

CHAPTER 11

Debate on Unconscious Perception

IAN PHILLIPS AND NED BLOCK

Part 1: Phillips

To the untutored ear, the idea that perception does not require consciousness may sound as absurd as the idea that thunderstorms do not require anything to be happening in the sky (cf. Wiggins 2001: 218), or that being red does not require being coloured (cf. Moore 1925: 46–7). What then persuades contemporary theorists that unconscious perception is hard, scientific fact?

To avoid “getting bogged down in theories of perception”, Prinz (2015: 372–3) stipulates that “unconscious perception” is to mean the “unconscious transduction of information . . . useable by the organism that transduces it”. But this will not suffice if our interest is in defending the philosophically substantive thesis that episodes *of the same fundamental kind* as episodes of conscious perception can occur unconsciously (Burge 2010: 374–5; Block 2012: 11–12; cf. Prinz 2010: 310). A traditional idea is that perception essentially involves occupying a subjective perspective on an objective world. Pursuing this idea, Burge characterizes perception as constitutively a matter of “objective sensory representation by the individual” (2010: 368). So characterized, not all useable transduced information constitutes perception. For an informational state to constitute perception it must (a) have objective content, representing how particulars are arranged in the subject’s external environment; and (b) be attributable to the individual, not merely, say, to their visuomotor system.

If consciousness were a requirement either for objectivity (e.g., Eilan, 2015) or for individual attributability, Burge’s characterization of perception would rule out unconscious perception. However, Burge rejects both

suggestions. For Burge, perceptual objectivity is achieved by exercise of the perceptual constancies (399): “capacities to represent environmental attributes, or environmental particulars, as the same, despite radically different proximal stimulations” (114). Further, a representation’s being attributable to the individual turns, paradigmatically, on whether the representation’s content is available to central, coordinating agency (333). Does a commitment to unconscious perception ineluctably follow? Only if centrally available, constancy-implicating representations can occur unconsciously. Here I argue that the empirical evidence which Burge and many others cite fails to establish this contention. Thus, even granting Burge’s controversial claims about perception, the existence of unconscious perception remains an open question. (For much more on these issues, see Phillips forthcoming; and Phillips in press.)

Cases of two types ground much contemporary belief in unconscious perception. First, clinical cases in which perception appears preserved despite loss of consciousness. Second, paradigms in which a stimulus continues to influence responding despite apparently being suppressed from conscious awareness.

Consider (type-1) blindsight, the striking phenomenon of preserved visual function (standardly evinced by successful forced-choice responding to a narrow range of stimuli) despite destruction of V1 and in the absence of acknowledged awareness (Weiskrantz 1986/2009, Cowey 2010). According to Burge: “blindsight patients perceive environmental conditions. The perception involves perceptual constancies—including motion, location, and size constancies. The perception guides action. There is strong reason to believe that some of these patients lack phenomenal consciousness in the relevant perceptions” (374). Does blindsight involve the perceptual constancies though? Early work on blindsight neglected this issue. Thus, Weiskrantz (2002: 572) notes “that size constancy, or in fact any of the visual constancies, has never been addressed in any blindsight studies of which I am aware”. More recent work supports a negative answer. For example, Alexander and Cowey (2010) provide evidence that whilst their two patients (MS and GY) retain a capacity to locate and detect stimuli, this capacity is exclusively based on the ability to detect sharp luminance contours and stimulus transients. Neither ability implicates the perceptual constancies, instead being interpretable purely in terms of a sensitivity to proximal stimulation (cf. Burge 2010: 352). In keeping with this, Alexander and Cowey conclude that MS and GY have only the ability to detect “events” varying in “subjective salience” (532). Similarly, Azzopardi and Hock (2011) show that motion detection in GY is limited to detection of “objectless” first-order motion energy (i.e., spatiotemporal changes in luminance) as opposed to detection of changes in position or shape. And Kentridge, Heywood, and Weiskrantz (2007) show that their patient DB matches coloured stimuli purely by wavelength and so lacks even rudimentary colour constancy. Such evidence suggests that the preserved visual functions of blindsight do not constitute perception proper.

Another issue raised by many clinical conditions including blindsight, neglect, and prosopagnosia is how we can be sure that a failure to report awareness reflects a genuinely complete absence of awareness. Signal detection theory (SDT) provides a helpful framework (Green and Swets 1966). The core insight of SDT is that responses in a perceptual task are the joint upshot of two factors: discriminative capacity (d') and response criterion (c). In so-called forced-choice tasks in which subjects must select which of two (e.g., spatial or temporal) intervals a target stimulus is presented in, subjects naturally adopt unbiased criteria, simply picking whichever interval produces the largest sensory response. Such tasks provide a direct guide to perceptual sensitivity. However, in many other tasks, the decision space is not symmetric and subjects often exhibit strong biases toward a particular response. For example, in “yes/no” detection tasks in which subjects are asked whether a stimulus is presented or seen, the threshold which a sensory response must meet to elicit a “yes” may be highly variable, exhibiting either “liberal” or “conservative” bias (see Figure 11.1).

Many hard-to-control factors encourage bias in ways which are (very plausibly) independent of awareness. For instance, a subject may exhibit conservative bias because they are naturally under-confident, in a low mood state, or have certain pre-conceptions about their own capacities or the experiment’s purpose. Furthermore, subjects with acquired field defects may have standing problems adjusting their criterion from that formerly appropriate, or across their differentially sensitive fields. Such difficulties will yield conservative bias (Azzopardi and Cowey 2001). The upshot is that a failure to report stimulus presence or awareness in the presence of preserved discriminative capacity cannot be assumed to reflect unconscious perception. Instead, we must always take seriously the possibility that it simply reflects conscious perception combined with conservative response bias. This “problem of the criterion” was used to cast doubt on much early psychological work on unconscious

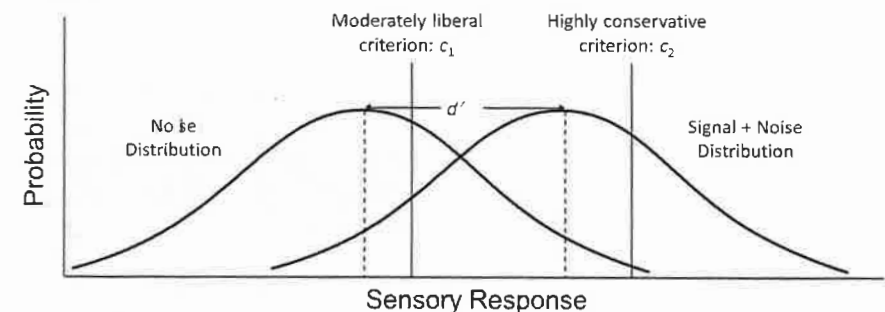


Figure 11.1 SDT analysis of a simple “yes/no” task. Only sensory responses above the subject’s variable response criterion elicit a positive, “yes” response. Two possible criteria are shown: the first (c_1) moderately liberal, the second (c_2) highly conservative.

perception (e.g., Eriksen 1960 and Holender 1986). It continues to plague studies of perception in clinical populations as well as many other putative cases of unconscious perception—for example, inattention blindness (e.g., Mack and Rock 1998; see Dulany 2001) and attentional blink (e.g., Luck, Vogel, and Shapiro 1996).

One way of avoiding the problem is to turn to studies in which subjects display no preserved discriminative capacity in respect of some feature (i.e., $d' = 0$) and yet that feature continues to exert a perceptual influence. The classic paradigm is masked priming in which masking renders a prime stimulus indiscriminable ($d' = 0$), and yet the prime still facilitates subsequent responses to congruent, supraliminal targets. However, such paradigms do not provide unproblematic evidence of unconscious perception. First, establishing that task relevant perceptual sensitivity is completely absent, as opposed merely to very low, is a methodological minefield. Second, the assumption that d' is a fully adequate measure of *phenomenal* consciousness is far more controversial than usually supposed (e.g., Schmidt 2007). Third, studies rarely concern themselves with showing that the priming effect implicates objective representation, and so perception proper. Here I highlight a fourth broad concern—namely, whether priming effects suffice to evidence individually attributable representations.

Consider an exemplary recent study by Norman, et al. (2014) in which subjects were asked to identify the colour of a mask. A preceding prime matched the mask either in surface colour or reflected colour (i.e., wavelength) but, because of a shift in illumination between prime and mask, not both (Figure 11.2). A c.25ms response advantage accrued under

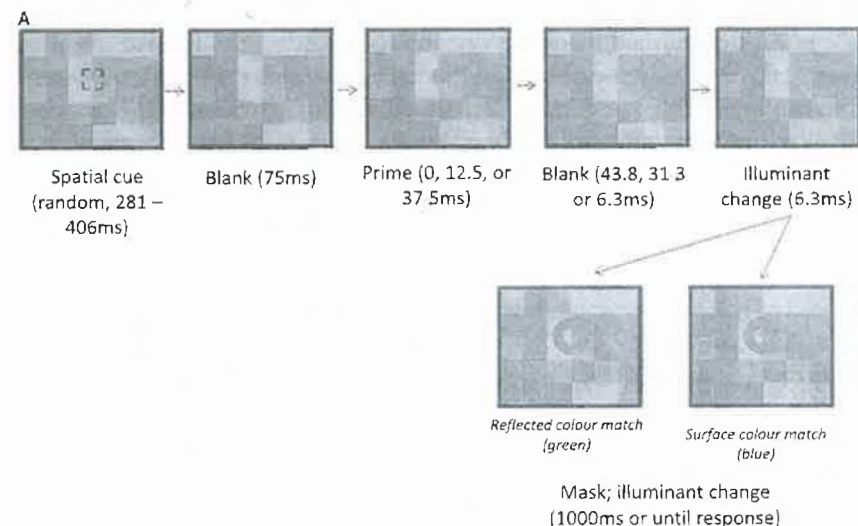


Figure 11.2 Trial sequence from Norman et al. (2014: 2824). Reproduced with permission. Copyright © 2014 Elsevier Ltd. All rights reserved. (Note that original version is, of course, coloured.)

surface-matching conditions indicating constancy-based objective colour representation. Moreover, the effect remained even when subjects could not detect the prime ($d' = 0$). This is arguably good evidence of unconscious objective representation. However, the natural understanding of the priming effect provides no reason to think such representations are available to central, coordinating agency. Consequently, the paradigm provides no evidence of *individual-level* perception. The natural understanding of the effect is that the prime activates objective colour representations in the visual system. This activation results in more fluent processing of subsequently presented congruent colours. As a result, the surface-matched mask is seen more quickly and easily, and so responded to faster. Responses are thus facilitated even though representation of the prime itself is entirely restricted to the visual system and so not individually attributable.

This opening discussion barely scratches the surface of decades of empirical work. Its purpose is simply to challenge the common conviction that unconscious perception is an incontrovertible empirical datum. To the contrary, the ambition of establishing the existence of individually attributable, objective representations completely outside of phenomenal awareness is fraught with difficulties. We should not assume that it will be achieved.

Part 2: Block

Is There Unconscious Seeing, and Why Care?

Seeing is a single fundamental natural kind, of which conscious and unconscious seeing are sub-kinds (Block 2010; Burge 2010). This fact provides difficulties for some of the major theories of perception. For example, naïve realism posits that there are no perceptual representations and that the phenomenology of perception is a matter of direct awareness of things and properties in the world (Travis 2004). But if there is unconscious perception, it must be a matter of perceptual representation that is not available to awareness. And if unconscious seeing is unconsciously representing, there is a strong case that conscious seeing is consciously representing.

Introduction

There is no well-confirmed theory of the scientific nature of consciousness. Consequently there is no scientific proof of any particular type of state that it is unconscious. And given the lack of any “criterion” for consciousness, any particular experiment will depend on assumptions that themselves have a questionable scientific status. But what holds for unconscious states also applies to conscious states—there is no scientific proof that you are consciously reading these words right now, and this point should put the first one into perspective. With unconscious states as with conscious states we have good reasons for attribution in particular cases—even if they fall short of the status of other scientific truths.

Ian Phillips and I have disagreements about whether there is such a thing as unconscious perception. Instead of focusing on the details of those disagreements, what I will do here is describe my favourite case of unconscious seeing.

Continuous Flash Suppression (CFS)

To understand what continuous flash suppression (CFS) is, let us start with binocular rivalry, a phenomenon diagrammed in Figure 11.3. “A” shows the bottom of the brain of a subject who is wearing red/green glasses and is viewing

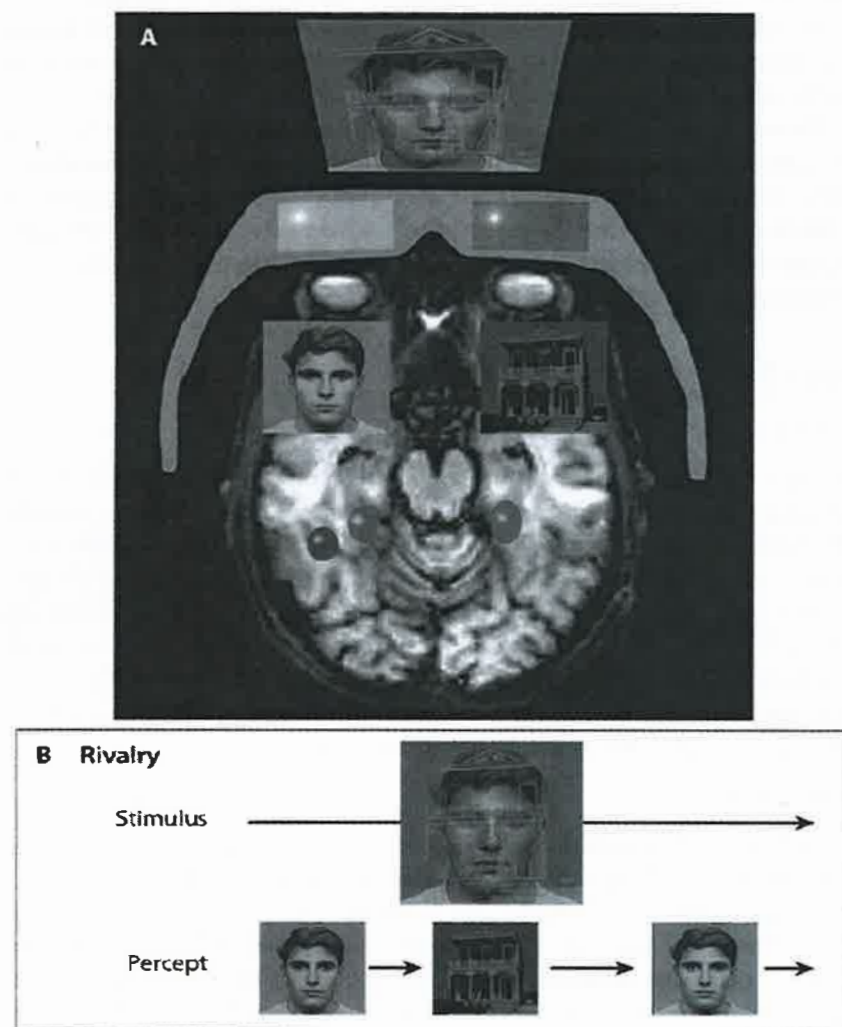


Figure 11.3 This diagram is similar to diagrams in Tong et al. (1998). I am grateful to Frank Tong for this diagram and permission to use it.

a red house superimposed on a green face. One eye receives a face stimulus, and the other a house stimulus. The conscious perception—diagrammed in “B”—is not a combined image but rather conscious alternation, with the whole visual field filled first by one image, then the other, then the first again, and so on, every few seconds for as long as the subject is perceiving the stimulus. Subjects report that when they are aware of a face, they are not at all aware of the house (except for occasional brief transitional images).

Much of the early visual processing does not change with the changing conscious percept. But when the face fills the whole visual field, the face processing system in the brain (part of which is indicated by the blue dot [farthest left]) is much more active while the areas that process the house (red dots [the two right-most dots]) are suppressed. And the reverse happens when the subject is conscious of the house. The reports suggest that the suppressed representation is not conscious.

Nao Tsuchiya discovered that a high-contrast rapidly changing (at 10 Hz) coloured image—known as a “Mondrian”—such as the one on the right in Figure 11.4 could make the perception of the stimulus in the other “suppressed” eye unconscious very reliably for up to 10 seconds and pretty reliably unconscious for several minutes.

When this CFS process is working properly,

1. Subjects are at chance in making a choice between alternative pictures that have been projected to the suppressed (non-Mondrian) eye.
2. Subjects give the lowest confidence rating on almost all trials.
3. Subjects often insist they are seeing nothing other than the Mondrian.

I have used a low-tech version of this CFS procedure (using red/green

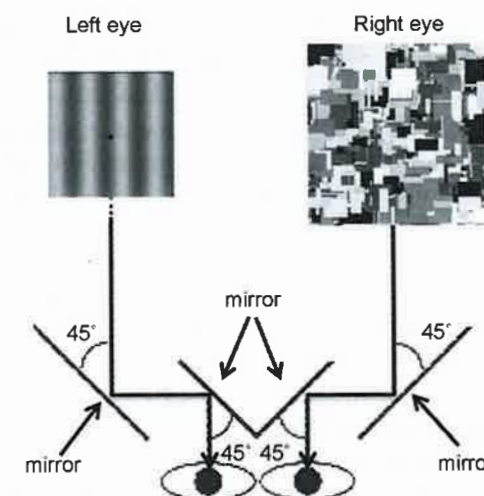


Figure 11.4 Mirror stereoscope setup for continuous flash suppression. I am grateful to David Carmel for supplying this figure and for permission to use it.

glasses) in many classes and talks. People often comment that nothing is being projected other than the Mondrian.

4. There is no difference in confidence between correct and incorrect choices of the input to the suppressed eye (Raio et al. 2012)—that is, confidence does not predict accuracy. And this suggests that even when subjects think they might have consciously seen something, they did not.

In addition, there are often differences in kind between processing under CFS and conscious seeing. Raio et al. (2012) compared conscious and unconscious fear conditioning. The stimuli in the suppressed eye was either a male or a female face, one of which was paired with a shock. Fear conditioning was measured by changes in skin conductance in response to the picture paired with the shock. Fear conditioning in the unconscious case ramped up quickly and died off quickly as compared with the conscious case. More interestingly, fear conditioning in conscious—but not unconscious—perception involved suppression of the response to the face that did not predict shock.

These facts certainly show unconscious processing, but does that processing involve perception?

Mudrik et al. (2011) used a version of CFS (diagrammed in Figure 11.5a) in which the non-Mondrian eye received a picture that slowly ramped up in contrast. The other eye was shown a Mondrian that decreased in contrast when the first picture got to full contrast. The photos included food being put in the oven, a basketball game, and an archery scene (depicted in Figure 11.5c). Each of the photos had an anomalous twin in which, for example, the basketball was replaced by a watermelon, the arrow was replaced by a tennis racket, or the food was replaced by a chessboard. Subjects were asked to press the right or left key as soon as they saw any indication of a scene on the left or the right. What the experimenters were interested in was whether the anomalous photos would break through the “cloak of invisibility” faster. And that was what they found, revealing perceptual integration with context in unconscious perception.

As always with purported unconscious perception, we must consider whether CFS allowed fragmentary conscious perception. If so, the appreciation of anomaly might only occur after partial awareness of the stimulus, with faster conscious processing of anomalous pictures being responsible for the result. Mudrik tested this possibility (Figure 11.5b) by integrating the pictures with the Mondrians. In the condition depicted in B, the blended images that were ramped up slowly were presented to both eyes so that the perception of the pictures—both anomalous and ordinary—was conscious. In this condition—in which there was real manufactured partial awareness of the sort postulated by the alternative hypothesis—there was no difference between the anomalous and ordinary pictures, thus disconfirming the alternative hypothesis.

Another experiment with similar methodology shows that fearful faces break through the cloak of invisibility faster than neutral or happy faces (Yang,

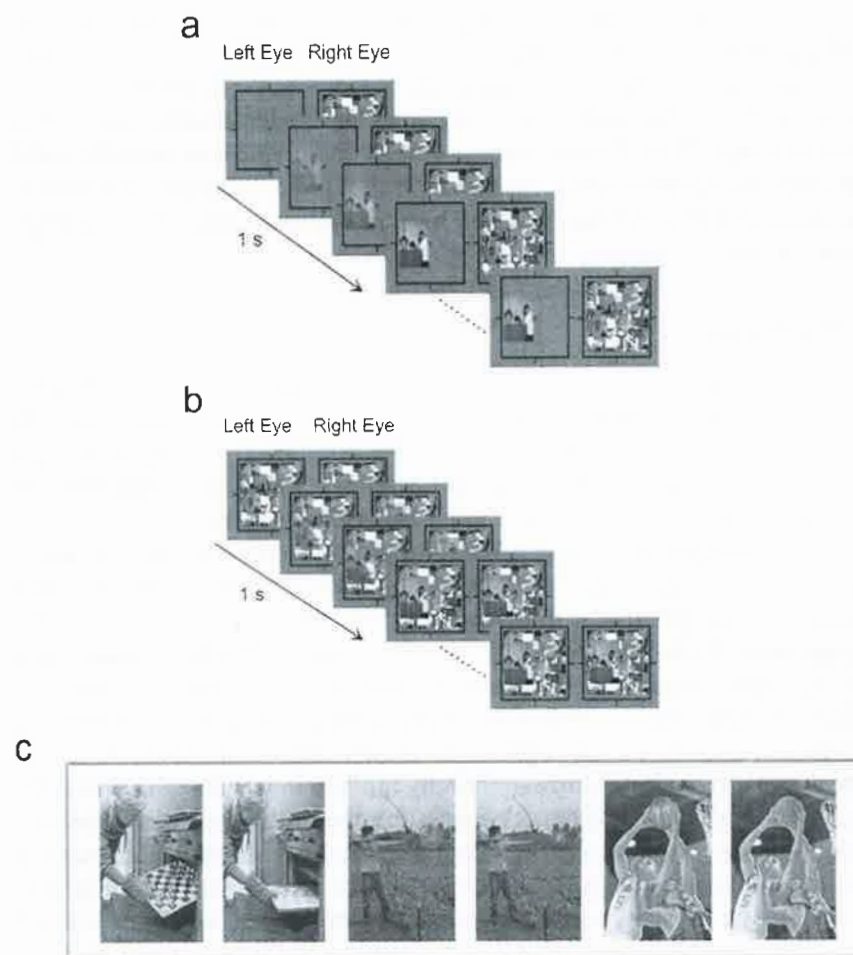


Figure 11.5a–c From Mudrik et al. (2011). I am grateful to Liad Mudrik for this figure.

Zald, and Blake 2007). In another, the subject’s attention was drawn or repelled from unconsciously perceived female or male nudes roughly in accordance with gender preferences (Y. V. Jiang et al. 2006). Thus, unconscious perception can involve high-level perceptual categorization that is relevant to personal-level concerns.

Unconscious perception must be both unconscious and perception, but there is a potential conflict between these desiderata. The best evidence for lack of consciousness would be if there was absolutely no effect on the visual system—but that would not be perception. And any effect on vision could be used by opponents to argue that the visual registration was not really unconscious.

Everything depends on the details, and I believe that the details cited show that CFS experiments can thread this needle.

I find the CFS form of unconscious perception more convincing than those involved in blindsight or visuo-spatial neglect, syndromes that involve brain damage. Brain damage creates uncertainty about how to understand the response. Another advantage of CFS is that the unconscious perceptions last many seconds, making subjects' insistence on having no awareness of any stimulus more convincing.

Part 3: Phillips

Ned Block's opening statement describes his "favourite case of unconscious seeing": continuous flash suppression. Here I argue that CFS confronts the same objections which I raised in relation to subliminal priming. As such, it does not convincingly demonstrate that perception of the same fundamental kind as ordinary conscious perception occurs unconsciously.

As with subliminal priming, CFS faces two broad concerns. First, is awareness completely abolished (cf. Yang et al. 2014)? Second, do demonstrable effects establish genuine perception by the individual? Here I focus on this second issue. Block takes the alleged fact that "high-level perceptual categorization that is relevant to personal-level concerns" occurs under CFS to establish individual-level perception. In doing so, Block apparently assumes that whether a representation is individually attributable turns on its content. An alternative view is that it turns, not on its content, but on its role. This is the natural understanding of Burge's suggestion that individual-level representations are paradigmatically those available to central agency. I appealed to this requirement to argue that evidence of objective representation in subliminal priming fails to establish individual-level perception. Various CFS paradigms merit a similar reply. For example, the acquired skin conductance responses evoked by unconsciously presented faces in Raio et al. (2012) do not demonstrate individual-level perception, since such responses are manifestations of the autonomic nervous system, not of central agency. This case seems to me clear-cut; more often it is a delicate question whether a given response-type constitutes an exercise of central agency. Consider the differential orientating responses made to gendered nudes in Jiang et al. (2006). Do these implicate central agency? Not obviously, if the effect is due to the automatic attraction of saccades (as Prinz 2010: 326 suggests; cf. Burge 2010: 333). Even if the effect is attentional, it is controversial whether all attentional effects involve central agency.

Setting individual-attributability aside, is Block right that high-level unconscious perceptual representation occurs under CFS? Block cites Yang et al. (2007) and Mudrik et al. (2011), paradigms in which certain stimuli (fearful faces and anomalous scenes) break free from CFS faster than others (neutral

faces and familiar scenes). However, the fact that certain stimuli are consciously perceived faster than others may simply indicate that some stimuli are easier (consciously) to detect than others. This no more demonstrates unconscious perception than does the fact that brightly coloured objects are easier to spot than dully coloured ones. To rule out this simple, differential detectability explanation, recent studies ran a control condition wherein stimuli are presented binocularly and made slowly more visible (see Figure 11.5b for Mudrik et al.'s version). Following Mudrik et al., Block argues that since subjects are equally quick to detect both types of stimuli in this control, the faster breakthrough of one type of stimulus from CFS implies specific high-level unconscious perception under CFS. However, as Stein, Hebart, and Sterzer (2011) (also Stein and Sterzer 2014) forcefully argue in relation to the structurally similar study of Jiang, Costello, and He (2007), the control condition used is inadequate. To see why, notice that, whereas in the CFS condition the time after which a stimulus breaks suppression is highly variable, in the control condition the steady ramp in contrast means that the timing of initial awareness is highly predictable. Since CFS and control conditions are studied in separate trial blocks, this creates a crucial difference in temporal uncertainty between conditions. Stein et al. (2011) show that when CFS and control trials are intermixed within blocks, the stimuli which break suppression faster do exhibit a corresponding detection advantage in control trials. This suggests that faster breakthrough is due to differential detectability. Nothing follows regarding unconscious perception.

Jiang et al.'s (2006) paradigm in which differential orientating responses are made following the presentation of female or male nudes under CFS avoids these concerns. However, it does not establish "high-level perceptual categorization" since coarse-grained, low-level features statistically associated with gender could equally mediate the effect. Block (2014) argues that perceptual aftereffects indicate genuine perceptual representation. We can test for gender-specific aftereffects by investigating whether an unambiguously female face presented under CFS biases the classification of a subsequently presented gender-ambiguous face. Recent evidence suggests that perceptual aftereffects from stimuli presented under CFS are absent with respect to gender (Amihai, Deouell, and Bentin 2011) and other high-level features including race (ibid.), holistic face processing (Axelrod and Rees 2014), binocular, higher-level components of face shape (Stein and Sterzer 2011), and (to a very large extent) facial expression (Yang, Hong, and Blake 2010). Pace Block, CFS appears to abolish high-level perceptual categorization.

These issues have intrinsic interest. Block suggests a wider significance: unconscious perception threatens naïve realism. Block's view rests on two contentions: (a) that conscious and unconscious seeing are of the same fundamental kind, and (b) that unconscious seeing "must be a matter of perceptual representation". Naïve realists will likely reject (a). Must they accept (b)? Naïve realism's core tenet is that perceptual episodes involve (non-representational) relations

to mind-independent objects, and so have such objects as constituents (Martin 2006). Could a hypothetical naïve realist think of unconscious perception as involving just such relations? It might be objected that such relations are intended to explain phenomenal character. Yet consider two imperfect analogies. Suppose a good life constitutively involves personal relationships, relationships which partly explain why that life is good. It does not follow that personal relationships of the same kind cannot occur within a bad life. Suppose (with Russellians) that true propositions have mind-independent objects amongst their constituents, objects whose identities partly explain such propositions' truth-values. It does not follow that false propositions lack mind-independent objects as constituents. The naïve realist does face trouble if she insists that sameness and difference in phenomenal character exclusively turns on sameness and difference in perceptual objects. However, naïve realists standardly reject this claim (e.g., Campbell 2009, Brewer 2011). Questions concerning unconscious perception may nonetheless have wider import. Belief in unconscious perception succours scepticism about the significance of consciousness. If perception is essentially conscious, consciousness may partly be important because seeing is.

Part 4: Block

Phillips is right that the controls in the “breaking-Continuous Flash Suppression” (b-CFS) study I cited were inadequate. I had not read the papers by Timo Stein and Phillip Sterzer and their colleagues that he cites.

In b-CFS, differences in breaking through the CFS “cloak of invisibility” are compared to differences in detection of “comparable” visible (i.e., without CFS) stimuli. Some stimuli may be easier to detect than others because of salient low-level features. Salient low-level features—rather than high-level features—could explain breaking CFS, and that possibility must be ruled out by controls. In addition, salient low-level features could trigger a non-perceptual response bias or tendency to respond faster to one of the options.

However, this control issue probably does not apply to the study I cited, Mudrik et al. (2011). They showed that the anomalous pictures do not differ from the non-anomalous pictures in standard measures of low-level saliency, and they independently controlled chromaticity and spatial frequency, thus making low-level confounds unlikely. Further, not even Stein and Sterzer think that a response bias is a real option in this case:

It is important to note that the possible impact of such non-perceptual factors may be limited to the comparison of upright and inverted faces and does not necessarily apply to other b-CFS studies using different stimuli. For example, it is difficult to imagine that observers would have different response criteria for images of complex scenes that differed only in their semantic content (Mudrik et al. 2011).

(Stein et al. 2011, 7)

Thus, if it is easier to spot a visible picture of someone shaving with a fork rather than with a razor, that can be explained by the same unconscious perception of anomaly underlying both conscious detection and breaking CFS.

Summarizing many studies, Phillips says, “Pace Block, CFS appears to abolish high-level perceptual categorization.” On the contrary, there is strong evidence for weak high-level perceptual categorization, including in one of the studies he cites (Yang et al. 2010) so long as there is spatial attention to the location of the stimulus. This point is emphasized in Stein, Thoma, and Sterzer (2015). And in a review of neuroimaging data, Stein and Sterzer (2014) conclude:

In summary, neuroimaging studies investigating the processing of visual information during interocular suppression have shown repeatedly that object- or category-specific neural activity in high-level visual areas of the ventral stream is strongly reduced, but can be retrieved when sufficiently sensitive methods of data analysis are used, such as multi-voxel pattern analysis of fMRI data.

In sum, there is substantial evidence for high-level unconscious perception.

As Phillips notes, the Jiang et al. (2006) CFS study does not use breaking CFS and so is immune to his criticisms of the b-CFS paradigm.

In the Jiang et al. (2006) study, the subject sees a fixation point; then each eye gets a pair of stimuli separated by a fixation point. One eye gets a pair of Mondrians while the other eye receives a nude (male or female) on one side with a texture of fragments of nudes on the other side. In Figure 11.6, the top and bottom in the second panel indicate what is presented to each eye. (Do not make the mistake of supposing that the subject sees a nude with one eye and nude texture with the other eye.) The pair of Mondrians separated by the plus sign presented to one eye suppresses conscious perception of both the nude and nude texture in the other eye. Then if the subject's attention is attracted or repelled by the unconscious perception of the nude, that is due to unconscious perception of the nude. The attraction or repulsion to one side or

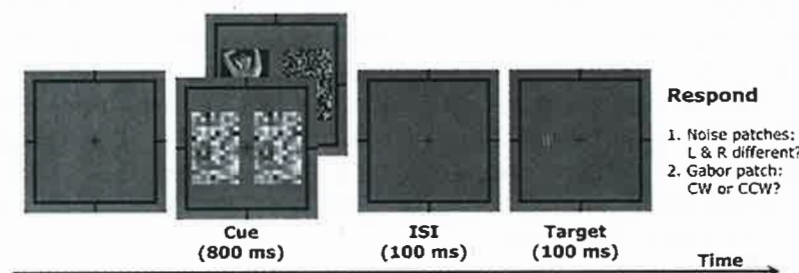


Figure 11.6 From Jiang et al. (2006). Reproduced with permission of *Proceedings of the National Academy of Sciences*.

the other is measured by a very brief presentation of a stripy noise patch that can be slightly tilted one way or the other, and the subjects have to say which. Attention is known to increase accuracy in this judgment so the direction of attention can be assessed by measuring the accuracy in the judgment of tilt.

Subjects are asked whether they saw any difference between the right and the left. If they report any difference, their data are excluded—on the assumption that some aspect of the nude must have leaked into consciousness since only the nude/texture provides any asymmetry in the stimuli. The conclusion of the experiment is that subjects' attention is attracted or repelled in a way that conforms to their gender preferences.

There have been some reports that high-level unconscious perception under CFS may involve low-level conscious perception, for example of a cloud of colour (Hong and Blake 2009; Zadbood, Lee, and Blake 2011; Mudrik et al. 2013; Gelbard-Sagiv et al. 2016). But the control in this study provides evidence that whatever low-level conscious perception there might be does not differentiate a nude from a nude texture, so the gender of the stimulus is perceived unconsciously.

Phillips says unconscious perception of low-level features associated with gender might explain the result. But even if that is right, the point of appeal to the high level is to justify the conclusion that the perception is by the individual rather than a reaction by a subsystem. And that is accomplished here by the relevance to personal-level gender preferences whether the perception is high or low.

Some of these effects are diagrammed in Figure 11.7 where the top graph shows bars of attraction (pointing up) and repulsion (down) for 10 heterosexual males (top) and 10 heterosexual females (bottom). Homosexual males resembled heterosexual females. As you can see, attention in heterosexual males was usually repelled by nude men, but heterosexual females and homosexual males tended to be positive or neutral about both nudes. The upshot is that whether high level or not, this is personal-level unconscious perception.

Phillips also says that the Jiang effect may not “implicate central agency” if it is due to “automatic” eye movements, as allegedly alleged by Prinz. I can't imagine how attraction or repulsion keyed to one's gender preferences could be automatic in any relevant sense of the term. Prinz claims that the unconsciously perceived nudes attract or repel eye movements rather than attention, but that is not to deny unconscious perception.

Contrary to Phillips, Burge and I both deny that involvement in central agency is a necessary condition of unconscious perception. The “paradigmatic” quoted by Phillips is a generic, not a universal (Burge 2010, 370). In any case the attraction and repulsion of attention is an individual-level matter and is not unrelated to agency.

In conclusion, though Phillips is right that the controls in the b-CFS studies were inadequate, the overall upshot of the studies described is that there is substantial evidence of unconscious perception.

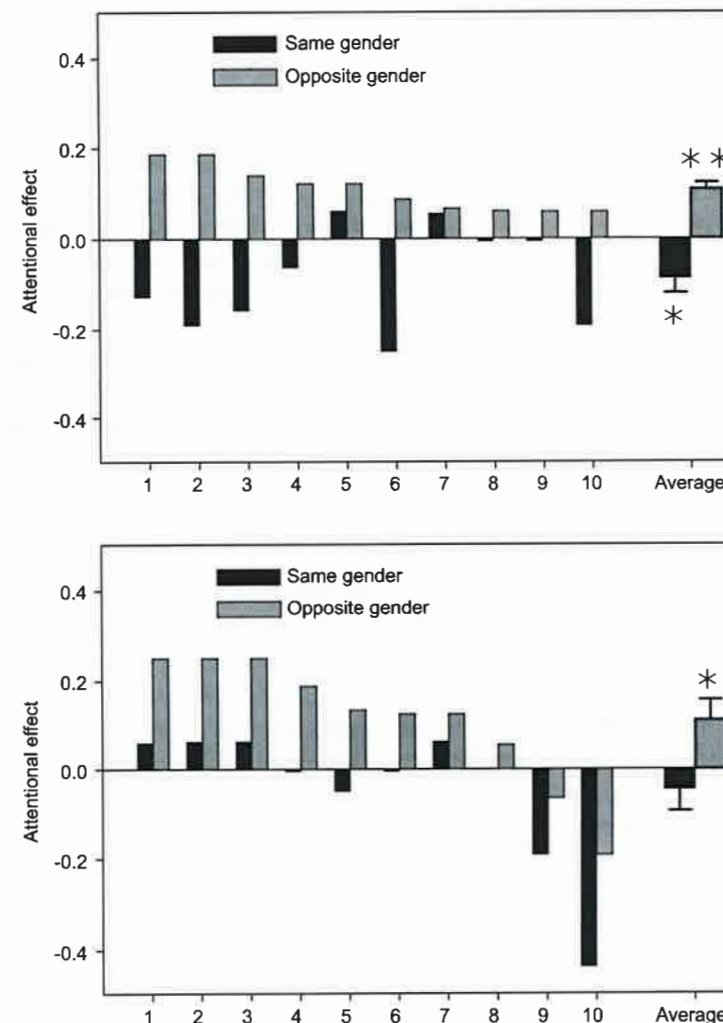


Figure 11.7 From Jiang et al. (2006). Reproduced with permission of *Proceedings of the National Academy of Sciences*.

Each pair of black and grey bars represents attraction and repulsion in one individual except the last pair of bars. This pair represents the averages.

Part 5: Phillips

I previously argued that CFS paradigms fail to demonstrate genuine unconscious perception by the individual. Here I reply to Block's objections before focusing on what I take to be our more fundamental disagreement.

In itself, the differential breakthrough of stimuli from CFS does not establish unconscious perception since it may simply reflect differing conscious

detection thresholds. Block accepts Stein et al.'s (2011) critique of extant control conditions designed to rule this out. Nonetheless, he suggests that such concerns probably do not apply to Mudrik et al. (2011). In support, Block quotes Stein et al. expressing scepticism that subjects would adopt differing response criteria in relation to Mudrik et al.'s stimuli. In my earlier reply, I did not mention response criteria partly for this reason and partly because Stein et al. provide evidence that the differential breakthrough of upright versus inverted faces in Jiang et al. (2007) also "cannot be ascribed simply to the influence of differential response criteria". Instead, they suggest that faster breakthrough results from "a lower detection threshold for upright faces"—crucially one not specific to CFS. Block objects to a differential detectability explanation regarding Mudrik et al.'s stimuli on the grounds that they were matched in respect of various low-level features. However, stimuli matched in the relevant ways may still differ in conscious detectability in a non-CFS specific manner. That is all the objection requires, and why Stein et al., whilst well aware of Mudrik et al.'s results, can reasonably claim that their criticisms are "relevant for and extend to all applications of the b-CFS paradigm" (2011: 4; cf. Stein and Sterzer 2014; and Gayet, Van Der Stigchel, and Paffen 2014). Certainly, Mudrik et al.'s findings may be due to unconscious perception of anomaly. Yet given what else we know about flash suppression, and can reasonably extrapolate from studies of binocular rivalry (e.g., Zimba and Blake 1983; see Breitmeyer 2014 for a review), our "default stance should . . . be not to expect much high-level unconscious processing during CFS" (Hesselmann and Moors 2015: 3).

Block contests my assessment of the relevant literature, finding in it "substantial evidence for high-level unconscious perception" under CFS. Block is right that Yang et al. (2010) only provide evidence that facial expression "is virtually abolished" (as the authors put it) or abolished "to a very large extent" (as I wrote). However, we should be cautious in relying on Yang et al. as positive evidence of weak high-level categorization outside of consciousness. To ensure unawareness, Yang et al. instructed subjects immediately to press a key if "they perceived anything other than the CFS display". This terminated the trial. If observers pressed the key on more than 15% of trials, they were excluded from analysis. Yang et al. report that 70% of observers completed the session and that these all "later confirmed that they had not perceived any faces during the CFS period upon questioning" (3–4). This methodology is doubly problematic. First, both key pressing and post-session questioning are subject to obvious response biases and so may easily underestimate true awareness. Second, the practice of post-hoc discarding trials/subjects who show awareness introduces a notorious statistical artifact which Newell and Shanks argue "renders the apparent evidence of unconscious processing almost meaningless" (2014: 50, commenting on Sklar et al. 2012; Carmel 2014 provides a clear exposition of the issue).

Concerns with ensuring unawareness aside, imaging data raise a further issue—namely, that differential cortical activation does not guarantee the presence of representations which can influence task performance (Williams, Dang, and Kanwisher 2007). Here, I suggest, we arrive at my more fundamental disagreement with Block. In my opening statement I cited Norman et al. (2014) as providing evidence of genuinely perceptual (constancy-involving) representation outside of consciousness. What I disputed was whether this constituted perception by the individual. Whether high-level feature representation occurs outside of consciousness is a separate issue. I thus agree with Block that whether Jiang et al.'s (2006) results reveal individual-level perception does not turn on whether the representations mediating their effect are high or low level. What matters is whether those representations are constancy-involving and individual-level. Here I press this second issue.

Let us grant that Jiang et al.'s results show unconscious attraction and repulsion of attention. Block's case that the mediating representations constitute perception by the individual "is accomplished . . . by [their] relevance to personal-level gender preferences". He adds: "I can't imagine how attraction or repulsion keyed to one's gender preferences could be automatic in any relevant sense of the term". However, personal-level gender preferences correlate closely with many reflexive, autonomic responses. For example, Rieger and Savin-Williams (2012) examine the differential pupillary responses elicited by gendered erotic stimuli. Such responses are naturally thought of as automatic. Furthermore, it is doubtful that we must think of the representations mediating them as individual-level. Perhaps Block's talk of responses being "keyed" to preferences requires the direct involvement of preferences in mediating responses from occasion to occasion. However, gender preference data cannot evidence responses "keyed" in this sense, since gender preferences cannot be manipulated on a trial by trial basis.

Block denies that "involvement in central agency" is a necessary condition of personal-level attribution. I did not propose such involvement as a necessary condition. My suggestion was only that when a representation is unavailable to central agency, we lack a positive ground for attribution. Nonetheless, Block and I agree that certain kinds of response may indicate personal-level attribution. However, Block claims that "attraction and repulsion of attention is an individual-level matter and is not unrelated to agency" (cf. Burge 2010: 372). On this we disagree. Where attentional responses are completely stimulus-driven reflexes, operating entirely outside of voluntary control (e.g., Schoeberl et al. 2015), and possibly mediated by subcortical pathways (e.g., Mulckhuyse and Theeuwes 2010), I am unpersuaded that we must think of them as exercises of individual-level agency. If they are not, we lack positive reason for thinking of the perceptual representations implicated by Jiang et al.'s data as constituting individual-level perception.

Part 6: Block

We agree that there are unconscious representations in CFS but disagree on whether they are personal or sub-personal. I have been arguing that they reflect personal-level values and understanding. Values: Phillips says attraction and repulsion in Jiang et al. (2006) may be involuntary stimulus-driven reflexes that are subcortically mediated. However, the only actual evidence he presents for this is that pupillary responses are affected by gendered erotic stimuli. He claims, "Such responses are naturally thought of as automatic". This is outdated. A recent review on this topic says: "The pupillary light response has long been considered an elementary reflex. However, evidence now shows that it integrates information from such complex phenomena as attention, contextual processing, and imagery" (Binda and Murray 2015, 1). This is a review, not an opinion by a fellow-traveler. Further, though exogenous spatial attention such as orienting to a loud noise is stimulus-driven and reflex-like, I know of no evidence for any reflex-like feature-based attention.

Moving from values to personal-level understanding—I quoted a review that concludes (p. 8): "In summary, neuroimaging studies investigating the processing of visual information during interocular suppression have shown repeatedly" *weak high level activations* (Sterzer et al. 2014). Thus, it is very likely that there is unconscious high-level representation.

I think whether unconscious representation constitutes unconscious perception turns on both content and role. On content: low-level properties like edge and texture register in early vision but are not normally part of personal-level cognition unlike our awareness of faces and emotions—hence the focus on high-level activation. On role: in the article just cited, Sterzer et al. note that although there have been many studies showing behavioral effects of CFS, no studies as yet have measured behavioral effects simultaneously with neuroimaging evidence of high-level perception. However, I know of no case of a high-level brain activation that does not have the potential to affect some kind of processing, if only on the temporal course of the processing (for example in priming).

Phillips appeals to a claim by Hesselmann and Moors (2015) based on work by Randolph Blake and Bruno Breitmeyer on binocular rivalry that the default should "be *not* to expect *much* high-level unconscious processing during CFS" (emphasis added). This appeal is doubly flawed. First, the strong evidence for high-level CFS activations I referred to earlier is evidence for *weak* activations—as are the pupillary effects. If the default is to expect not "much" activation, that actually supports my position.

Second, Phillips' claim depends on a dubious inference from binocular rivalry to CFS. He says, "Yet given what else we know about flash suppression, and can reasonably extrapolate from studies of binocular rivalry (e.g. Zimba and Blake 1983; see Breitmeyer 2014 for a review) . . .". However, Breitmeyer

(2015) argues that binocular rivalry blocks off processing at the earliest stages of vision, whereas CFS operates at a mid-level.

Even in the earlier (2014) Breitmeyer article, Breitmeyer places CFS above binocular rivalry in his hierarchy. If a stimulus (say a disk) is followed quickly by another stimulus (say a ring) which shares boundaries with the first stimulus (e.g., the disk sits just inside the ring), then conscious perception of the first stimulus can be reduced or eliminated. This "metaccontrast masking" is strongest with the stimulus in one eye and the mask in the other especially when the stimulus and mask are presented nearly simultaneously, suggesting a combination of binocular suppression and metaccontrast masking (Schiller and Smith 1968). CFS flickers at 10 hz suggesting that it also combines metaccontrast masking with binocular suppression and that combined effect puts it higher on the hierarchy.

A further item of evidence: Sklar et al. (2012) showed unconscious "semantic" priming in CFS. Sklar et al. presented three-digit subtraction problems to subjects under CFS (e.g., 9–3–4). Subjects then had to pronounce a single consciously presented digit that could be the result (e.g., 2). Results were faster than non-results. Subjects were asked to report the parity of the first digit in the subtraction problem, and those who got it right were excluded. And in a debriefing afterward, they excluded four subjects who said they had seen the primes.

Phillips says excluding subjects who report more than the lowest visibility introduces a "notorious statistical artefact" (Shanks and Berry 2012). I don't think the conditions for this artifact are met, but I don't have the space for a discussion. There are four good reasons for thinking the effect was unconscious. First, Sklar et al. used Anthony Greenwald's respected regression method that is designed to be used with a variety of visibilities (Greenwald, Klinger, and Schuh 1995). This method allows an extrapolation from higher visibilities to zero visibility. (See Kouider and Dehaene 2007, for further explanation.) Greenwald's method showed a significant unconscious effect. Second, performance on the objective test was negatively correlated with the unconscious effect, suggesting that the effect is unrelated to conscious perception. Third, as Ran Hassin and Asael Sklar have emphasized in correspondence, the effect size for conscious priming is the same or at most twice the size of an unconscious effect. So in order for the effect in this study to be due to conscious perception, more than half the subjects would have had to be conscious of the stimuli—even after the elimination of all who scored above chance on the objective task. Fourth, the priming worked for subtraction but not addition. If subjects were indeed conscious of the stimuli, they should have been just as conscious of the addition as subtraction stimuli. (They speculate as to what the difference in unconscious processing of addition and subtraction and devise a procedure that shows effects for addition.)

In sum, though there are plenty of loose ends in a rapidly moving field, there is a good case for personal-level unconscious representation.

Part 7: Phillips

I have been arguing that the existence of unconscious perception (construed as objective sensory representation by the individual) remains an open question. Where Block sees a few loose ends, I see unravelling tangled threads. Here I pull further on certain threads before offering some brief closing remarks.

Block argues that unconscious representations in CFS are individual-level since they reflect personal-level values and understanding. I cannot see how Jiang et al.'s data establish Block's values claim (nor related claims about role). Block grants that "exogenous spatial attention" may be "stimulus-driven and reflex-like" but denies that the "feature-based attention" involved in Jiang et al. could be. But what does "feature-based" mean here? In Jiang et al., attention is not directed to gender as a feature but by gendered erotic stimuli to a spatial location. It is well-attested that fearful emotional stimuli can differentially draw reflexive spatial attention (e.g., Phelps, Ling, and Carrasco 2006, experiment 2). And an increasing body of work, including Jiang et al., indicates that "biological relevance, and not exclusively fear, produces an automatic spatial orienting toward the location of a stimulus" (Brosch et al. 2008: 362).

Block draws attention to Breitmeyer (2015). What he does not draw attention to is that Breitmeyer there supports my suggestion that Jiang et al.'s effect may be subcortically mediated. Breitmeyer writes: "a suppressed erotically charged image presented in the left visual hemifield could, via retino-subcortical routes, activate the contralateral (right) pulvinar/amygdala, which, in turn, would activate their ipsilateral neocortex and thus bias attentive processing of stimuli in the left visual field" (243, fn. 6). Block is right that Breitmeyer does not think that CFS operates at the same level as binocular rivalry (BR). This does not mean that there is nothing that we can "reasonably extrapolate" from BR. After all, Breitmeyer holds that CFS partly relies on BR suppressive mechanisms. Moreover, whereas Block wishes to place CFS above metacontrast masking in the functional hierarchy, Breitmeyer places CFS "relatively low . . . in the functional hierarchy, somewhere *between* binocular-rivalry suppression and suppression by backward pattern or metacontrast masking" (2015: 243, fn. 7, my emphasis; cf. 2014: Fig. 5.4).

Breitmeyer justifies his (avowedly speculative and tentative) placement of CFS above BR by appeal to Sklar et al. (2012), which Block also focuses on. This striking study reports the priming of responses to targets (e.g., 2) by equations with those targets as answers (e.g., $9-3-4=$). My earlier complaint that perceptual priming cannot directly reveal individual-level representation applies here. But this point aside, does Sklar et al. provide good evidence of sophisticated unconscious processing under CFS? As mentioned, a major issue here is the statistical artefact potentially introduced by the post hoc exclusion of subjects who performed above chance on either objective or subjective measures of awareness. Block denies that the conditions for this artefact

are met (he does not say why), and finds it implausible that at least half of non-excluded subjects could have been conscious of the prime (something he suggests would be necessary to explain the relevant effect-size). I disagree. Sklar et al. excluded 60% of subjects. This suggests that the significant majority of their original group may have been conscious of the primes. This surely does raise serious concerns about truncation artefacts. It also appears consistent with half of the remaining subjects having some minimal awareness of the primes (cf. Hesselmann et al. 2015: §4.2).

Block offers three further reasons for thinking that Sklar et al.'s effect was unconscious. First, their use of Greenwald's respected regression method. However, Greenwald's method is highly controversial given the large assumptions it requires, and great care is needed in its application (Doshier 1998, Merikle and Reingold 1998). Lacking space for a full discussion, let me note one salient point from Doshier which connects to Block's second argument in favour of unconscious perception—namely, that performance on the objective task was negatively correlated with facilitation effects. This negative correlation indicates a non-linear relationship between direct and indirect measures. However, given such a relationship, facilitation may reduce to zero with or before the direct measure (indicating no unconscious perception), and yet the best-fitted linear regression misleadingly yield precisely the kind of non-zero intercept which Sklar et al. report as evidence of unconscious perception. At a minimum then, more sophisticated analysis is required for this method to be probative. Block finally argues that, in the relevant experiment, priming occurred for subtraction but not addition. But why think that this supports thinking of the effect as unconscious? Conscious or unconscious, the absence of an addition effect needs explaining. Sklar et al. suggest "that participants may have been less strategic in the [easier] addition equations", providing evidence for this in relation to conscious arithmetic (Experiment 8). Thus, a strategic explanation is demonstratively available in relation to conscious perception.

Where does this leave us? Throughout our exchange, Block has proposed various CFS studies as persuasive evidence for unconscious perception (e.g., Jiang et al. 2006; Mudrik et al. 2011; Sklar et al. 2012). However, as Block says, "everything depends on the details". And, upon scrutiny, the proffered interpretation of these—and structurally similar—studies unravels. Arguably, breaking flash suppression studies only reveal differences in conscious detectability; attentional paradigms only reveal sub-individual-level perceptual representation; and the widespread practice of truncating data leads to the artefactual appearance of unconscious perception where none exists. Such unravelling is not unique to CFS. As briefly discussed in my opening remarks, neither traditional perceptual priming studies nor clinical conditions such as blindsight and neglect convincingly establish unconscious perception (see further Phillips forthcoming; and Phillips in press). Furthermore, whilst it has been convenient here to adopt a broadly Burgean conception of perception,

that conception is hardly beyond dispute (e.g., Campbell 2011). And obviously answers to questions about unconscious perception turn crucially on our conception of perception. The upshot is that for all the resurgent field's excitement about new techniques and findings, the current consensus in favour of unconscious perception remains significantly grounded in faith as opposed to fact.

Part 8: Block

Anna Karenina

I endorse the "Anna Karenina" view of unconscious perception (Block 2011) according to which all conscious perceptions are alike, but each unconscious perception is unconscious in its own way. Successful conscious perception is a dance of oscillating feed-forward-and-back loops. Unsurprisingly, there are many substantially different methods of producing unconscious perception that interfere with the dance in different ways. Breitmeyer (2015) describes 24 substantially different ways in which unconscious visual processing can be produced, of which we have here discussed only a few.

Given this variety of mechanisms, it is not surprising that Phillips' criticisms of experimental paradigms have no real unity (other than the allegation of not-perception or not-unconscious). Here is a list of some of the experimental paradigms he discusses with a shorthand description of his criticisms:

- Blindsight: failure of constancies and decision-theoretic criterion issues.
- Unconscious colour registration: representations are not available to central agency.
- Breaking CFS (continuous flash suppression): control trials did not rule out CFS-specific effects, Breitmeyer hierarchy suggests high-level effects should not occur, post-hoc discarding of aware trials illegitimate, cortical activations may be epiphenomenal.
- Gender-CFS: low-level confounds, reflexes.

Personal Level

Here are some areas of agreement between Phillips and me. First, we agree that there are unconscious representations that are involved in perception. (I say those representations often constitute perception, and he says not.) Second we agree that there are unconscious representations in perception that are objective. Phillips notes he "cited Norman et al. 2014 as providing evidence of genuinely perceptual (constancy-involving) representation outside of consciousness". Phillips first complains that these colour representations are nonetheless sub-personal because they "are not available to central coordinating agency". Burge and I think central availability is not necessary for

unconscious perception, and Phillips agrees, saying that the real point is that without such central availability we have no positive reason for ascribing the personal level. But when a sensory registration reflects personal-level *understanding* (Mudrik et al. 2011) or *values* (Jiang et al. 2006), that is a reason to think it is a personal-level perception.

Value

Phillips objects to Jiang et al. (2006) by alleging that it can be explained by unconscious perception of low-level features associated with gender. However, the connection to personal-level gender preferences is what is at issue, not high versus low level. Phillips also claims that the Jiang effect might be reflexive and subcortical, appealing to supposed reflexive effects of gender on pupil size. But as I noted, pupillary effects often reflect high-level processes. He also references Prinz's view that the result is due to attraction of eye movements. But Prinz (2012) argues that unconscious recognition of the stimulus is what attracts the eye movement (p. 116).

One caution about Jiang et al. (2006): this result is the only one I know of in which personal-level preferences are so strongly revealed in unconscious perception.

Understanding

I highlighted CFS as a method of producing unconscious perception because the episodes of unconscious perception last seconds (or even minutes) instead of milliseconds, and it can be experienced firsthand by anyone with a computer and a 10-cent pair of red/green glasses. When I started, I was ignorant of two issues concerning CFS, though I don't see either of them as problems for the studies I cited (and neither apply to the Jiang et al. [2006] study just mentioned). One of the problems—the one emphasized by Phillips—seems to me a red herring. Many of the CFS experiments compared effects under CFS with comparable tasks without CFS to show there were no "CFS-specific" effects. This way of conceiving of the controls is a mistake. All should agree that unconscious processing underlies all conscious perception—though Phillips and I disagree about whether those underlying unconscious processes themselves constitute perception. So it would not be surprising if—without CFS—subjects recognize shaving with a fork faster than shaving with a razor. The real point of the controls should be to rule out low-level confounds and decision effects. On low-level confounds: Mudrik et al. use two batteries of measures to equate for low-level features. This gives their study evidential weight. A second problem with CFS is that as I mentioned there are brief periods of partial awareness—of low-level properties such as colour (Mudrik et al. 2013). However, since anomaly is not such a low-level property, this is not a substantial problem. Note that rationale given for the controls is to avoid CFS-specific effects on behavior. However, if we move from a behavioral

experiment to brain imaging, there is no need for such controls. I quoted Sterzer et al. (2014) on unconscious representation in CFS:

In summary, neuroimaging studies investigating the processing of visual information during interocular suppression have shown repeatedly that object- or category-specific neural activity in high-level visual areas of the ventral stream is strongly reduced, but can be retrieved when sufficiently sensitive methods of data analysis are used, such as multi-voxel pattern analysis of fMRI data.

Note that this comes from a review by the team that Phillips relies on and does not use the methodology that he objects to. These studies don't test behavioral effects of these activations in the same experiments, but any neural activation can affect the temporal course of responding ("priming") in an appropriately chosen task. Philosophers may be thinking of the colour of wires in a computer that do not affect its operation, but this kind of causal isolation does not happen in the brain.

In sum, there is strong evidence that unconscious sensory registration often reflects person-level values and understanding.

I turn now to a different paradigm.

Sandwich-Masking

In Draine and Greenwald (1998), subjects were presented with a "sandwich-masked prime", in this case, a word is preceded and succeeded by "masks", noisy stimuli known to make the sandwiched item harder to see. Immediately after that they were given a speeded task: classify a word presented without masks—the "target"—as pleasant or unpleasant. Immediately after that they had to decide whether the prime was a word or a series of Xs and Gs. (This tests how visible the prime was.) Both the primes and the targets were chosen from negative words like "vomit", "kill", and "bomb", and positive words like "honor", "happy" and "kiss". The result was that if the prime and target were in the *same evaluative category*, subjects were faster in classifying the target and made fewer errors. Values for unconscious perception were obtained by Greenwald's regression technique (mentioned in my last segment) in which responses under various levels of visibility are extrapolated back to zero visibility. The classifications of the primes and targets in this study engage both personal-level values and cognition.

The experiment just described was criticized by many, including the authors, because the same words were repeated as primes and targets, and it was found that even single consonants from the repeated words worked as primes—suggesting that the result was due to associations and that unconscious understanding of the evaluative was not required. Using accumulated wisdom of many years of inquiry using this sandwich-masked priming

technique, Klauer et al. (2007) give a new and convincing version of the experiment showing unconscious priming of *novel* evaluative and gender-related stimuli similar to the ones just described. The degree of priming was the same regardless of visibility of the prime, strongly suggesting that the effect does not depend on conscious perception. And they got the same results even when the visible targets were smiley and grumpy faces and the primes were the evaluative words, again suggesting that unconscious evaluative categorization was involved.

A similar congruency priming experiment was used with stimuli like the anomalous pictures illustrated earlier—for example, a person drinking from a football rather than from a bottle (Mudrik and Koch 2013). The primes were low in contrast, presented briefly (33 ms) and sandwich-masked. (In the Mudrik 2011 CFS experiment described earlier, similar pictures were presented at full contrast for 2.5 seconds.) Subjects were shown a sandwich-masked prime that could be anomalous or not, then a consciously presented target that could also be anomalous or not. Subjects had to press a button indicating whether the target was "weird", then rate the prime visibility, then whether the prime was "weird", being instructed to guess if they did not know. Results were reported only for subjects whose rating was "saw nothing". (I don't have the space to explain why this procedure is legitimate.) The result was that subjects were slower to judge that a consciously presented picture was congruent (i.e., not "weird") if it was preceded by an incongruent prime than if it was preceded by a congruent prime. The authors suggest that the unconscious processing of an incongruent prime may have attracted attention, depriving the subsequent task of attention. Again we have unconscious sensory registration that engages personal-level cognition.

In conclusion, there are many experimental paradigms that support personal-level unconscious visual perception. Criticisms form an ad hoc list.

References

- Alexander, I., & Cowey, A. (2010). Edges, colour and awareness in blindsight. *Consciousness and Cognition*, 19, 520–533.
- Amihai, I., Deouell, L., & Bentin, S. (2011). Conscious awareness is necessary for processing race and gender information from faces. *Consciousness & Cognition*, 20, 269–279.
- Axelrod, V., & Rees, G. (2014). Conscious awareness is required for holistic face processing. *Consciousness & Cognition*, 27, 233–245.
- Azzopardi, P., & Cowey, A. (2001). Why is blindsight blind? In B. De Gelder, E. De Haan, & C. Heywood (Eds.), *Out of Mind: Varieties of Unconscious Processes*, 3–19. Oxford: Oxford University Press.
- Azzopardi, P., & Hock, H. (2011). Illusory motion perception in blindsight. *Proceedings of the National Academy of Sciences of the United States of America*, 108, 876–881.
- Binda, P., & Murray, S. (2015). Keeping a large-pupilled eye on high-level visual processing. *Trends in Cognitive Sciences*, 19(1), 1–3.
- Block, N. (2010). Attention and mental paint. *Philosophical Issues: A Supplement to Nous*, 20, 23–63.

- Block, N. (2011). The Anna Karenina theory of the unconscious. *Neuropsychanalysis*, 13(1), 34–37.
- Block, N. (2012). The grain of vision and the grain of attention. *Thought*, 1(3), 170–184.
- Block, N. (2014). Seeing-as in the light of vision science. *Philosophy and Phenomenological Research*, 89(3), 560–573.
- Breitmeyer, B. (2014). Functional hierarchy of unconscious object processing. In B. Breitmeyer (Ed.), *The Visual (un)Conscious and Its (dis)Contents*, 89–102. Oxford: Oxford University Press.
- Breitmeyer, B. (2015). Psychophysical “blinding” methods reveal a functional hierarchy of unconscious visual processing. *Consciousness and Cognition*. doi: <http://dx.doi.org/10.1016/j.concog.2015.01.012>
- Brewer, B. (2011). *Perception and Its Objects*. Oxford: Oxford University Press.
- Brosch, T., Sander, D., Pourtois, G., & Scherer, K. (2008). Beyond fear rapid spatial orienting toward positive emotional stimuli. *Psychological Science*, 19(4), 362–370.
- Burge, T. (2010). *Origins of Objectivity*. Oxford: Oxford University Press.
- Campbell, J. (2009). Consciousness and reference. In B. McLaughlin & A. Beckermann (Eds.), *The Oxford Handbook of Philosophy of Mind*, 648–662. Oxford: Oxford University Press.
- Campbell, J. (2011). Tyler Burge: Origins of objectivity. *The Journal of Philosophy*, 108(5), 269–285.
- Carmel, D. (2014). *Some things we need to think about when investigating unconscious perception*. Paper presented at the ASSC18. <https://www.youtube.com/watch?v=UoCZ-pg10mo>
- Cowey, A. (2010). The blindsight saga. *Experimental Brain Research*, 200, 3–23.
- Doshier, B. (1998). The response-window regression method—Some problematic assumptions: Comment on Draine and Greenwald (1998). *Journal of Experimental Psychology: General*, 127(3), 311–317.
- Draine, S. C., & Greenwald, A. G. (1998). Replicable unconscious semantic priming. *Journal of Experimental Psychology: General*, 127(3), 286–303.
- Dulany, D. (2001). Inattentional awareness. *Psyche: An Interdisciplinary Journal of Research on Consciousness*, 7(5). <http://www.theassc.org/files/assc/2499.pdf>.
- Eilan, N. (2015). Perceptual objectivity and consciousness: A relational response to Burge’s challenge. *Topoi*, 1–12. doi: 10.1007/s11245-015-9325-4
- Eriksen, C. (1960). Discrimination and learning without awareness: A methodological survey and evaluation. *Psychological Review*, 67, 279–300.
- Gayet, S., Van Der Stigchel, S., & Paffen, C. L. (2014). Breaking continuous flash suppression: Competing for consciousness on the pre-semantic battlefield. *Frontiers in Psychology*, 5, 460.
- Gelbard-Sagiv, H., Faivre, N., Mudrik, L., & Koch, C. (2016). Low-level awareness accompanies “unconscious” high-level processing during continuous flash suppression. *Journal of Vision*, 16(1:3), 1–16.
- Green, D. M., & Swets, J. A. (1966). *Signal Detection Theory and Psychophysics*. Oxford: John Wiley.
- Greenwald, A., Klinger, M., & Schuh, E. (1995). Activation by marginally perceptible (“subliminal”) stimuli: Dissociation of unconscious from conscious cognition. *Journal of Experimental Psychology: General*, 124, 22–42.
- Hesselmann, G., Darcy, N., Sterzer, P., & Knops, A. (2015). Exploring the boundary conditions of unconscious numerical priming effects with continuous flash suppression. *Consciousness & Cognition*, 31, 60–72.
- Hesselmann, G., & Moors, P. (2015). Definitely maybe: Can unconscious processes perform the same functions as conscious processes? *Frontiers in Psychology*, 6(584), 1–5.
- Holender, D. (1986). Semantic activation without conscious identification in dichotic listening, parafoveal vision, and visual masking: A survey and appraisal. *Behavioral and Brain Sciences*, 9, 1–66.
- Hong, S., & Blake, R. (2009). Interocular suppression differentially affects achromatic and chromatic mechanisms. *Attention, Perception & Psychophysics*, 71(2), 403–411.
- Jiang, Y., Costello, P., & He, S. (2007). Processing of invisible stimuli: Advantage of upright faces and recognizable words in overcoming interocular suppression. *Psychological Science*, 18, 349–355.
- Jiang, Y. V., Costello, P., Fang, F., Huang, M., & He, S. (2006). A gender- and sexual orientation-dependent spatial attentional effect of invisible images. *Proceedings of the National Academy of Sciences*, 103(45), 17048–17052.
- Kentridge, R., Heywood, C., & Weiskrantz, L. (2007). Colour-contrast processing in human striate cortex. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 15129–15139.
- Klauser, K., Eder, A., Greenwald, A., & Abrams, R. (2007). Priming of semantic classifications by novel subliminal prime words. *Consciousness and Cognition*, 16, 63–83.
- Kouider, S., & Dehaene, S. (2007). Levels of processing during non-conscious perception: A critical review of visual masking. *Philosophical Transactions of the Royal Society B*, 362, 857–875.
- Luck, S., Vogel, E., & Shapiro, K. (1996). Word meanings can be accessed but not reported during the attentional blink. *Nature Scientific Reports*, 383, 616–618.
- Mack, A., & Rock, I. (1998). *Inattentional Blindness*. Cambridge, MA: MIT Press.
- Martin, M. G. F. (2006). On being alienated. In T. Gendler & J. Hawthorne (Eds.), *Perceptual Experience*, 354–410. Oxford: Oxford University Press.
- Merikle, P., & Reingold, E. (1998). On demonstrating unconscious perception: Comment on Draine and Greenwald (1998). *Journal of Experimental Psychology: General*, 127(3), 304–310.
- Moore, G. E. (1925). A defence of common-sense. In J. Muirhead (Ed.), *Contemporary British Philosophy (2nd series)*, 193–223. London: Allen and Unwin. (Reprinted from: Philosophical Papers).
- Mudrik, L., Breska, A., Lamy, D., & Deouell, L. (2011). Integration without awareness: Expanding the limits of unconscious processing. *Psychological Science*, 22(6), 764–770.
- Mudrik, L., Gelbard-Sagiv, H., Faivre, N., & Koch, C. (2013). *Knowing where without knowing what: Partial awareness and high level processing in continuous flash suppression*. Paper presented at the Vision Science Society conference, Naples, Florida.
- Mudrik, L., & Koch, C. (2013). Differential processing of invisible congruent and incongruent scenes: A case for unconscious integration. *Journal of Vision*, 13(13), 1–14.
- Mulckhuysen, M., & Theeuwes, J. (2010). Unconscious attentional orienting to exogenous cues: A review of the literature. *Acta Psychologica*, 134, 299–309.
- Newell, B., & Shanks, D. (2014). Unconscious influences on decision making: A critical review. *Behavioral and Brain Sciences*, 37(1), 1–19.
- Norman, L., Akins, K., Heywood, C., & Kentridge, R. (2014). Color constancy for an unseen surface. *Current Biology*, 24(23), 2822–2826.
- Phelps, E., Ling, S., & Carrasco, M. (2006). Emotion facilitates perception and potentiates the perceptual benefits of attention. *Psychological Science*, 17(4), 292–299.
- Phillips, I. (in press). Consciousness and criterion: On Block’s case for unconscious seeing. *Philosophy and Phenomenological Research*.
- Phillips, I. (forthcoming). Unconscious perception reconsidered.
- Prinz, J. (2010). When is perception conscious? In B. Nanay (Ed.), *Perceiving the World*, 310–332. Oxford: Oxford University Press.
- Prinz, J. (2015). Unconscious perception. In M. Matthen (Ed.), *Oxford Handbook of Philosophy of Perception*, 371–389. Oxford: Oxford University Press.
- Prinz, J. J. (2012). *The Conscious Brain*. New York: Oxford University Press.
- Raio, C., Carmel, D., Carrasco, M., & Phelps, E. A. (2012). Nonconscious fear is quickly acquired but swiftly forgotten. *Current Biology*, 22(12), 477–479.
- Rieger, G., & Savin-Williams, R. (2012). The eyes have it: Sex and sexual orientation differences in pupil dilation patterns. *PLoS One*, 7(8), 1–10.
- Schiller, P., & Smith, M. (1968). Monoptic and dichoptic metacontrast. *Perception & Psychophysics*, 3, 237–239.
- Schmidt, T. (2007). Measuring unconscious cognition: Beyond the zero-awareness criterion. *Advances in Cognitive Psychology*, 31(1–2), 275–287.
- Schoeberl, T., Fuchs, I., Theeuwes, J., & Ansorge, U. (2015). Stimulus-driven attentional capture by subliminal onset cues. *Attention, Perception & Psychophysics*, 77(3), 737–748.

- Shanks, D., & Berry, C. (2012). Are there multiple memory systems? Tests of models of implicit and explicit memory. *The Quarterly Journal of Experimental Psychology*, 65(8), 1449–1474.
- Sklar, A., Levy, N., Goldstein, A., Mandel, R., Maril, A., & Hassin, R. (2012). Reading and doing arithmetic nonconsciously. *Proceedings of the National Academy of Sciences*, 109, 19614–19619.
- Stein, T., Hebart, M., & Sterzer, P. (2011). Breaking continuous flash suppression: A new measure of unconscious processing during interocular suppression? *Frontiers in Human Neuroscience*, 5(167), 1–17.
- Stein, T., & Sterzer, P. (2011). High-level face shape adaptation depends on visual awareness: Evidence from continuous flash suppression. *Journal of Vision*, 11(8), 1–14.
- Stein, T., & Sterzer, P. (2014). Unconscious processing under interocular suppression: Getting the right measure. *Frontiers in Psychology*, 5(387), 1–5.
- Stein, T., Thoma, V., & Sterzer, P. (2015). Priming of object detection under continuous flash suppression depends on attention but not on part-whole configuration. *Journal of Vision*, 15(3), 1–11.
- Sterzer, P., Stein, T., Ludwig, K., Rothkirch, M., & Hesselman, G. (2014). Neural processing of visual information under interocular suppression: A critical review. *Frontiers in Psychology*, 5(453), 1–12.
- Tong, F., Nakayama, K., Vaughan, J. T., & Kanwisher, N. (1998). Binocular rivalry and visual awareness in human extrastriate cortex. *Neuron*, 21(4), 753–759.
- Travis, C. (2004). The silence of the senses. *Mind*, 113(449), 57–94.
- Weiskrantz, L. (1986/2009). *Blindsight: A Case Study Spanning 35 Years and New Developments*. Oxford: Oxford University Press.
- Weiskrantz, L. (2002). Prime-sight and blindsight. *Consciousness & Cognition*, 11(4), 568–581.
- Wiggins, D. (2001). *Sameness and Substance Renewed*. Oxford: Oxford University Press.
- Williams, M., Dang, S., & Kanwisher, N. (2007). Only some spatial patterns of fMRI response are read out in task performance. *Nature Neuroscience*, 10, 685–686.
- Yang, E., Brascamp, J., Kang, M.-S., & Blake, R. (2014). On the use of continuous flash suppression for the study of visual processing outside of awareness. *Frontiers in Psychology*, 5(724), 1–17.
- Yang, E., Hong, S., & Blake, R. (2010). Adaptation aftereffects to facial expressions suppressed from visual awareness. *Journal of Vision*, 10(12), 1–13.
- Yang, E., Zald, D., & Blake, R. (2007). Fearful expressions gain preferential access to awareness during continuous flash suppression. *Emotion*, 7, 882–886.
- Zadbood, A., Lee, S., & Blake, R. (2011). Stimulus fractionated by interocular suppression. *Frontiers in Human Neuroscience*, 5(135), 1–9.
- Zimba, L., & Blake, R. (1983). Binocular rivalry and semantic processing: Out of sight, out of mind. *Journal of Experimental Psychology: Human Perception and Performance*, 9, 807–815.