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# Reply to Block: Adaptation and the Upper Border of Perception[1]

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Ned Block's sketch of my account of perception is accurate. He makes a valuable substantive contribution. I shall outline some points about psychological kinds, and then focus on methodological issues.

Initial inputs into perceptual systems and very early results of processing these inputs are *pre*-representational *informational-registrational states*. Such states correlate with, are caused by, and function to correlate with features of the environment. But they do not have accuracy conditions as an aspect of their natures. They are not perceptual states.

*Perceptual states* are representational states with accuracy conditions as aspects of their natures. Perceptual states are embedded in perceptual constancies, capacities to perceptually represent a given attribute or particular under a wide range of proximal stimulation. Perceptual states are always associated with certain types of short-term *perceptual memory* and *perceptual anticipation*. Perception, perceptual memory, and perceptual anticipation figure in guiding *pre-conceptual actional representation*.[2]

These four types of representational states are usefully thought of as operating at the same level of representation. All occur in an animal's psychology if any does. All occur in very simple animal psychologies. In evolution, they are the first representational states that have veridicality conditions. Perception is the causal basis for the other three types of states and provides many of the attributives employed by the other three. But all have similar representational formats. All are *modal*: visual, auditory, tactile,

[1] I thank Ned Block and Johannes Burge for comments.

[2] I table perceptual imagination. Determining whether such imagination, including dreaming, occurs in lower animals that have perception requires more investigation. For discussion of sensory registration and perception, see my *Origins of Objectivity* (Oxford: Clarendon Press, 2010), chapters 8–9.

proprioceptive, or what not, though each can be influenced intermodally. None are in themselves properly counted *cognition*. Cognition involves further levels of processing.

A different level of representation occurs in *pre-conceptual cognitive representation*. An example is preconceptual amodal representation. Such representation takes input from perception, but abstracts from any specific perceptual modality. Psychological maps for navigation and perhaps certain representations of magnitudes are instances.[3] Another type of pre-conceptual representation is formed through learning or other processing in long-term memory (modal or amodal). Even certain operations on working visual memory count as cognitive. Like perceptual-level representation, the foregoing cognitive representations are *pre-conceptual* in lacking *propositional* representational format.

Like perception, these types of pre-conceptual cognitive representation have the same structure as noun phrases constituted of contextual-determiner-dominated attributives—the structure of that F or those Fs. When representation occurs, the representational types are *applied* in a demonstrative-like manner. In all perceptual-level and most pre-conceptual cognitive-level representations, such determiner-governed attributions are part of a complex iconic array. Visual perception consists in a rich, topographical array of demonstratively applied attributives, at various levels of specificity. Amodal maps and magnitude representations have the same structure: that of attributives governed by referential, contextually applied determiners.

The most fundamental divide among representational kinds lies, I think, between pre-conceptual and conceptual states. Equivalently, the divide is between those states with structures whose function is purely to identify characterized particulars and those states with propositional structures, which contain elements (like main verb phrases) whose primary representational function is not to serve identification.

Primitive examples of states with propositional structures are perceptual beliefs. These connect perceptual representation with propositionally structured analogs, what I call 'conceptualizations' of perceptual representation. Propositional structure marks abilities to engage in propositional inference. Propositional inference is distinguished from other types of transformations—for example, transformations within the visual system, transformations between perceptions and perception-guided actional states, and transformations from perceptions to perceptual beliefs.

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[3] C. A. Gallistel, *The Organization of Learning* (Cambridge, Mass.; MIT Press, 1990); Elizabeth Camp, 'Thinking with Maps', *Philosophical Perspecives* 21 (2007), 145–182; Susan Carey, *The Origin of Concepts* (Oxford: Oxford University Press, 2009); Micheal Rescorla, 'Cognitive Maps and the Language of Thought', *British Journal of Philosophy of Science* 60 (2009), 377–407; *Origins of Objectivity*, *op. cit.*, 492–528.

These three levels of representation—perceptual, pre-conceptual cognitive, and conceptual/propositional—utilize different types of attributives. Although they may represent the same attributes, the attributives differ in marking different psychological competencies and in being embedded in different law-like patterns.

The issue that I focus on is that of determining whether the most primitive form of an attributive for a given attribute is perceptual. Again, a perceptual attributive, a pre-conceptual-cognitive attributive, and a conceptual attributive can all indicate and attribute the same attribute (property, relation, or kind).

The visual system produces attributives for shapes. There are also pre-conceptual-cognitive attributives and conceptual attributives (modal and amodal) for many of the same shapes. Any perceptual attributive can be conceptualized. There are, however, only *conceptual* attributives for economic recession.

So there are clear cases of attributives that occur in perceptual systems (shape attributives) and clear cases of attributives that do not (economic-recession attributives). I am interested in not-so-clear cases. Do attributives for a given attribute occur in a perceptual system or only elsewhere?

I focus on human visual-perceptual psychologies.

I begin with a distinction between *low-level visual attributives* and *higher-level visual attributives*. Block cites visual attributives that indicate shapes and other spatial properties or relations, textures, colors, lightness, and motion, as examples of low-level visual attributives. There is no serious question whether attributives for these attributes occur in visual systems. Other attributives are higher-level attributives.

All causal factors in normal formation of higher-level perceptual attributives go through low-level perceptual attributions. Suppose that body, face, and dangerous are higher-level visual-perceptual attributives. A visual system cannot produce a representation of something as a body, or as a face, or as dangerous without attributing a shape or motion by which it is perceived as a body, a face, or dangerous.

The point applies not only to higher-level *visual* attributives, but to all higher-level attributives that are applied on the basis of perception—including higher-level attributives that occur only in conceptual systems. On the basis of vision alone, one can represent something as a pushing, as an instance of agency, as a pine tree, as a piano, or as one's favorite movie villain—*only* by visually attributing low-level attributes. Some higher-level attributives for the listed attributes are probably produced in the visual system as well as in conceptual systems. Others are produced only posterior to perception, even though ordinary language allows us to use all these attributives in seeing-as locutions. Ordinary-language 'seeing-as' does not distinguish perceptual from conceptual attributives.

In *Origins of Objectivity* I discussed applications of higher-level visual perceptual attributives for *body* on the basis of low-level perceptual attributions (437–470). The low-level attributives concern three-dimensional shapes with connected boundaries.

Block discusses higher-level attributives for faces and certain facial expressions. By focusing on adaptation effects that bias an attribution to an "ambiguous" facial expression, he argues that there are attributives for faces, and for angry and fearful facial expressions, that can be applied on the basis of perception. These attributions can depend not only on current low-level perceptual attributions, but also on preceding *adapting* low-level perceptual attributions. The most natural explanation of the adaptation invokes attributives for facial expressions.

Block's conclusion—that there are higher-level, perceptually applied attributives for faces and facial expressions of anger and fear—is fairly obvious. The value of his argument lies in illustrating a way of thinking in psychology. Block wants to use resources in the argument to support a less obvious conclusion—that there are *perceptual* higher-level attributives for such attributes, perceptual in the sense that they are produced in the visual system.

Before pursuing this matter, I distinguish between *specific* and *generic* low-level attributives. An example of a *specific* low-level attributive is an attributive for the most specific shape that one sees as being in a given position—perhaps a tubular quarter-moon shape, of a given size, curvature, and so on, tapering to narrow ends. This shape might be grouped as an instance of a more generic shape, which would have as instances shapes of numerous sizes, degrees of tapering, and so on. Specific attributes may be grouped by a visual system as instances of a generic shape. Perhaps the generic grouping is that of the specific shapes characteristic of a kind of edible body (in fact, a banana). An attributive that constitutes an individual's capacity to use any of numerous different shapes as a perceptual basis for attributing *edible body* (of the given type) is a *generic*, low-level shape attributive. Attributives are psychological kinds of attributive capacities.

Block holds that to explain relevant adaptation effects in terms of low-level geometrical primitives alone 'would take increasingly baroque congeries of low-level properties'.

Grouping specific low-level attributives to constitute a generic low-level geometric attributive in systematically responding to faces and facial-expressions does show that generic low-level attributives are the perceptual bases of higher-level attributives for faces and facial expressions. A specific low-level shape attributive has in its extension the most specific shape that, on a given occasion, causes the higher-level face attributive. A generic spatial attributive has in its extension all specific shapes that would, for an individual at a given time, cause attribution of the higher-level face attributive, allowing for errors in shape perception. The ecological, applicational,

actional, and emotional associations of those low-level shape attributives, and their groupings, are so systematically connected to faces that they must be explained as triggers for attributions of faces. Faces and functional reactions to them caused the formation of both the grouping of specific shapes and the facial attributives for which the generic attributive is the applicational basis. The "congery" of *specific* low-level geometrical attributives that comprise a generic grouping would be inexplicable apart from the higher-level attribute *face* and its effects on the psychology. This is a causal-constitutive explanation of the generic grouping and the presence of higher-level facial attributives.[4]

Let us return to the point that one can see something as an anger- or fear-expression *only* by perceptually attributing *some* low-level geometrical properties. When there is a higher-level emotion-expression attribution applied via perception, there is always also a low-level specific geometrical perceptual attribution from which the higher-level attributive is computed. There is always a low-level generic attributive that applies to instances of those specific low-level attributes that *would*, at a given time, cause the higher-level attribution, again, allowing for error in low-level perception.

The point that perceptually based applications of higher-level facial attributions go through low-level geometrical attributives is intuitive. The point is grounded in what is known about how perceptual systems work. Perceptual processes begin by forming low-level attributions.

As the adaptation effects show, there are low-level geometrical attributions that can ground either of two higher-level attributions, depending on what antecedent attributions of facial expressions occurred. These antecedent attributions are grounded in their own low-level geometrical attributions—specific and generic.

Where higher-level attributions apply via low-level attributions, there is, constitutively, some systematic psychological difference in the ways these two types of states operate in an individual's psychology. There are different conditions in which the low-level generic geometrical attributives and the higher-level attributives would be applied. For example, if one could

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[4] Since face attributions occur on the basis of occluded shapes, disfigured faces, and partial sketches of faces, the range of specific shape-attributives grouped by a face-recognitional capacity is very complex. Because of adaptation and learning, the range changes. Different specific shape attributives, hence different generic shape attributives with different extensions, trigger face-recognition for an individual at different times. Relevant generic shapes are usually not of interest to physics or geometry. It would be a mistake, however, to think of the shape type as "disjunctive", except relative to explanation in those sciences. The groupings are associated with shape-patterns that signal faces. They have an objectivity like that of the North Sea, to use Frege's example. The objectivity is not in any general sense "disjunctive". The fact that a grouping or kind is systematically relevant to shipping routes and territorial claims, or to recognition of faces, suffices to give it objective-kind status, even if the sciences of physics and geometry do not refer to it.

show an individual that a given geometrical configuration that usually grounds facial attributions was not the configuration of a face, then the application of the face and face-expression attributives would cease, whereas the application of the specific and generic geometrical attributives would continue. Such differences can be elicited behaviorally.

Block's second empirical phenomenon concerns transfers of adaptation between heights of T-shapes, on one hand, and faces whose eyes-, nose-, and mouth-proportions correspond to the different heights of T-shapes. Adaptation to inverted faces, or to inverted T-shapes, operates about as well on subsequent view of the different stimulus type (Face to 'T' or 'T' to Face) as it does within stimulus type (Face to Face or 'T' to 'T'). In such cases, adaptation works almost entirely on specific low-level geometrical attributives that do not themselves cause face-attributions. In adaptation to *upright* faces, 55% of the aftereffect of the adaptation is face-specific, and 45% is not. Block concludes that the higher-level attributives play a larger role than low-level attributives—at least those that are common to Ts and faces—in understanding the attribution. This point needs qualification.

Block remarks,

> if upright face perception and aftereffects [were to] derive only from face-specific attributives, there should be no transfer in either direction between faces and Ts.

I think it vanishingly unlikely that adaptation could derive only from higher-level attributives, skipping low-level attributives altogether.[5] A visual system makes the higher-level facial attributions only through low-level attributives that attribute geometrical/textural features, and perhaps motion features, more specific to faces. Adaptation that in no way operated on some low-level features is empirically very unlikely. If there were no transfer between faces and 'T's, it would be empirically warranted to conclude that adaptation, in upright cases, depends entirely on geometrical differences between Ts and those shapes more distinctively associated with faces.

In fact, adaptation does not fail to transfer between upright faces and Ts. There is enough geometrical similarity to allow some cross-category transfer. It is unsurprising that the geometrical patterns that are more specific to facial types than 'T's are account for more of the adaptation.

Higher-level facial attributives never float free from low-level geometrical attributions in formation processing, as Block's formulation may suggest.

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[5] Geometrical attributives are not to be associated purely with very early processing, which is known to operate on registrations that derive from small sub-parts of any ecologically salient shape. Visual-geometrical processing continues through stages that apply to whole scenes. It is vanishingly unlikely that facial attributions could show adaptation, without depending on adaptation of *some* geometrical attribution.

The higher-level perceptually based attributions are always formed via attribution of *some* low-level ones. When low-level geometric features cause attribution of higher-level ones, those low-level features that are relatively *distinctive* to apprehending higher-level attributes contribute to adaptation. In this case, they make a larger contribution than the low-level features common to 'T's and facial structures.

I think, contrary to what Block seems to suggest in the passage quoted above, that it is not known that higher-level face attributives have causal power *in adaptation*. The low-level shape attributives that trigger face-attribution could be doing all the causal work in adaptation. Attributives for facial expressions are certainly effects of adaptation. Determining whether they are causes *in adaptation* requires more experimentation.

I return to whether a given higher-level attributive is produced in the visual system. This issue is fundamental. Understanding natural psychological kinds, including the upper border of perception, hinges on it. Locating psychological origins of higher-level attributives that are of great philosophical interest—attributives for *body*, *cause*, *agency*, emotion-expression types—hinges on it.

The issue is complex. It is more complex than distinguishing origins in perception from origins in propositional thought. As noted, there are amodal non-conceptual cognitive representations.[6] Cognitive attributives are formed through learning processes operating in long-term perceptual memory. Such attributives can be sensory-modal and triggered by low-level perceptual attributives, but never produced in a perceptual system. So other types of non-perceptual attributives besides conceptual attributives are applied via low-level perceptual attributives.

No criterial tests determine whether a higher-level attributive is formed in a perceptual system. One must use evidence from different sources.

Block highlights adaptation as a source of evidence. He thinks that facial and facial-expression attributives are prima facie perceptual because they are subject to adaptation effects. I think the matter less straightforward.

As he recognizes, the Schwiedrzik-Ruff et. al. experiments concern adaptation effects only for low-level perceptual representations.[7] The experiments center on the effect of perception of the geometry of textural surface elements on perception of a surface's tilt.

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[6] Block's remark 'Since adaptation does not depend on what the perceiver judges, it is hard to see how it could be a cognitive effect' is a slip. Many post-perceptual, cognitive effects do not depend on judgment or other propositional attitudes. For example, unconscious reformations of an amodal cognitive map need not involve judgment.

[7] C. M. Schwiedrzik, C.C. Ruff, et. al., 'Untangling Perceptual Memory: Hysteresis and Adaptation Map into Separate Cortical Networks' *Cerebral Cortex* (2012), epub ahead of print.

These experiments show that adaptation is based in sensory registration and perception, especially early perception, whereas priming has its basis in later processing stages. Schwiedrzik-Ruff et. al. localize adaptation for perception of tilt from surface texture in early visual areas, V2 and V3. Other studies show that adaptation can occur in visual areas V1-V5, and in the infero-temporal cortex.

Adaptation in the earliest area of visual processing (V1) requires longer exposures than adaptation in more advanced areas. Visual processing in V1 shows adaptation, in conscious subjects, only after exposures of 500 milliseconds (500 ms) or longer. Relatively advanced stages of perception-formation can exhibit adaptation after briefer exposures (150 ms). These later stages center on global geometrical features—the sorts of features that are the low-level apprehensional bases for face- and facial-expression attribution.[8]

This distinction provides a further tool for investigating the low-level perceptual basis for higher-level attribution. Since higher-level attributives tend to be global, adaptation specifically relevant to their perceptually-based applications can be distinguished from local adaptation that affects higher-level attribution, but that is not its immediate applicational basis. Adaptation, say in V1, that operates on *local* low-level attributives for (or informational-registrational states that derive from) parts of more global geometrical attributes can be distinguished from adaptation that operates on those *global* low-level geometrical attributives—specific or generic—that are the immediate applicational bases of higher-level attributives.

Appeals to adaptation, by themselves, are limited in determining whether a higher-level attributive is perceptual. Block notes limitations. I emphasize them.

There is extensive evidence that adaptation is a sensory—as distinguished from cognitive—process. But whenever a higher-level attributive exhibits adaptation, there is the question whether the adaptation operates on its low-level, perceptual applicational bases, even while the higher-level attributive itself is formed only post-perceptually. In other words, even if a higher-level attributive is *not* formed in a perceptual system, but nevertheless has a perceptual applicational basis in low-level perceptual attributions, *perceptually based applications of that non-perceptual higher-level attributive will still exhibit adaptation*. Such adaptation would be caused by low-level sensory-perceptual attributives alone. Low-level sense-perceptual adaptation always carries along higher-level *non*-perceptual attributives, as well as higher-level perceptual attributives, that depend directly for their perceptual applications

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[8] S. Suzuki, 'High-Level Pattern Coding Revealed by Brief Shape Aftereffects' in *Fitting the Mind to the World: Adaptation and After-Effects in High-Level Vision*, C. W. G. Clifford and G. Rhodes eds. (Oxford: Oxford University Press, 2005).

on low-level attributives. So, *in themselves*, adaptation tests *cannot*, even prima facie, determine whether a higher-level attributive is perceptual.

Further types of evidential considerations can join with adaptation considerations to adjudicate whether a higher-level attributive is perceptual. One such type concerns whether responses to higher-level attributions—including adaptive responses—depend on the retinal location of the stimuli. Their doing so is relevant evidence for whether the higher-level attributive is perceptual. Individuation of perceptual states and perceptual attributives is conditioned by the perspective yielded by ways light strikes the retina, even assuming that the attribution is of an attribute represented as being in a position in distal space.

However, some types of visual perceptual memory and certain perceptual concepts are *also* retinally conditioned. Even where they localize entities in space, they retain the perceptual perspective occasioned by the particular ways in which the retinae received light when the antecedent perceptions were formed. If application of a higher-level attributive is independent of how light strikes the retinae, but depends purely on the location in space where the stimulus occurs, then the attributive is *not* perceptual, though it may originate through learning processes in perceptual memory. But it may be non-perceptual even if its applications are retinally dependent. So although this evidential source is relevant to our issue, it also is not determinative.

Another source of evidence is localization in the brain of processes that underlie formation of higher-level attributives. As Block notes, even when a process is localized in an area that serves perception, we usually cannot be sure that that area does not depend for its operation on other areas that serve post-perceptual attributions. Usually, we also cannot be sure that those perceptual areas do not also serve post-perceptual attributions. Facial and certain causal attributions have been shown to depend on events in brain areas that serve vision. Such evidence bears on whether a type of higher-level attributive occurs in a perceptual system. It is rarely decisive.

These types of evidence can be combined.[9] Absent a strong alternative explanation, a combination of evidence can support believing, provisionally, that a higher-level attributive is perceptual.

The view that a higher-level attributive is *non*-perceptual must eventually show how it is formed. Timing considerations are relevant. If an attributive is acquired, the account of *how* it is acquired can be relevant. Certain acquisitions through explanation-based teaching can render it plausible that a type

[9] A fine example of combining different types of evidence—including evidence from adaptation and retinal dependence—to argue that attributives for *causation* are perceptual is M. Rolfs, M. Dambacher, and P. Cavanagh, 'Visual Adaptation of the Perception of Causality', *Current Biology* 23 (2013), 250–254.

of higher-level attributive is originally conceptual. Or the acquired attributive may be a natural-kind attributive, whose possession depends on a capacity to distinguish between what an entity looks like and what it is. Such a capacity is non-perceptual.

In principle, a higher-level attributive for a given attribute could come to be produced in a perceptual system through cognitive/conceptual influence, even though no attributive for the attribute originated in perception. Many philosophers and psychologists have claimed that specific instances of such top-down "penetration" occur. But the empirical track record for such claims is dismal. This is a complex topic that cannot be thoroughly canvassed here. But many such claims derive from a few basic oversights.

One common error is to overlook the role of attention in grouping low-level attributes that perceptually trigger non-perceptual higher-level attributions. As Block notes, in the acquisition of expertise, *conceptual* higher-level attributives can cause attention to and new grouping of specific low-level attributes. For example, expertise in bird species or piano types can produce a capacity to attend to, group, distinguish, and remember certain geometrical patterns, in ways that a non-expert would not. It is known that practice and expertise can affect organization of perceptual capacities for grouping shapes.[10] In such cases expertise-guided attention to specific low-level attributes can help form generic low-level attributives that constitute a refined perceptual applicational basis for *non*-perceptual higher-level attributives. No new, perceptual higher-level attributives need be acquired.

Adaptation in these areas has not been extensively tested. I expect experts to show different adaptation patterns from non-experts. Bird-species- or piano-experts might show adaptive effects for shape configurations crucial for differentiating bird-species- or piano types, whereas non-experts show no such effects. Perceptually based applications of higher-level non-perceptual representations like piano will be affected by adaptation of lower-level perceptual groupings. There is no evidence that bird-species or piano- representations are produced in the visual system. Explanation of expert application of such representations is well explained by standard accounts of visual processing, which do not appeal to higher-level perceptual attributives.

A complimentary error is to overlook non-perceptual-attributive formation in long-term memory. Low-level perceptual attributives constitute the perceptual basis for applying relevant cognitive attributives. Claims that perception is penetrated by higher-level attributives often just assume that higher-level attributives that are applied on the basis of perception are

[10] N. K. Logothetis, J. Pauls, and T. Poggio, 'Shape Representation in the Inferior Temporal Cortex of Monkeys', *Current Biology* 5 (1995), 552–563.

perceptual. No effort is made to rule out standard explanations that locate them in cognitive memory.[11]

In any case, determining whether a higher-level attributive for a given attribute that can be applied on the basis of perception is produced in a perceptual system hinges on best scientific explanation of several factors.

I think that Block is probably right that face-related attributives are perceptual. He is certainly right that adaptation is evidentially relevant. I believe that best explanation of a variety of experimental evidence, combined with evolutionary considerations, will probably show that not only facial and certain facial-expression attributions, but also certain causal-, agency-, and functional attributions (for example, of danger or food)—as well as body attributions—occur in perceptual systems. Except perhaps in the body case, these conjectures are not empirically secure. Still, they have some empirical support.

I agree with Block that phenomenological and other armchair approaches to determining what attributives are perceptual are deeply wrong-headed. I think them epistemically worthless. One cannot distinguish cognition from perception in any warranted way from the armchair. The processes for forming attributives on the basis of perception are too fast, inaccessible to consciousness, and complex to allow phenomenological or other armchair methods to distinguish perception from cognition. Only sophisticated use of experimental evidence bears on these issues in a way that goes beyond uninformed playing.

Another error, which Block rightly criticizes, is the claim that only conscious perception is genuine perception by individuals.[12] 'Unconscious perception' is alleged to be a technical term applicable to sub-personal states that are irrelevant to traditional philosophical issues about perception. This view is as uninformed as older views that maintained that the domain of psychology is the domain of introspection. Understanding perception depends on understanding formation laws governing it. Such laws cite unconscious sensory-representational states of individuals that are as basic to understanding individual action as are unconscious beliefs and intentions.

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[11] Similar points are made by Z.W. Pylyshyn, 'Is Vision Continuous with Cognition? The Case for Cognitive Impenetrability of Visual Perception', *Behavioral and Brain Sciences* 22 (1999), 341-365; F. H. Durgin, B. Klein, A. Spiegel, C.J. Strawser, and M. Williams, 'The Social Psychology of Perception Experiments: Hills, Backpacks, Glucose, and the Problem of Generalizability', *Journal of Exp[erimental Psychology: Human Perception and Performance* 38 (2012), 1582-1595; C. Firestone and B.J. Scholl, '"Top-Down" Effects Where None Should be Found: The El Greco Fallacy in Perception Research', *Psychological Science* 25 (2014), 38-46; C. Firestone and B.J. Scholl, 'Enhanced Visual Awareness for Pajamas and Stilettos? Perception vs. Memory in "Top-down" Effects', forthcoming.

[12] I criticize the view in *Origins of Objectivity*, *op. cit*., 374–376.