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Adaptation, Signal Detection and the Purposes of Perception: Reply to Ian Phillips and Chaz Firestone

Ian Phillips and Chaz Firestone have written a wonderful article on the rationale for adaptation as an indicator of perception and more generally on the purpose of perception, full of insights and challenges.

Adaptation

The issue they raise that I find the most interesting and challenging and where I didn't say enough in the book is whether there is any independent justification for adaptation as an indicator of perception or whether my reliance on phenomenology (and also retinotopy) to ground adaptation makes adaptation superfluous.

I will approach the issue by reminding the reader of my three-layer methodology as explained in Chapter 1.

Here are the three layers: (1) Use armchair criteria of perception and of cognition to roughly delineate the categories of perception and cognition. (2) Use the armchair categories to isolate scientific indicators. In particular, I chose perceptual adaptation, rivalry, pop-out, illusory contours and speed of processing but as I indicated, I could have picked many other indicators. (3) Use the scientific indicators to isolate the underlying constitutive features of perception and of cognition.

As I also explain, the use of a variety of scientific indicators raises a problem of circularity. The problem is that the justification of any given indicator depends on invocations of other indicators. I argued that the circularity is benign so long as the indicators converge on the same results and those results match up better with the armchair criteria than would have resulted with other indicators.

My case for benign circularity is threatened by the issue raised by Phillips and Firestone of whether some of the indicators play no real role at all. In particular, do I validate adaptation by appeal to retinotopy and phenomenology where retinotopy and phenomenology just stand on their own? If so, they argue, adaptation has no independent significance as an indicator.

I'll start with a case that fits their criticism in which an indicator has no independent significance: In binocular rivalry, a type of eye movement called optokinetic nystagmus is used as an indicator of which stimulus the subject is consciously aware of. Of course the eye movements' role as indicators is validated by the subject's phenomenological judgments but the eye movements are nonetheless incredibly useful in circumstances in which we do not want the subject to make such judgments, because these judgments would register on brain scans and make it more difficult to isolate the neural basis of the experience itself. (This methodology is known as the "no report" paradigm.) The general point is that we can have an extremely useful non-phenomenological indicator that is entirely based in phenomenology. Still, optokinetic nystagmus has no

independent significance as an indicator. Is adaptation in the same boat as optokinetic nystagmus? I will explain why adaptation is different.

To approach this issue, we need to distinguish high-level and low-level perceptual phenomenology. Recall that low-level perception is the immediate product of sensory transduction and is the causal basis of high-level perception, i.e. perception that is not the immediate product of sensory transduction but rather depends on further processing. Notable low-level perceptual representations represent shape, size, texture, hue, motion, depth, contrast and brightness. High level perceptions mentioned in the book are perceptions of faces, emotional expressions, causation and numerosity.
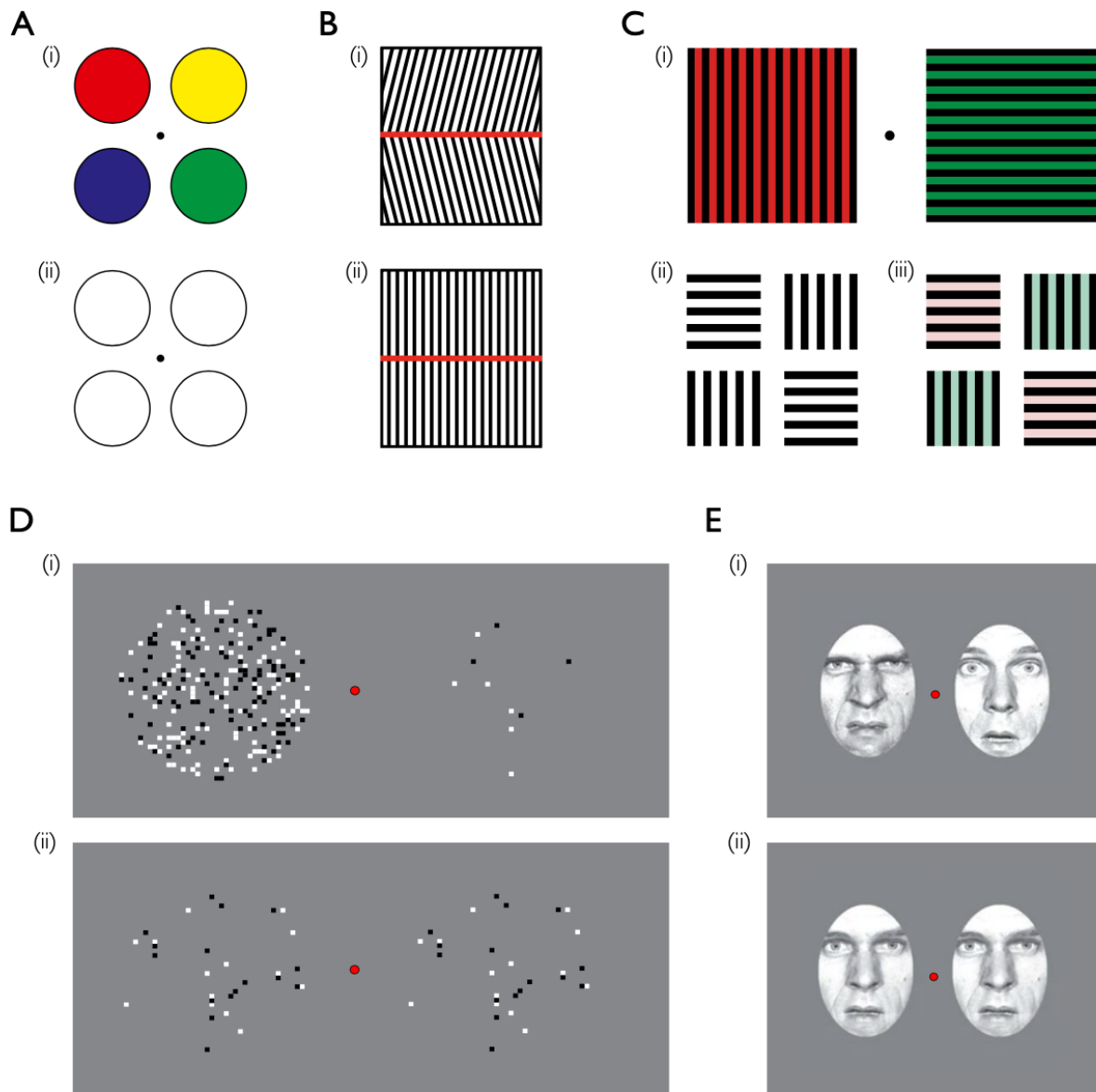

Figure 1 from Phillips and Firestone

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Look at Figure 1 in Phillips' and Firestone's article (reproduced here for convenience), specifically at the top halves of parts A, B and C. In A(i), it is perfectly clear from the first person that one is perceiving colors, with hues of red, yellow, blue and green. In B(i), one perceives slightly clockwise tilts on the top and slightly counterclockwise tilts on the bottom. And in C(i), one perceives red and black vertical stripes and green and black horizontal stripes. We can be sure that we visually attribute these qualities from the phenomenology itself. If one stares at the (i) parts of these figures and then at the (ii) parts, one experiences the adaptation phenomena in which the perceptual attributions change, but the change in perceptual attributions carries no force that is not already carried by the phenomenology of the pre-adaptation perception. So far, adaptation is playing no real role, just as Phillips and Firestone suggest.

Although the phenomenology of perception is sufficiently recognizable to tell us that we are perceiving, it isn't much use in distinguishing low-level from high-level perception or either one from the non-ampliative perceptual judgment that is most directly based on perception. (This is minimal, immediate, direct perceptual judgment; see the critique by Steven Gross in this issue for more discussion of this kind of perceptual judgment. When I say 'perceptual judgment' in what follows I mean minimal immediate direct perceptual judgment.)

Something can look expensive or look like a piano or a pine tree (examples I use in the book). But one cannot tell from the phenomenology whether when something looks expensive, that stems from perceptually representing it *as expensive* -- or whether what one is experiencing is the phenomenology of the color, shape, texture and other low-level properties together with the perceptual judgment that it is expensive (or is a piano or a pine tree). (This issue is also discussed in (Begby, 2011; Block, 2014; Siegel & Byrne, 2016)). That is, introspection is useless in deciding between (1) high-level perception and (2) low-level perception without high level perception but with high-level perceptual judgment. Of course, there will be high level perceptual judgement in both (1) and (2) but in (2) the high level perceptual judgment is based on low-level perception.

Without appealing to adaptation, we can't use introspection to distinguish high-level phenomenology from low-level phenomenology and we can't use introspection to distinguish either one from perceptual judgment.

So how exactly does adaptation help with the problem? Look at the adaptation stimuli in Figure 1D. After staring at a fixation point in the top image for 30-60 seconds, and then looking at the releaser stimulus in the bottom part of the image, what you experience is that the left cloud of dots on the bottom briefly looks to have fewer dots than the right cloud of dots. Then after a fraction of a second, they look to have the same number of dots. The explanation is that we have spatiotopic visual channels for high numerosity and low numerosity. Focusing at the top of D decreases the sensitivity for high numerosity on the left and decreases the sensitivity for low numerosity on the right, yielding the repulsive effect when looking at the bottom of D. As I mentioned, students in my classes who view these stimuli often suppose that I have surreptitiously changed the stimulus.

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The phenomenology changes as a result of adaptation even though the stimulus stays the same. But why is this change in phenomenology any more significant than the static phenomenology prior to the change?

We can rule out the most significant low-level explanation of the change due to adaptation: it is clear from introspection that dots do not seem to appear or disappear despite the changes in apparent numerosity. After staring at the top part of D and then looking at the bottom part, it just looks from the get-go that there are more dots on the right and fewer on the left. And then it seems the numerosities are equal on the two sides, without any appearance or disappearance of dots. (See for yourself!) The one potential low-level confound is whether the operative change might be in texture density rather than numerosity. This is an empirical issue that has been explored with great ingenuity by creating stimuli in which texture density and numerosity are separated in various ways. One particularly impressive experiment, summarized in (Block, 2019), added lines connecting dots, increasing the texture density while decreasing the apparent numerosity. The adaptation effects depended on the numerosity, not the density.

The phenomenology of adaptation is part of the package of evidence that shows that numerosity perception is at least in part a high-level perceptual phenomenon. But the fact that it is the phenomenology of adaptation that I am appealing to does not show adaptation is playing no real role since static phenomenonology—without adaptation— would not suffice for establishing the result.

A top-down source of the change in perceptual judgment is very unlikely since one has no tendency to *believe* that the paper stimulus actually changes. So the change in perceptual judgment is plausibly due to the change in high-level perception. And that suggests that we don't have to appeal to any supposed phenomenology of high-level perceptual judgment to explain the effect. And the reasoning just discussed depends essentially on adaptation, so adaptation is playing a real role.

In sum, in distinguishing low from high level perception and distinguishing both from perceptual judgment, adaptation plays a real role.

I haven't said anything yet though about whether adaptation plays an independent role in ruling out "criterion" effects. Decision criteria influence how much perceptual information the subject needs to respond in a certain way. Consider a "detection" task in which the subject is supposed to press one button if there is a stimulus and another if there is no stimulus. If there are very many no-stimulus trials, subjects will tend towards a "conservative" criterion in which they must be quite sure there is a stimulus to push the yes button. And if you reward the subject for detecting the stimulus without penalizing them for "false alarms" (incorrect yes button presses), the subjects will respond by liberalizing detection, pressing the yes button without being very sure there is a stimulus.

Can a "criterion" effect explain away the evidence for numerosity perception? No, because the changes in phenomenology of first seeing the bottom part of D as having more dots on the right and then equal numbers on both sides is clearly a change in perceptual phenomenology and not at all like the phenomenology of a changing

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criterion of the sort described in the last paragraph. Note that although the appeal here is to phenomenology, it is the phenomenology of adaptation, so adaptation is playing a real role.

Retinotopy and Spatiotopy

Moving to retinotopy and spatiotopy: Retinotopic effects depend on where light falls on the retina and they typically move with the eye. Spatiotopic effects preserve retinal neighborhood relations but do not move with the eye. The adaptation effects in D and E are spatiotopic because they depend on whether the adaptor and the releaser are on the left or right side of space. The left cloud of dots in D(ii) look to be fewer than they are after the adaptation because the left cloud of dots in D(i) were numerous.

So why do we need adaptation at all in reasoning about numerosity perception given that we know which dots are on which side of space and which dots fall on which parts of the retina? The answer is that these facts tell us nothing about numerosity perception, whether there is numerosity perception at all or alternatively vision just attributes low level properties and we make judgments about numerosity. The reasoning I went through a few paragraphs ago that that distinguishes low-level from high-level perception and both from perceptual judgment all depended on adaptation.

Signal Detection Theory

I will now move to a disagreement between me and Phillips and Firestone on the proper role of signal detection theory. Signal detection theory is pervasive in their reply though it is only discussed explicitly near the end. Their discussion makes heavy use of the signal detection theory notion of a "criterion".   I'll start with the issue they raise at the end of their article since it reflects in a simple straightforward manner why I think the signal detection theory framework is problematic in application to the issues of my book. The issue is my thesis that perception is a winner-takes-all faculty. I argue that there is always a dominant perception and that a likely explanation is that the purpose of perception encourage the design of a perceptual system that does not wallow in ambiguity.

As I note in Chapter 4, the dominant percept can take a number of forms. In one, the rival percepts merge and in another the rival percepts compete.   In binocular rivalry, there is an interplay of local and global features in determining winners. Two faces— one projected to each eye-- can be sufficiently "compatible" in a sense described in Chapter 4 for representations of face stimuli to merge when the subject is attending holistically to the face but to compete when the subject is attending to local features. In particular, a masculine and feminine face (one projected to each eye, as shown in Chapter 4), result in a percept as of an androgynous face when the subject attends to the face as a whole. But when the subject attends to parts, the two faces alternate. See Figure 2, reproduced from Chapter 4

As Phillips and Firestone note, it is not easy to see how a winner-takes-all nature of perception is compatible with a signal detection framework in which there is a continuous balance between distributions representing different percepts. This shows an inadequacy in signal detection theory: it concerns the information content of perception, not the percept itself. Let me explain.

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As Phillips and Firestone note, in a stimulus situation in which stimuli are degraded, there is substantial information in subjects' second and even third "guesses". But the second and subsequent choices reflect the information in a non-dominant percept that is not present—or perhaps not clearly present--to the person.

It is true that the information reflected in the second and subsequent choices are represented in the visual system. When a subject has a percept as of an androgenous (merged) face, the information from the masculine and feminine faces are present in an implicit form. When the subject attends to the parts of the face, and when the feminine face is dominant, there is no hint of the masculine face at the personal level (although there can be patchy versions of both that briefly appear in the transition). The dominant face is the only one present in the person level percept although the information about the suppressed face is still represented in the perceptual system. Signal detection theory concerns the information represented in the visual system but without emendation it does not concern the percept itself. It is a defect in signal detection theory that it has no notion of what is present at the personal level and this failure stems from the lack of thresholds in signal detection frameworks.

Matthias Michel and Hakwan Lau suggest, following (Michel & Lau, 2021; Witt, Taylor, Sugovic, & Wixted, 2015), a modification of signal detection theory in which thresholds are introduced as "perceptual criteria" as distinct from the report or decision criteria usually understood as part of signal detection theory. Decision criteria influence how much perceptual information the subject needs to respond in a certain way. For example, if in a detection task, you reward the subject for correct no-stimulus judgments without penalizing them for incorrect no-stimulus judgments, the effect will be to shift the subject temporarily towards a "conservative" bias in deciding on and reporting a stimulus, i.e. the subject will only say the stimulus was there when they are pretty sure it was.

The idea of a perceptual criterion is that signals whose strength is less than the perceptual criterion are unconsciously perceived.[1] Second choice accuracy can be accounted for by such a model. A low threshold model in which the noise distribution is sometimes over threshold would also explain confident false alarms, since confidence judgments could be based in part on the noise distribution. (I am indebted to Matthias Michel and (Wixted, 2020).). (But see (Phillips, 2021)).

Note that the dominant perception issue is not just about phenomenology and consciousness: it is about the dominant percept and that is a wider notion than just the notion of a conscious percept. Adaptation effects can occur in unconscious perception of tilt as noted in Chapter 2. As I also note in Chapter 2, binocular rivalry can occur in unconscious perception. And fruit flies show binocular rivalry though they may not be conscious creatures.

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[1] Perhaps there should be another "perceptual criterion" above which is unconscious perception and below which is no perception at all. A criterion below which there is no perception at all is required to account for binocular rivalry in unconscious perception.

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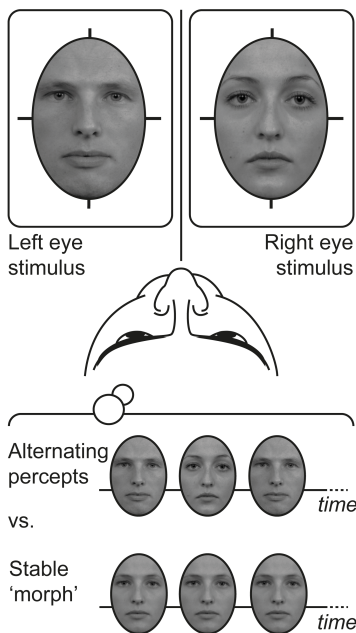
Figure 2 *Binocular rivalry stimuli. The masculine face is presented to the left eye and the feminine face to the right eye. If the subject is attending to local features or parts such as the eyes, standard binocular rivalry ensues. This is indicated by the label "alternating percepts". If the subject is attending to holistic features such as gender or the identity of the person, the subject sees a morphed androgynous face, as pictured. Thanks to Chris Klink for this figure. See (Klink, Boucherie, Denys, Roelfsema, & Self, 2017).*

In the book, I made a suggestion concerning why we have dominant percepts—that since the perceiving subject often has to act quickly, "it won't do for perception to wallow in ambiguity". As Stephen Jay Gould noted, evolutionary accounts are often "just so stories" (Gottlieb, 2012). They may sound plausible but other stories that conflict with them can also sound plausible. While mentioning Gould, Phillips and Firestone counter with another evolutionary suggestion:

> But in any event, since in the case of non-reflex actions there must always be a decision to act or not, it is unclear why ambiguity precludes quick action. If one sets a criterion which says: "Run if there is even a 1% chance of a tiger being present," one does not need a winner-takes-all tiger percept to run quickly.

Of course, complication in perception would presumably come at a cost. For whatever reason, the visual system apparently does not follow the advice of Phillips and Firestone and does not use signal detection parameters in determining perceptual content, even though they play a role in confidence judgments and in guessing. One might speculate (of course just another just so story) that adding probabilities to perceptual contents would excessively complicate the visual system. (There has been a debate about

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whether perception is indeed probabilistic. See (Block, 2018; Denison, 2017; Morrison, 2016; Munton, 2016).)

"The" Purpose of Perception

Turning now to the issue of the title of Phillips' and Firestone's critique, I don't think we have a very large disagreement.

As I mentioned in Chapter 2, perceptual adaptation operates via many different mechanisms. It is a network phenomenon and not merely a cellular phenomenon. It encompasses quite different kinds of perception, notably both opponent process perception and multi-channel. It operates in both high and low level perception. In its multiple mechanisms it reminds me of depth perception. Multiple mechanisms does suggest evolutionary selection but exactly what the relevant purposes are is unclear.

As they note, I say "The evolutionary purpose of perception is acquiring information about what is happening here and now. Call that 'news'." I'm slightly embarrassed by my use of the word "the" here since everyone knows that postulating evolutionary purposes is very often a matter of "just-so" stories, and postulating single purposes seems especially speculative.

If the evolutionary pressure is general enough, perhaps it can be justified and indeed the purpose of taking in information about here and now does seem general enough that as they say it "will be hard to disagree" with. But that sets me up with a problem which they express in the form of a dilemma:

> In other words, Block faces a dilemma: Either understand "news" broadly as "information about what is happening here and now" and give up on the idea that this purpose explains perception as characterized by adaptation; or understand "news" more narrowly as referring to changes along a specific feature dimension, but then lose the plausibility of the claim that detecting news is a general purpose of perception.

Now we all learned in Dilemma 101 that the horns of a dilemma have to be incompatible—or at least we have to be forced to choose between them. One horn is the one just discussed, acquiring information about the here and now and we seem to agree that that is a very general purpose of perception. Information about specific changes in the environment is a special case, so perception have both the general and a number of specific purposes that are special cases of the general purpose.

Still, Phillips and Firestone are right that it is not obvious how either the general or specific purposes just mentioned really show why adaptation is so important in perception.[2]

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[2] Thanks to Matthias Michel, and to Ian Phillips and Chaz Firestone for comments on an earlier version.

Block, N. (2022). "Adaptation, Signal Detection and the Purposes of Perception: Reply to Ian Phillips and Chaz Firestone." *Analysis Reviews*.

Begby, E. (2011). Review of Origins of Objectivity. *Notre Dame Philosophical Reviews, 2011*. Retrieved from http://ndpr.nd.edu/news/24627-origins-of-objectivity/

Block, N. (2014). Seeing-As in the Light of Vision Science. *Philosophy and Phenomenological Research, 89*(3), 560-573.

Block, N. (2018). If perception is probabilistic, why does it not seem probabilistic? *Philosophical Transactions of the Royal Society B: Biological Sciences, 373*(1755).

Block, N. (2019). Tyler Burge on Perceptual Adaptation. In A. Pautz & D. Stoljar (Eds.), *Blockheads! Essays on Ned Block's Philosophy of Mind and Consciousness.* (pp. 71-78). Cambridge MA: MIT Press.

Denison, R. N. (2017). Precision, Not Confidence, Describes the Uncertainty of Perceptual Experience: Comment on John Morrison's "Perceptual Confidence". *Analytic Philosophy, 58*(1), 58-70. doi:10.1111/phib.12092

Gottlieb, A. (2012, September 17, 2012). It Ain't Necessarily So. *New Yorker*.

Klink, P. C., Boucherie, D., Denys, D., Roelfsema, P. R., & Self, M. W. (2017). Interocularly merged face percepts eliminate binocular rivalry. *Scientific Reports, 7*(1), 7585. doi:10.1038/s41598-017-08023-9

Michel, M., & Lau, H. (2021). Is blindsight possible under signal detection theory? Comment on Phillips (2021). *Psychol Rev, 128*(3), 585-591. doi:10.1037/rev0000266

Morrison, J. (2016). Perceptual Confidence. *Analytic Philosophy, 57*(1), 15-48. doi:10.1111/phib.12077

Munton, J. (2016). Visual Confidences and Direct Perceptual Justification. *Philosophical Topics, 44*(2), 301-326.

Phillips, I. (2021). Bias and blindsight: A reply to Michel and Lau (2021). *Psychol Rev, 128*(3), 592-595. doi:10.1037/rev0000277

Siegel, S., & Byrne, A. (2016). Rich or Thin? In B. Nanay (Ed.), *Current Controversies in Philosophy of Perception* (pp. 59-80). New York and London: Routledge.

Witt, J. K., Taylor, J. E. T., Sugovic, M., & Wixted, J. T. (2015). Signal detection measures cannot distinguish perceptual biases from response biases. *Perception, 44*(3), 289-300. doi:10.1068/p7908

Wixted, J. T. (2020). The forgotten history of signal detection theory. *Journal of experimental psychology. Learning, memory, and cognition, 46*(2), 201-233. doi:10.1037/xlm0000732