliminal priming paradigm might include a response time task to measure the effects of a prime on processing of a target (i.e., either facilitation or interference) as well as one or more measures of awareness of the prime itself. The awareness measure can take many forms: a forced-choice response in an identification task administered after the main experiment; a qualitative visibility judgement; a confidence judgment; a funnel interview probing participants about their awareness of the link between the prime and their behavior, and so on.

The plurality of forms of awareness (and their associated measures) highlights a core source of disagreement in studies of priming: which measure of awareness is needed to support a particular claim? Subliminal perception (Kouider & Dehaene, 2007) studies explore whether stimuli that have not been consciously encoded can influence subsequent responses. Studies of implicit memory (Schacter, Dobbins, & Schnyer, 2004) examine whether the retrieval process can occur automatically and unconsciously even when the original stimulus was consciously perceived. Implicit learning studies (Cleeremans, Destrebecqz, & Boyer, 1998) are most concerned with whether learning occurs in the absence of awareness of the relationships among ensembles of consciously processed stimuli. Participants might be aware of the presence or absence of a stimulus, they might have conscious memory of a previous experience, they could have an intention to use some information, or they might realize that their judgments are influenced by what they remember.

Thus, consciousness is not a unitary construct. It encompasses many dimensions of experience, each influenced by different processes (Cleeremans, 2003; 2011). Given that its scope ranges from subjective claims of perceptual awareness to metacognition and cognitive control, there is no universally accepted operational definition of what it means for someone

to be aware of something. Given the variety of meanings of “awareness,” identifying which form of awareness (or lack thereof) is important for a claim is essential (Nisbett & Wilson, 1977). Do claims about awareness refer to encoding or retrieval? Do they involve individual stimuli or relationships among stimuli? Do they require the absence of intentions? Social and cognitive psychology priming studies historically have been interested in different aspects of awareness.

Even with a complete description of the form of awareness that matters for a theoretical claim, measuring awareness presents a greater challenge. Most studies of awareness in priming rely on a form of dissociation logic: The outcome measure is sensitive to the prime even when another measure reveals no awareness. Not all measures provide equally appropriate tests for awareness, though, and this issue remains a point of contention in the literature.

The debate over dissociation logic has long focused on a distinction between subjective and objective measures of awareness. Subjective measures rely on the participant to report what they have consciously perceived on each trial and take that report as an accurate indication of awareness. If the participant claims not to have seen a stimulus, then they did not see it. In contrast, objective measures separate sensitivity to the presence of a stimulus from the confidence of that judgment. The motivation behind the objective approach is that any given self-report of awareness could be influenced by confidence as well as awareness. People might claim not to have seen a stimulus because they are conservative about saying “yes” when they are uncertain, even if they actually did process it consciously. Objective measures typically use a signal detection approach across many trials to show that people were not sensitive to the presence of the subliminal stimuli. They do not take the response on any one trial as indicative of whether or not that stimulus was consciously perceived, because on a single trial, it is not possible to separate sensitivity from their criterion, their default bias to say “yes” or “no.”

Subjective measures have been criticized for failing to disentangle conscious processing from differences in confidence. Objective measures have been criticized because behavioral sensitivity does not necessarily imply conscious experience. Nevertheless, any measure of

awareness should meet four criteria (Newell & Shanks, 2012; Shanks & St John, 1994) to unambiguously establish that processing was unconscious:

- (1) The awareness measure should be taken at the same time as the outcome measure, ideally on a trial-to-trial basis (*immediacy*)
- (2) The awareness measure should tap the knowledge that is relevant to the behavior (*relevance*)
- (3) The awareness measure should be at least as sensitive to the relevant knowledge as is the outcome measure (*sensitivity*)
- (4) The awareness measure should be unaffected by experimental demands or social desirability (*reliability*)

A failure of the immediacy criterion leaves open the possibility that people were aware of the relevant material at the time they performed the outcome measure, but forgot by the time they were tested. Asking participants after a study to report their awareness of primes during the task violates the immediacy criterion. The immediacy criterion is essential in studies of subliminal perception, where the stimulus itself is, by design, weak and fleeting. It is not easy to meet, though, due to the observer paradox: Asking people to report their awareness of a prime on each trial draws attention to the prime, potentially increasing awareness of it.

A failure of the relevance criterion leaves open the possibility that the task measures the wrong form of awareness and that unmeasured aspects of awareness drove any effects of the prime on the outcome measure. For example, studies of implicit learning (for a review see Cleeremans et al., 1998) examine whether people unconsciously abstract the regularities among sets of stimuli in the same way that natural grammar abstractly describes how words can be combined to form sentences. When asked about the rules they learned, most participants cannot explicitly identify the regularities. But they might perform well on the outcome task based on awareness of the similarities between training and test items. A measure of awareness must check for awareness of any aspect of the primes that might affect performance on the outcome measure.

A failure of the sensitivity criterion means that people were aware, but the measure was not sensitive enough to detect their awareness. If a more sensitive measure could reveal awareness of the relevant information, then claims of non-conscious processing are unmerited. It might seem that asking people to report whether or not they noticed a stimulus would be a highly sensitive measure; presumably, people should be able to report the contents of their own consciousness. But such reports reflect more than just sensitivity to the presence of a stimulus—they also incorporate biases. For instance, people might refrain from reporting on knowledge held with low confidence. Moreover, verbal reports might not be accurate reports of actual experiences, and typical methods cannot distinguish genuine reports from reconstructed ones (Hall, Johansson, Tärning, Sikström, & Deutgen, 2010; Nisbett & Wilson, 1977).

A failure of reliability leaves open the possibility that measures of awareness were influenced by demand characteristics or other biases. A reliable measure should be sensitive only to awareness of the stimulus and not to other factors that could influence reports of awareness. Few studies use measures of awareness that are immune to such biases, and those that do rarely consider the possible contributions of demand characteristics (Klein et al., 2012; Rosenthal, 2009).

Although meeting all four requirements is necessary to unequivocally document the absence of awareness, it is still hotly debated whether any method actually does so (Cheesman & Merikle, 1986; Hannula, Simons, & Cohen, 2005; Holender, 1986; Kouider & Dehaene, 2007). Over the past 30 years, cognitive psychologists have used increasingly refined methods to assess awareness in studies of priming, although all are still subject to criticism based on a failure to meet one or more of these criteria. We explore those developments and this continued debate in the context of the broader study of priming within cognitive psychology. We then turn to the study of priming in social psychology.

Priming in cognitive psychology

Most modern priming research builds on models of spreading activation (Collins & Loftus, 1975; McNamara, 1992). The core principle underlying such models is that semantic

representations are interlinked, with more closely related words and more similar concepts connected more strongly. For example, the representation for the word “nurse” is closely linked to the representation of “doctor,” but less tightly linked to “uniform.” Activating the word “nurse” activates the word “doctor” strongly, but the more remote the association, the less activation it produces: Activation spreads, but diminishes in potency as it does.

Cognitive psychologists often use priming to infer the structure of semantic representations. For example, they might present the prime word “nurse” and then measure the speed with which people can determine that another word (e.g., “doctor,” “uniform,” or “house”) is a word or non-word (Neely, 1977). The closer the semantic association (determined separately), the faster the response on such a lexical decision task (Collins & Loftus, 1975; McNamara, 1992; Patterson, Nestor, & Rogers, 2007).

In this spreading activation account, priming occurs passively and automatically—as long as the prime word is perceived, it triggers a cascade of semantic associations, leading to faster processing of related words. That automaticity assumption triggered a related question: Could semantic priming occur if people processed the prime but were not aware of having done so?

This question placed the study of semantic associations squarely into a larger, older, and contentious debate about the existence and potency of subliminal perception. That debate has raged for more than 100 years, with a repeating cycle of provocative claims of subliminal perception followed by methodological debunking (Greenwald, Spangenberg, Pratkanis, & Eskenazi, 1991; Holender, 1986). At times, the debate about subliminal perception has veered into domains more commonly studied in social psychology, including persuasion and influence (Strahan, Spencer, & Zanna, 2002). But, within cognitive psychology, the core issues have been the measurement of awareness and the question of what can and cannot occur in its absence.

Although many studies have attempted to document subliminal perception over the past century and a half (e.g., Sidis, 1898), only in the past 30 years has there been a concerted effort to test whether subliminal primes can activate semantic networks, leading to faster judgments for related stimuli. The most prominent early attempts to document semantic

processing with methods designed to eliminate awareness were carried out in the 1980s by Marcel (1983). Marcel presented prime stimuli briefly, followed by a visual mask that limited further perceptual information for the prime. For example, participants might view the word “salt” as a prime, followed by a mask, and even though they could neither recall nor identify the prime word, they still were better able to process the subsequently target word, “pepper” (as opposed to the unrelated “lotus”); they showed semantic priming without the ability to identify the prime. This finding reinvigorated the study of semantic priming by subliminal stimuli.

In what might be the most comprehensive critical appraisal of the evidence for subliminal semantic priming, Holender (1986) reviewed all of the primary methods used to measure subliminal semantic processing, identified the criteria necessary to claim that a stimulus actually was processed without awareness, and showed that all prior results failed to meet those criteria. Holender argued for the use of objective measures of awareness: Document that a prime had an effect while also providing direct and objective evidence that the subject could not have consciously perceived the prime at the time it appeared.

At first blush, Marcel’s priming studies appear to meet Holender’s rigorous criteria, a set similar to the four we described above: Participants processed target words faster following a related prime despite an inability to remember the prime. However, the ability to report a prime’s visibility after a study, even a prime that was flashed briefly and masked, fails to meet the immediacy criterion. It might also fail to meet the sensitivity criterion. As a result, it is difficult to distinguish effects that stem from genuinely unconscious processing from effects stemming from weakly conscious and forgotten primes.

Given the challenge of measuring performance at the time of presentation in a way that meets all of the necessary criteria for awareness, many researchers have adopted what is now known as an “objective” assessment of awareness: Show that people are insensitive to the presence of a prime as a way to rule out awareness. If people cannot reliably discriminate the presence of a prime from its absence, then they can not have conscious access to the meaning of that prime. Objective measures bypass the immediacy requirement by showing that subjects *could* not have consciously detected the prime rather than by arguing that they *did*

not detect it. It provides a way to measure awareness reliably, using signal detection methods. Nevertheless, whether this meets the sensitivity criterion can still be debated (e.g., see Dulany, 2001): Is detection necessarily the most sensitive measure of awareness? And, objective measures of awareness potentially fail the relevance criterion: Does a detection task measure the same aspects of awareness as a given outcome measure?

Even studies designed to meet the most rigorous criteria for testing awareness can still fall short, leaving open the possibility that semantic priming effects were consciously mediated. Many recent studies such studies (Dehaene, 2008; Draine & Greenwald, 1998; Snodgrass, Bernat, & Shevrin, 2004, Naccache & Dehaene, 2001) have been subsequently debated, which highlights the continuing challenges involved in ruling out awareness altogether.

In fact, some researchers propose abandoning the attempt to exhaustively eliminate awareness, arguing that doing so may be impossible in principle. If consciousness is not a unitary construct, then there may be no single measure that is adequately sensitive. Moreover, any measure might not be process-pure, tapping exclusively conscious or unconscious processing. If so, then using an adequately sensitive measure of awareness to show that participants could not have seen a prime might have the side effect of also eliminating any unconscious processing of that prime (Reingold & Merikle, 1988).

To address this problem, (Reingold & Merikle, 1988) adopted a different approach, comparing direct measures of performance to indirect ones. Direct measures make explicit reference to the relevant discrimination and include deliberate or explicit judgments (e.g., recognition or recall). Indirect measures make no reference to the relevant discrimination, instead measuring performance (e.g., stem completion in memory tasks). If all measures include both conscious and unconscious components, then by assumption, the direct measures should exhibit a greater conscious component. Presumably, subjects should be more successful in using conscious information when instructed to do so. By this logic, whenever an indirect measure shows greater sensitivity to the prime than a comparable direct one, the difference should be interpreted as evidence of unconscious influences on performance.

The "Process Dissociation Procedure" (Jacoby, 1991) takes this logic a step further. Cognitive control is typically assumed to require consciousness: One cannot control what one is not aware of. Although this claim also is debated (Van Opstal, Gevers, Osman, & Verguts, 2010), Jacoby proposed to a method to assess the respective contributions of automatic (unconscious) and controlled (conscious) influences by pitting the direct measure against the indirect one. For instance, participants first memorize a list of words. Then they perform a direct task in which they are asked to complete word stems with words that were *not* on the memorized list. If they still complete the stems with the memorized words, then that provides evidence for the automatic influence of the studied words: the words produced priming when conscious access should have prevented priming¹.

Procedures like these capitalize on qualitative differences: The pattern of performance differs when people perform the direct task and the indirect task. Such differences add strength to the argument that the tasks tap different underlying mechanisms. Most evidence from the subliminal perception literature finds the same pattern of results with and without awareness, with the purportedly subliminal measures just showing weaker effects (Desender & Van den Bussche, 2012). By demonstrating larger or qualitatively different effects in the task that presumably requires less awareness, researchers can argue that performance on the subliminal task is not just due to reduced (but still present) awareness.

These procedures can produce theoretically important dissociations between tasks, and they provide some suggestive evidence for unconscious processing. However, they too can be criticized for not meeting all four criteria. For example, the direct and indirect measures might just be testing different aspects of awareness, failing the relevance criterion. And, the approach depends on the assumption that the direct measure is more sensitive than the indirect one, but it might just be more subject to explicit reporting biases.

This discussion highlights the prolonged debate within cognitive psychology about subliminal perception and semantic processing in the absence of awareness. Hard-core

¹ See Payne (2001), Payne, Jacoby and Lambert (2002), Payne, Jacoby and Lambert (2004) as well as Stewart and Payne (2008) for the application of the process dissociation procedure in social psychology.

skeptics can still hold to the claim that there is no indisputable evidence for subliminal semantic priming. And, even proponents of subliminal perception argue that demonstrating the absence of awareness requires exceptional rigor or a set of contentious assumptions.

Nobody doubts the existence of semantic priming. The debate is about the need for consciousness and the claims that follow if subliminal semantic priming occurs. For the vast majority of studies of semantic priming in cognitive psychology, the issue of awareness is of minimal relevance. It is important only for particular types of claims: those arguing that such access is necessarily automatic, those positing routes to behavior that do not require conscious decisions, or those suggesting that much reasoning or deliberation occurs outside of awareness. Most semantic priming effects studied in cognitive psychology, whether they are conscious or unconscious, are small and fleeting.

Priming in social psychology

Although early studies had already suggested that subtle primes could affect social judgment unbeknownst to the subject (e.g., Bargh & Pietromonaco, 1982; Devine, 1989; Higgins, Rholes, & Jones, 1977; Srull & Wyer, 1979), the seminal studies of Bargh, Chen, and Burrows (1996) in the 1990s were the first to show that the automatic effects of primes extended to overt actions. The wealth of studies conducted since then appears to confirm the power of automatic behavioral priming. For example, people primed with the concept of “professor” perform better on knowledge tasks (Dijksterhuis & van Knippenberg, 1998); people primed with the concept of cleanliness or warmth may behave more prosocially (Vohs, Redden, & Rahinel, 2013; Williams & Bargh, 2008); participants primed with a picture of a dog (vs. a cat) behave more loyally (Chartrand, Fitzsimons, & Fitzsimons, 2008), and so on. A recent review of behavioral priming in social cognition concluded “What were once considered shocking and controversial effects are now widely accepted among social psychologists” (Wheeler & DeMarree, 2009, p. 577).

The “discovery” of automatic priming effects on behavior triggered the exploration of a variety of prime-to-target relationships with little exploration of the processes underlying each effect. The diversity of these reports gives the impression that priming is ubiquitous and

unavoidable. Such effect studies continue to appear at a steady rate (e.g., Gibson & Zielaskowski, 2013; Lammers, Dubois, Rucker, & Galinsky, 2013; Shimizu, Sperry, & Pelham, 2013), but theorists have begun to devote more attention to the boundary conditions of priming effects and the processes that may underlie the phenomena (for examples, see: Bargh, 2006; Jonas, 2013; Wheeler & DeMarree, 2009).

This sustained interest in priming within social psychology developed from a broader interest in the role of automatic processes. Until the 1970s, many of the phenomena that now fall under the umbrella of “social cognition” (e.g., causal attribution, person perception, or attitude change) were studied using self-report methods: People were asked to explain why they evaluated, judged, or behaved as they did. In the 1970s, that approach came under fire from Nisbett and Wilson (1977) who showed how wrong we can be about the reasons for our behaviors and beliefs. The critique paralleled earlier criticisms (Mandler & Mandler, 1964) of Titchnerian introspective methods (Titchener, 1902), noting how we often lack introspective access to the mechanisms underlying our cognition.

Nisbett and Wilson’s lasting contribution came from their discussion of the different ways in which we can be aware of the causes of our behavior. Their analysis played a central role in the development of social cognition as a field by encouraging the use of methods inspired by cognitive psychology. They put forward that people may be “(a) unaware of the existence of the stimulus that influenced their response (b) unaware of the existence of the response (c) unaware that the stimulus has affected the response” (p. 810), a statement that echoes the need to specify the form of awareness being measured.

Nisbett and Wilson (1977) did not focus on subliminal perception, considering the phenomenon to be plausible but not central to their claims. Rather, they addressed how stimuli exert their influence on behavior without this influence being consciously registered or accurately understood by subjects (i.e., point “c” above). From this perspective, priming is theoretically important because it suggests that people’s behavior may be influenced by factors they fail to recognize as potential causes of their actions. Thus, what matters chiefly is whether people are aware of the *effect of the prime on the outcome* (e.g., behavior,

impression, judgment,...) rather than whether they are aware of the prime itself. This approach, which accords a peripheral role to issues of awareness of the prime, also characterizes the way social psychologists have approached priming more recently. In the majority of priming studies conducted after Nisbett and Wilson's work, participants actually were aware of the prime (cf. Higgins, 1996).

Still, social psychologists frequently rely on purportedly subliminal stimuli as a way to study how primes influence behavior automatically. In one of the seminal papers on priming in social psychology, Bargh (1992) lists two reasons why social psychologists do so: (a) any influence of a subliminal prime must occur automatically rather than via conscious intervention or deliberation, and (b) the effects of subliminal primes reveal the "way in which social stimuli are interpreted, categorized or evaluated prior to the output of these analyses being furnished to conscious awareness" (p. 238).

The issue of automaticity is central to many areas of social cognition, including dispositional attribution, stereotype activation, impression formation, the effects of attitudes on judgments, etc. Automatic processes are those that are unintentional, effortless, outside awareness, and ballistic once initiated (Bargh, 1994). Few processes meet all of these criteria, with most processes in social cognition satisfying a subset of these requirements (Bargh, 1994).

Subliminal priming, though, meets all of these criteria: "Lack of awareness of the stimulus ensures that its subsequent effects were unintended by the subjects" (Bargh, 1994, p. 10). Subliminal effects rule out possible demand effects, strategy shifts, or explicit biases that might otherwise account for a link between the prime and the target behavior. And, if those processes are automatic, then they can reveal the sorts of social processes that are fundamental to how we see the world, those that operate independently of our explicit desires, beliefs, and goals. Thus, even if the use of subliminal priming has not been the norm in social cognition, demonstrating an effect of subliminal primes has been the gold standard for establishing that the underlying process is automatic.

Besides the two reasons mentioned by Bargh, a third appeal of subliminal priming comes from the excitement of showing how subtle factors can have large, counter-intuitive effects

on behavior (cf. Giner-Sorolla, 2012; Gray & Wegner, 2013 on the role of aesthetic standards in scientific publication). And, no stimulus can be more subtle than a subliminal one. Social cognition is replete with surprisingly powerful and counter-intuitive effects of purportedly subliminal stimuli: Subliminally flashed Israeli flags induce changes in political positions and voting behavior weeks later (Hassin, Ferguson, Shidlovski, & Gross, 2007), subliminal fast food logos affect the choice of an interest rate (Zhong & DeVoe, 2010), priming the concept of God makes believers less likely to endorse responsibility for their actions (Dijksterhuis, Preston, Wegner, & Aarts, 2008), etc. Such studies, which reveal the powerful real-world effects of seemingly trivial events are darlings of the media because they provide a compelling narrative that counters the intuitive belief that we know the reasons for our decisions and actions. They regularly appear in top journals and are highly cited, providing an incentive for other researchers to use similar methods.

This broad visibility also contributes to skepticism from cognitive psychologists who study subliminal perception because almost none of these studies meet the criteria necessary to show that the prime fell entirely outside of awareness; Most claim that the stimulus is subliminal without directly addressing those criteria.

How do social psychologists assess awareness?

In many priming studies in social cognition, a single prime influences a single outcome measure, a method that does not permit systematic tests of the detectability of the prime. And, even those studies that use multiple priming trials (e.g., Hassin et al., 2007) typically do not use sensitive measures of awareness of the prime (for exceptions, see Devine, 1989, Helper et al, 2013). The most common approach involves using a funneled debriefing, after measuring the outcome behavior, to determine whether participants can guess the purpose of the study, whether they remembered the prime, or if they inferred the link between the prime and the outcome behavior (Bargh & Chartrand, 2000). If a sizable proportion of participants correctly report the link between the prime and behavior, then researchers worry that any effects on the outcome measure were potentially affected by conscious demands. For example, Bargh and Chartrand (2000) question the value of any experiment in which an "alarmingly high proportion" (i.e., > 5%) of participants must be excluded because they report the correct

prime-behavior link during debriefing. Note that this method of assessing awareness does not meet any of the criteria for claiming that a stimulus was processed without awareness. The test of awareness was delayed rather than immediate, it relied on verbal reports that might be inadequately sensitive, it might not be reliable because it could be influenced by demands, and it might not be relevant if verbal reports do not tap the same processes thought to be unconscious. The use of verbal reports to assess awareness is ironic in light of the role that Nisbett and Wilson's (1977) criticism of such methods played in the development of priming research in social psychology.

Some studies do go beyond funnel debriefing and use additional methods to assess awareness of the prime. In an influential guide to conducting priming research, Bargh and Chartrand (2000) recommend a follow-up test in which they show primes and ask participants to guess what they are. They conclude that the primes were subliminal "...if the participant is not able to guess any of the words or identify the gist of the pictorial content" (p. 10). Again, the test of awareness uses a potentially insensitive measure (verbal report) that might be subject to biases (e.g., subjects might be conservative in their guesses) and that is conducted after the priming episode. Indeed, people may have been aware of the primes but have trouble retrieving them (see Bargh, Bond, Lombardi, & Tota, 1986), or they may simply resort to the most economical option which is to report that they saw nothing.

Other approaches recommended by Bargh and Chartrand (2000), include conducting an additional experiment to assess awareness of the prime directly (e.g., Bargh et al., 1986; Bargh & Pietromonaco, 1982; Devine, 1989, study 2), an approach common in cognitive psychology as well (Dehaene et al., 2001). For example, in a study of the effect of parafoveally presented stereotype primes on a subsequent impression-formation task (Devine, 1989, study 2), a control condition measured awareness directly. Participants viewed the same words under the same conditions and were asked to guess each word. They successfully guessed fewer than 2% of the stereotype related words, which was taken as evidence that participants were not aware of the meaning of the primes. Although this method is more rigorous than funnel debriefing, the inability to name words does not exclude all conscious

semantic processing.² Devine also conducted a recognition test with new participants. At the end of the priming task, participants viewed a list of words (some of which had been presented previously and some not), and they reported which ones they had seen. Their recognition performance did not vary as a function of the priming condition and was no better than chance. Note, though, that this method does not meet the immediacy criterion, and it too might not be optimally sensitive.

In an example of an unusually rigorous test of awareness in a social psychology priming study (Hepler & Albarracin, 2013, study 2), subjects were "subliminally" primed with words related to action or inaction which subsequently affected performance on a go/no-go task. In addition to funnel debriefing, participants completed a prime recognition task twice (i.e., identifying primes among distractors) as well as a prime discrimination task in which they viewed primes under the same timing conditions as the primary task and had to make a forced choice identification (which of two words was shown). Participants showed poor recognition and discrimination performance. Moreover, the results were unchanged after eliminating data from those participants who showed better discrimination and recognition accuracy, and performance on the discrimination task was uncorrelated with the effects of priming. It still is possible that the discrimination and recognition tasks were inadequately sensitive to pick up awareness of the presence and conscious influence of a prime, the approach in this study is laudable for its rigor.

Unfortunately, the use of such a thorough awareness check is rarely reported in social psychology. Many priming studies do not even provide enough detail about the method to determine exactly how awareness was tested. For example, Zhong and Devoe (2010) presented fast-food logos or control logos for 12ms in the context of a lexical decision task and showed that the fast food logos made people more impatient (operationalized as the time taken to read a text passage). When reporting how they determined that the primes were subliminal, they state "when asked after the experiment what they had seen in the flashes, all the participants reported that they had seen color blocks without any meaningful pattern" (p.

² For example, the relevance criterion might not have been met: Social desirability concerns might have discouraged participants from uttering stereotype-related words, thereby explaining lower naming rates for those words than for neutral ones. In some respects, this approach is comparable to a naming task used by Sidis (1898), one considered inadequate by most subliminal perception proponents.

620). No information is provided about the nature of the questions, and no systematic tests are conducted to demonstrate that the primes must have fallen outside awareness. Other studies provide no test of awareness at all, simply assuming that the stimulus must have been subliminal because the presentation was brief (e.g., Bargh et al., 1996; Veltkamp, Custers, & Aarts, 2011; Hirschberger, Ein-Dor, Caspi, Arzouan, & Zivotofsky, 2010)

Summary. In cognitive psychology, the question of awareness is paramount; demonstrations of subliminal priming could reveal an alternative mechanism for semantic processing, and if such effects can be explained via explicit processes, the findings themselves may be uninteresting. In social psychology, what counts is whether the prime's influence on behavior happens outside of awareness, and using subliminal presentation is one way to ensure that those effects occurs automatically.

Unfortunately, lack of awareness is often assumed rather than tested, and when tests are conducted, they are insufficiently stringent to meet the standards set by subliminal perception researchers (the same holds true for some experiments in cognitive psychology). Claims that a stimulus or its influence fell outside of awareness typically rely on post-experiment funnel debriefing, a procedure that falls short of most established criteria for documenting the absence of awareness.

When a claim rests on the absence of awareness of the primes themselves, researchers must take steps to document the absence of awareness. Those steps could include using signal detection methods to document that participants cannot discriminate the presence of the prime from its absence (i.e., showing that d' for the detection of a stimulus is actually 0 for every subject). Note that this standard is far more challenging to meet than demonstrating an inability to identify or remember a flashed prime, but it provides clear evidence that the observer did not consciously process the prime; if they cannot discriminate the presence of a prime from its absence, then they presumably cannot process the meaning of the prime. Using signal detection analysis across a set of trials also distinguishes discriminability from response bias (i.e., participants might not report a stimulus that they did process with some awareness).

Typically, a signal detection analysis of awareness would be conducted separately from the main priming trials to avoid contaminating the priming measures themselves. Consequently, they do not meet the immediacy criterion. Moreover, people might improve in their ability to detect the primes over the course of a study, so in an ideal design, discriminability would be tested before and after the priming period to verify that d' has not changed.

This objective standard for awareness is perhaps the most stringent, and few studies meet it. But, when a study does not meet this standard, any claims that the prime was processed entirely without awareness must be qualified appropriately. At a minimum, researchers must recognize that a failure to report the presence of a prime or to remember it later is not the same as the ability to consciously process it at the time of presentation. Verbal reports and recognition judgments are influenced both by sensitivity to the presence of the stimulus and by the decision criterion, and claims about awareness require an assessment of whether the prime was consciously perceived, not of whether people neglected to report a low-confidence percept.

In some cases, documenting the complete absence of awareness is not important; the need for such controls depends on the claim the researchers want to make. For example, imagine a simple test in which a subject views a video and then fails to report the presence of a person in a gorilla suit (Simons & Chabris, 1999). If the researcher wants to test whether the gorilla fell entirely outside of awareness but still influenced subsequent performance, then stringent measures of awareness are needed and the verbal report of noticing is inadequate. If, however, the researcher does not wish to explore whether the gorilla was processed unconsciously in the absence of a verbal report, then more stringent tests are unnecessary. For example, they could safely conclude that the gorilla influenced later performance even when it went *unreported*, a claim that might well be informative and interesting (Simons, 2000; Wolfe, 1999; although there is little evidence for such an effect).

To determine whether awareness matters for a claim, consider whether the finding would be interesting or informative if the crucial aspect of the prime occurred with awareness. For example, take the case in which priming with words related to aging leads participants to walk more slowly (Bargh et al., 1996). In that case, the primes were consciously perceived—

subjects descrambled sentences that were fully visible and they had to perceive the relevant words to do so. Unawareness of the stimulus is irrelevant. How about the link between the prime and behavior? If participants were fully aware of the link between the age-related words and their walking speed, the finding would not be as interesting—it could be attributed to task demands, expectancy effects, or other biases. The finding is important only to the extent that it cannot be explained by such explicit biases, so documenting the absence of awareness of the link between the prime and outcome measure is essential.

In most social psychology priming studies, experimenters try to eliminate demand characteristics and other explicit biases in order to show that the prime had its effect automatically. They frequently do so by claiming subjects were unaware of the primes themselves or of the influence of the primes on their behavior. Yet, such claims of awareness require more careful testing and reporting than typically occurs. When evaluating such claims, we should consider whether and in what ways the finding would still be interesting even if subjects were aware.

Three sources of conflict and how to resolve them

Awareness

Cognitive and social psychologists have focused on different aspects of awareness in the study of priming. Cognitive psychologists have spent decades debating the appropriate way to document subliminal priming because they are fundamentally interested in what unconscious processing would tell us about the mechanisms of semantic processing and representation. In contrast, social psychologists have largely used the absence of awareness as a way to verify that priming effects occur automatically and are not subject to explicit demands and situational biases.

In studies of subliminal perception, researchers decrease stimulus intensity or presentation time until the prime is weakened enough to elude consciousness. In studies of automaticity, the stimuli often are strong, but they exert their influence automatically, in the absence of awareness of the link between the prime and behavior. This difference in emphasis has resulted in a difference in how cognitive and social psychologists verify the absence of

awareness in their research. Whereas cognitive psychologists studying subliminal perception typically attempt to meet all four of the criteria for documenting awareness, many priming studies in social psychology rely instead on post-hoc debriefing and verbal reports of awareness.

These differences in approach inspire conflict, largely due to different uses of the term “awareness,” but they also could be resolved easily. Priming studies only need to specify the aspect of awareness that is crucial to the claimed effects. Is a lack of awareness of the prime itself essential? Is a lack of awareness of the prime-outcome link essential? Would the finding still be of interest if subjects were aware of the prime or the prime-behavior link?

If the finding would be uninteresting if subjects were aware, the paper should explicitly discuss the ramifications of awareness and note that limitation. If the finding would be interesting regardless of whether or not participants were unaware, the paper can make stronger claims and note how it would be interesting in each case.

Simply increasing the precision of claims about awareness and automaticity would help, but papers also must fully describe how awareness was measured and identify the limitations of those assessments. If an assessment fails to meet one or more the four criteria necessary to rule out awareness, the paper must acknowledge that failure and discuss its implications for any claims about awareness and automaticity.

Processes

Within cognitive psychology, the presumed mechanism underlying priming is the spread of activation within semantic networks (Collins & Loftus, 1975). In this model, activation diminishes with semantic distance (McNamara, 1992) and fades quickly, often disappearing after a few hundred milliseconds (Muscarella, Brintazzoli, Gordts, Soetens, & Van den Bussche, 2013). From this theoretical perspective, some effects of primes on judgment and behavior seem ungrounded. For example, claims that a subliminal flag can produce long-lasting effects on political attitudes and voting behavior (Hassin et al., 2007) runs counter to the limited spread of semantic activation and the duration and potency of such primes in subliminal perception. As social psychologists (e.g., Jonas, 2013) have themselves noted,

other findings of strong behavioral consequences of subliminal stimuli or subliminal stimulus-behavior links (e.g., Aarts & Dijksterhuis, 2002) are similarly hard to explain in terms of traditional accounts of spreading activation within semantic networks.

Although several theoretical models have been proposed to account for the substantially more powerful priming in social psychology experiments (e.g., Bargh et al., 1996; Bargh, Schwader, Hailey, Dyer, & Boothby, 2012; Dijksterhuis & Bargh, 2001; Loersch & Payne, 2011), these accounts remain relatively underspecified. For example, the Perception-Behavior link account claims that primes activate representations that then directly activate relevant behaviors and goals (Bargh et al., 1996; Bargh, et al., 2012; Dijksterhuis & Bargh, 2001), but the model does not make explicit predictions about *which* motor behavior will be activated by a given mental representation (e.g., the trait "aggressive" may be manifested in many different motor behaviors) or which of the many environmental primes we experience will exert an effect on behavior (the "reduction problem" highlighted by Bargh, 2006). Although situationally activated goals and motivations seem to play an important role (cf. Bargh, 2006; Wheeler & DeMarree, 2009), current accounts make few a priori predictions, in large part because of their inherent complexity.

For instance, in a review of moderators of priming effects, Wheeler and Demarree (2009) propose a model³ that assumes that a prime first activates a construct in memory. The activated construct then directly influences a behavioral representation, which itself directly drives behavior. But its influence can be mediated by many other processes, including how people represent their goals as well as how they perceive the situation, themselves, or other people. The authors list as many as 16 such moderators, each of which is assumed to modulate some aspect of the complex pathways that link perception to action.

With so many degrees of freedom, it would be unsurprising if priming effects were hard to replicate. Yes, moderators are a possibility, but what is the evidence that they do play a role? Most priming studies are underpowered to detect even medium sized effects of the prime, and they are massively underpowered to detect an interaction of that effect with one or more moderators (see Simonsohn, 2014). Demonstrating that a moderator matters would require a

³ Note that Wheeler and DeMarree (2009) prefer the term "descriptive summary" to "model"

large-scale, confirmatory study showing how varying the moderator varies the outcome. Without such studies, there would be no way for researchers to know that moderators matter.

Replicability

At least two factors contribute to the skepticism expressed by some cognitive psychologists about social priming research. First, large priming effects from subtle manipulations are not the norm in cognitive psychology, where weaker manipulations produce weaker, not stronger, effects. The surprisingly large effects (at least to cognitive psychologists) (Pashler, Coburn, & Harris, 2012), coupled with the lack of published direct replications of these findings within the social psychology literature, increase the concern that these effects might not be as robust as a perusal of the literature would suggest (Carlin & Standing, 2013; Doyen, Klein, Pichon, & Cleeremans, 2012; Harris, Coburn, Rohrer, & Pashler, 2013; Pashler et al., 2012; Shanks et al., 2013).

A deeper cause of conflict over replicability follows from differences in the sorts of replications valued by cognitive and social psychologists. Cognitive psychologists historically have tended to devalue individual differences, looking for mechanisms common to most or all people. Consequently, they expect any published effect to be replicable with any reasonably similar population of subjects, provided that the reported methods are followed precisely. Multiple-experiment papers in cognitive psychology often include a direct replication of another finding, followed by extensions of that finding.

In contrast, social psychologists assume that the primes activate culturally and situationally contextualized representations (e.g., stereotypes, social norms), meaning that they can vary over time and culture and across individuals. Hence, social psychologists have advocated the use of “conceptual replications” that reproduce an experiment by relying on different operationalizations of the concepts under investigation (Stroebe & Strack, 2014). For example, in a society in which old age is not associated not with slowness but with, say, talkativeness, the outcome variable could be the number of words uttered by the subject at the end of the experiment rather than walking speed.

The problem with conceptual replication in the absence of direct replication is that there is no such thing as a “conceptual failure to replicate.” A failure to find the same “effect” using a different operationalization can be attributed to the differences in method rather than to the fragility of the original effect. Only the successful conceptual replications will be published, and the unsuccessful ones can be dismissed without challenging the underlying foundations of the claim. Consequently, conceptual replication without direct replication is unlikely to change beliefs about the underlying effect (Pashler & Harris, 2012).

Given the existence of publication bias and the prevalence of questionable research practices (John, Loewenstein, & Prelec, 2012), we know that the published literature likely contains some false positive results. Direct replication is the only way to correct such errors (Simons, 2014). The failure to find an effect with a well-powered direct replication must be taken as evidence against the original effect. Of course, one failed direct replication does not mean the effect is non-existent—science depends on the accumulation of evidence. But, treating direct replication as irrelevant makes it impossible to correct Type 1 errors in the published literature.

Conclusions

Our review of priming research in cognitive and social psychology highlighted important differences in the underlying assumptions, methods, and goals of these fields. Whereas cognitive psychologists historically have used priming to study of structure of mental representations and the extent to which information processing takes place without awareness, social psychologists have used priming to study the automatic effects of a stimulus on behavior. For most studies in social psychology, using subliminal primes is a powerful way to ensure automaticity as well as to eliminate possible demand effects on behavior.

Given evidence from subliminal perception research showing that (a) the effects of primes tend to be small and short-lived, and (2) even the most stringent tests to rule out awareness are controversial, perhaps it is unsurprising that claims of large and lasting effects of primes on behavior have come under scrutiny.

We identified three changes that would help the field move beyond this clash of traditions. First, be more precise in defining what aspect of awareness matters and how it is measured. Second, focus on direct replications and confirmatory tests of proposed moderators. Third, continue to probe the different types of mechanisms that might underly priming effects.

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