

# Attention, Gestalt Principles, and the Determinacy of Perceptual Content

Ben White

Forthcoming in *Erkenntnis*

<https://doi.org/10.1007/s10670-020-00234-3>

**Abstract:** Theories of phenomenal intentionality have been claimed to resolve certain worries about the indeterminacy of mental content that rival, externalist theories face. Thus far, however, such claims have been largely programmatic. This paper aims to improve on prior arguments in favor of phenomenal intentionality by using attention and Gestalt principles as specific examples of factors that influence the phenomenal character of perceptual experience in ways that thereby help determine perceptual content. Some reasons are then offered for rejecting an alternative interpretation of these examples, according to which the phenomenal effects of attention and Gestalt principles play no role in the determination of perceptual content.

**Keywords:** phenomenal intentionality; perceptual content; content indeterminacy; attention; Gestalt principles.

## 1. Introduction

Most of us assume that there is a determinate fact of the matter as to what our perceptions, thoughts, beliefs, and desires are about or of. When I think about rabbits, e.g., it seems clear that it is *rabbits*, and not rabbit stages, undetached rabbit parts, or any disjunction of such entities that I am thinking about. Our first-person judgments about the contents of our own mental states conflict strongly in this regard with certain arguments of Quine (1960) and Davidson (1979), which purport to show that it is indeterminate what (if anything) such states are about or of. While most philosophers reject Quine and Davidson's conclusions, those who do so are still left with the challenge of explaining how our intentional states come to possess the determinate contents that they have.

Theories of phenomenal intentionality (PI), which posit a form of mental content that is determined by phenomenal consciousness, have been touted by their proponents as offering a more satisfactory response to this challenge than externalist theories of content, which hold that the content of our mental states is instead determined by certain causal and/or biological relations between our internal states and the environmental features that they represent. Thus far, however, such claims made in support of PI have been largely programmatic. This paper aims to remedy this gap in the case for PI by showing how attention and Gestalt principles help fix the contents of our perceptual states by altering the phenomenal character of perceptual experience (hereafter simply “perceptual experience”), thereby lending concrete support to the view that at least some forms of mental content are determined by phenomenal consciousness. While this paper focuses solely on perceptual content, this strikes me as the right place for theories of PI to start, as the contents of non-perceptual mental states can I think be seen to derive their determinacy at least partly from the relations that they bear to perception (and not, as other proponents of PI have claimed, from any special non-sensory, cognitive phenomenology<sup>1</sup>). If this is correct, then the first step in building a case for PI is to show that phenomenal consciousness does indeed determine perceptual content. Once this is established, advocates of PI (PIlists) can then go on to explain non-perceptual content in terms of certain content-determining relations between perception and non-perceptual mental states. This further task, however, lies beyond the scope of this paper. My goal here is merely to help take the first step just mentioned.

The paper is structured as follows: Section 2 summarizes the difficulty that externalist theories face in accounting for the determinacy of mental content. Section 3 introduces PI as an alternative to externalism and suggests that support for PI might be derived from perception. Sections 4 and 5 focus on attention and Gestalt principles as factors that influence perceptual

experience in ways that help determine the contents of perception. Section 6 then considers a potential objection to the foregoing account, which alleges that any impact that attention and Gestalt principles have on perceptual content can be explained without any reference to phenomenal consciousness.

## 2. Externalist theories of content and the problem of content indeterminacy

What is it about our mental representations of rabbits that makes them *about* rabbits as opposed to nuns or airplanes or undetached rabbit parts? Externalist theories of mental content attempt to answer such questions by appealing to certain causal and/or biological relations between the internal states of minded beings and the surrounding environment. Foremost among such theories are causal theories of content (CTC), which hold (roughly) that the content of a mental representation  $x$  is  $F$  iff  $x$  is appropriately caused by  $F$ , and teleological theories of content (TTC), which hold (roughly) that the content of a mental representation  $x$  is  $F$  iff  $x$  has the biological function of indicating  $F$ . Both CTC and TTC face serious difficulties in accounting for the determinacy of mental content. The following brief summary of these problems should help us see why one might be drawn to PI as a potential way of overcoming them.

The basic problem for CTC<sup>2</sup> can be illustrated by way of an analogy with Quine's (1960, ch.2) argument for the inscrutability of reference.<sup>3</sup> Just as the necessary coincidence of rabbits, rabbit stages, and undetached rabbit parts, and the equivalence in the effects they have on our sense organs makes it impossible, by Quine's lights, to tell which of these candidate referents the term "gavagai" refers to (even if uttered always and only in the presence of rabbits), the necessary coincidence and causal equivalence of these various candidate *representata* likewise make it impossible for any purely *causal* theory of mental content to explain how a mental state

could represent one without also representing all the others. The contents of any thoughts that we seem to have about rabbits will consequently end up being classified by CTC as indeterminate between rabbits, rabbit stages, undetached rabbit parts, and anything else that is necessarily coincident with such entities. In attempting to individuate mental representations solely in terms of their causes, CTC is thus unable to account for our ability to have distinct, determinate thoughts about necessarily coincident things that are indistinguishable in terms of their effects on us.

Those who are attracted to externalist theories of content might seek to avoid this problem by abandoning CTC in favor of TTC, which holds (roughly) that a mental state  $x$  represents  $F$  iff it has the biological function of indicating  $F$  (where  $x$  indicates  $F$  iff  $x$  causally covaries with or “carries information about”  $F$ ) (Dretske, 1988; Millikan, 1984, 1989; Neander, 2017). By analyzing mental content in terms of biological functions, TTC incorporates an element of normativity that is absent in CTC, and consequently fares much better in dealing with cases that seem to require reference to what a given mental representation is *supposed* to represent. Nevertheless, TTC remains vulnerable to the objection to CTC raised above, for while TTC does not require mental representations to represent their current causes, it still holds the content of any such representation to be fixed by a purely causal process involving the causation of certain of its previous tokenings by some object or property  $F$  and the consequent selection of the capacity to produce such tokens due to their usefulness as  $F$ -indicators. As noted above, though, mental representations of necessarily coincident entities cannot be distinguished from one another solely on the basis of their causes. Just as the fact that a representation  $x$  is caused by  $F$  doesn’t determine whether  $x$  represents  $F$  or some other necessarily coincident entity  $G$ , so too the fact that previous tokenings of  $x$  have been regularly caused by  $F$ s in such a way as to lead to

the preservation of the capacity to produce  $x$ s is inadequate to determine whether  $x$  represents  $F$  or  $G$ . For given that  $x$  causally covaries with both  $F$  and  $G$  (and  $F \vee G$ ), there is no way to tell which of these candidate *representata*  $x$  was selected as an indicator of. As Gates (1996, 336fn12) puts it: “Whatever has been ‘selected for’ its prowess as a horse-detecting mechanism has also been selected for its uncanny ability to detect undetached horse parts.” In sum, since TTC follows CTC in explaining what a representation represents in terms of some causal relation between (previous tokens of) the representation and (previous instances of) its *representatum*, it is ultimately no more able than CTC to account for the existence of distinct, determinate mental representations of necessarily coincident *representata*.<sup>4</sup> Both theories are thus incapable of individuating mental representations at a level of grain fine enough to match our own representational capacities. The following sections will attempt to show why PI might be thought to succeed where externalist theories like CTC and TTC fail.

### **3. Phenomenal intentionality, perceptual experience, and perceptual content**

Theories of PI hold that there is a form of mental content (referred to in this paragraph as “content<sub>p</sub>”) that depends upon phenomenal consciousness. The nature of this dependence is taken to ensure (at minimum) that content<sub>p</sub> supervenes on phenomenal consciousness, in the sense that the content<sub>p</sub> of the mental states of any two individuals cannot differ unless there is some corresponding difference in their current phenomenal states, and whenever one is in a mental state with a certain content<sub>p</sub>, one must be in some phenomenal state that is at least nomologically sufficient for being in a mental state with that content<sub>p</sub>.<sup>5</sup> On such a view, the phenomenal character of one’s mental states may thus be said to *fix* or *determine* the content<sub>p</sub> of those states,

and those of one's mental states that have content<sub>p</sub> may likewise be said to *derive* their content<sub>p</sub> from phenomenal consciousness.

While PI has been claimed to resolve the determinacy problems that plague externalist theories of content, Plists often leave it unclear how exactly phenomenal consciousness determines mental content. In touting this advantage of PI, Strawson (2010, 352-3) thus endorses “the *pff!* thesis,” according to which the “answer to [the] question ‘How can the quality of experience pin things down determinately’ is: It just can.” Searle (1992, 164) likewise states that while “our intentional states often have determinate intentional contents...all of that presupposes consciousness,” but does little to explain what it is about consciousness that enables it to make intentional contents determinate. All he offers on this issue is that “[i]n the case of conscious thoughts,...the aspectual shape [i.e. the determinate, intensionally specified content of such thoughts]...constitutes the way the agent thinks about or experiences a subject matter: I can think about...water...*as* water without thinking of it *as* H<sub>2</sub>O” (157). This, however, merely states what needs explaining. Certainly we do seem to be able to think about or experience a given subject matter in various determinate ways, but what specific contribution does phenomenal consciousness make to our having this ability?

The remainder of this paper lays the groundwork for what I hope is a more satisfactory answer to this question by examining how certain factors that alter the phenomenal character of our perceptual states thereby help determine their content as well. The specific factors that I'll be looking at are attention and Gestalt principles of perceptual organization. While there may be other aspects of perceptual experience that also play an important role in fixing perceptual content, these two factors nevertheless strike me as particularly well-suited to play such a role, and may at the very least show how greater specificity can be lent to PI-based accounts of

perceptual content. As mentioned at the beginning of the paper, this is only the first step in a more general PI-based theory of mental content, as some explanation must still be given of how the determinacy that our perceptual states derive from perceptual experience is then transmitted to the contents of non-perceptual mental states, e.g. thoughts, beliefs, and desires. While I have some thoughts about how this might be done,<sup>6</sup> developing them would take us beyond the scope of the present paper. I'll therefore be focusing strictly on perceptual content, or, more specifically, on how attention and Gestalt principles affect our perceptual experience in ways that help determine what our perceptions represent.

In investigating the impact that these two factors have on perceptual experience and perceptual content, we should be careful not to lose sight of the problem of indeterminacy that was taken as grounds for rejecting externalist theories of content in Section 2. I will therefore return often to the question of how the phenomenal effects of attention and Gestalt principles might help explain our ability to perceive rabbits *as* rabbits, rather than as rabbit stages, or undetached rabbit parts. In emphasizing this question, however, I should note that I take this example as purely illustrative of the kind of determinacy worries that an adequate theory of perceptual content must address, regardless of whether we can in fact perceive natural kinds (e.g. rabbits) and other high-level properties, or whether the contents of perception are instead limited to low-level properties, e.g. color, shape, size, and location. The problem of content indeterminacy is independent of the latter issue, as questions about the determinacy of our perceptual representations of low-level properties can be raised just as easily as they can for high-level properties. Just as one can ask whether, when looking at a rabbit, we perceive it as a rabbit, a rabbit stage, or a collection of undetached rabbit parts, so too one can ask whether, when looking at a circle, we perceive it as a circle, a circle stage, or a conjunction of arcs. Even

if perceptual content is confined to low-level properties, a theory of perceptual content must therefore still account for the determinacy of our perceptual representations of such properties. Those who think that perceptual content *is* confined to low-level properties can thus replace any references to rabbits, rabbit stages, etc. with references to circles, circle stages, etc. throughout.

#### **4. Attention**

While most agree that attention has some effect on the phenomenal character of perception, disagreement persists over whether attention produces these effects by altering the properties that objects appear to have (e.g. their apparent contrast, color, brightness, and size), or whether such appearances remain constant despite shifts in attention, with the phenomenal changes that accompany such shifts being explained in some other way. The phenomenal impact of attention can play a role in the determination of perceptual content regardless of which stance one takes on this issue, but the precise nature of this role will differ depending on how the phenomenal effects of attention are understood. The difference between these two stances can be seen in their conflicting interpretations of an experiment conducted by Carrasco et al. (2004), which some (including Carrasco et al.) have taken to show that attention alters apparent contrast. In this study, subjects were asked to fixate continually on a point midway between two Gabor patches that were presented to them after their attention had been drawn to the left, right, or center of their point of fixation by a brief cue. When the patches appeared, subjects then pressed a key indicating the orientation of the patch that appeared higher in contrast. The results showed “that when observers’...attention was drawn to a stimulus location, observers reported that stimulus as being higher in contrast than it really was, thus indicating [(in Carrasco et al.’s view)] that attention changes appearance.” (Carrasco et al., 2004, 309).



Interpreted in this way, Carrasco et al.'s results suggest that by altering apparent contrast, shifts in attention affect not only the phenomenal character but also the content of our visual experience. For if redirecting our attention changes the apparent contrast of certain surfaces in our visual field, then it thereby changes the properties that those surfaces are perceptually represented as having. Hence Wu's (2014, 124) remark that "If correct, [Carrasco et al.'s] results show that the subject's state of attention is a determinant of some of the contents of the subject's visual experience."<sup>7</sup>

In contrast to the foregoing interpretation of Carrasco et al.'s results, Beck and Schneider (2017) argue that attending to an object does *not* affect the properties it appears to have (e.g. its apparent contrast, size, or color), but merely increases its phenomenal *salience*. On Beck and Schneider's (2017, 473) view, the reason why subjects in Carrasco et al.'s study, when presented with two patches of equal contrast, reported the orientation of the attended patch rather than the unattended one is *not* because attending to a patch increases its apparent contrast, but rather because attending to a patch increases its phenomenal *salience*, and when *forced* to choose which of two stimuli is more intense in some respect (e.g. is "the highest in contrast, the fastest, the biggest, etc.") in a case where there is no apparent difference in their properties, subjects will select the more salient stimulus by default. On this view, the data that Carrasco et al. interpret as showing that attention alters appearances is instead merely an artifact of their experimental paradigm, which requires subjects to make a "forced-choice comparative judgment in a time-pressured situation" (Beck and Schneider, 2017, 473).

In support of this interpretation, Beck and Schneider (2017, 474) note that when the experimental set-up is altered so that subjects are merely asked to judge whether two patches appear to have the same contrast (rather than which is higher in contrast), their judgments are

unaffected by which patch they are attending to. The same holds likewise of other apparent properties, e.g. speed and simultaneity, which have been claimed to be influenced by attention. This suggests that the evidence previously taken to support the view that attention alters appearances may be the effect of a decision bias induced by a flawed experimental paradigm rather than indicative of any real impact that attention has on the properties that objects appear to have.

Despite these differences, Beck and Schneider (2017, 482) nevertheless *agree* with Carrasco et al. that “attention alters the phenomenal character of perceptual experience.” In Beck and Schneider’s view, however, attention alters perceptual experience merely by virtue of the fact that objects are more phenomenally salient when attended to. In rendering objects more phenomenally salient, attention does not affect the properties that they are represented as having (by making them appear higher in contrast, brighter, larger, etc). The phenomenal salience conferred on attended objects thus cannot, according to Beck and Schneider (2017, 489), be equated with any representational feature of perceptual experience; it “is not reducible to objects of awareness or representational content.” It is instead a primitive “qualitative feature of experiences” that Beck and Schneider (2017, 483) define simply as “the phenomenal character of perceptually attending.”

While Beck and Schneider deny that attention alters the apparent properties of objects, the phenomenal effects that they ascribe to attention can still have an impact on perceptual content by fixing the representational *target* of our current perceptual state, even if it leaves the *properties* that we perceptually attribute to that target unaltered. In rendering the current object of attention more phenomenally salient than the various other objects that are relegated to the background of our current perceptual experience, attention picks the attended object out as the

*representatum* of our current perceptual representations. The phenomenal salience that attention confers on its objects may thereby exert a determining influence on perceptual content that could help explain our ability to form distinct, determinate perceptual representations of necessarily coincident objects (e.g. rabbits, rabbit stages, and undetached rabbit parts). Just as the way in which we attend to certain ambiguous figures (e.g. the Necker cube, or the duck-rabbit) determines what we see such figures *as*, so too the way in which we attend to a rabbit may help determine whether we perceive it *as* a rabbit, a rabbit stage, or a collection of undetached rabbit parts, as different ways of attending to the rabbit will render certain of these candidate *representata* more phenomenally salient than others (Campbell, 2002, 222-3). Likewise, when attending specifically to a certain part of a rabbit's body, say its nose, the fact that we perceive it as the nose of a rabbit rather than as a nose attached to various undetached rabbit parts or a nose at the center of a series of nose-less rabbit stages might be at least partly explained by the fact that our attention was recently focused on or has now also covertly spread to adjoining parts of the rabbit in such a way as to make the nose's status as a component of a larger, enduring rabbit more phenomenally salient than its relation to the other coincident entities just mentioned.<sup>8</sup>

This ability of attention to single out perceived objects can be ascribed to the role that attention plays in binding the various features that an object is represented as having (many of which are processed relatively independently of one another in distinct brain regions) together into a single perceptual representation of a unified object located at a certain position in egocentric space (Campbell, 2002, 31-3; Treisman, 1998; Treisman and Gelade, 1980). As one of the central mechanisms of perceptual binding, the manner in which attention is allocated within one's current experience will determine which of the various features in the perceived environment are bound together as features of the same thing (e.g. whether distinct rabbit parts

or rabbit stages are bound together as components of the same enduring individual). The way in which objects are individuated and distinguished from one another in perception thus depends to a large degree on the way one attends to one's surroundings. Different patterns of attention applied to the same stimulus will consequently yield different perceptual representations of the objects and features that one's environment contains. Regardless, then, of whether one interprets the results of Carrasco et al.'s experiment as showing that attention alters the properties that objects appear to have, or instead as showing that attention renders attended objects more phenomenally salient while leaving their apparent properties unchanged, attention can be seen as having an impact on perceptual experience that helps determine the content of perception as well, either by conferring determinacy on our perceptual representations of objects' properties, or by fixing the target of our current perceptual state.

## **5. Gestalt principles**

While the phenomenal effects of attention play a major role in the determination of perceptual content, such effects cannot be the whole story as to how our perceptual states acquire the specific contents that they have. As Palmer and Rock (1994, 37) note, in order for attention to fixate on certain features in the perceived environment, some basic structure must already be imposed on our perceptual experience to distinguish those features which are eligible to serve as potential objects of attention.

Logic dictates that some amount of visual organization must occur at an early stage in visual processing and that it must occur preattentively...[D]iscrete perceptual elements of some sort must first be present to serve as candidates for further element-based processing.

Only after such elements are present can we attend selectively to one or another, recognize them if they are familiar, learn about them, remember them, and so on.

Triesman and Gelade (1980, 134) likewise suggest that some further structuring of perceptual experience is needed beyond that supplied by attention in order to distinguish between “spatially overlapping objects” that fall “within the same spatio-temporal [attentional] ‘spotlight’.”

Consider, e.g., Campbell’s (2002, 18) example of “a glass which is currently being clasped in a hand” in such a way that “the parts of the glass [are] no closer to each other than they are to the parts of the hand.” While different patterns of attention may suffice to determine whether we perceptually represent the object that the hand is clasping as a glass or a glass stage, unless the region of space that the glass occupies has first been distinguished from the surrounding hand along with any other potential targets of attention that occupy adjoining spatial regions, attention may have no clearly defined object or location to fixate on. In short, some structuring of the perceived environment into distinct object-containing regions seems necessary prior to the deployment of attention in order to provide us with a set of potential objects to attend to.

As Campbell points out (2002, 18, 35, 37), Gestalt principles of perceptual organization seem well suited to perform this additional structuring role. Gestalt principles describe various ways in which visual elements are perceptually grouped, segmented, and organized by virtue of their relations to other elements in one’s visual field (Wertheimer, 1938; Palmer, 1999, ch.6). Due, e.g., to the Principles of Proximity and Similarity, elements that are closer to one another in one’s visual field and/or more similar to one another with respect to their visual features (e.g. their color, shape, or size) are *ceteris paribus* more likely to be grouped together in one’s visual experience. Due to the Principle of Good Continuation, line segments that fall along roughly the same smooth trajectory are *ceteris paribus* more likely to be perceived as part of the same line

than segments that form a sharp angle. Due to the Principle of Closure, figures with closed outlines are *ceteris paribus* more likely to be perceived as distinct bounded wholes, and small gaps or discontinuities in otherwise continuous contours tend to be “filled in” to yield perceptions of figures with closed, smooth boundaries. Lastly, due to Principle of Common Fate, elements that move in roughly the same direction at the same rate and time are *ceteris paribus* more likely to be grouped together as well.

In addition to these classical Gestalt principles, Palmer and Rock (1994) posit a further Principle of Uniform Connectedness (UC) that they argue is even more fundamental than the aforementioned principles in that it is needed to construct the basic visual elements that the classical Gestalt principles operate on. Due to this principle, objects that project to regions in the retinal image that are connected to one another and share certain visual features in common tend to be perceived as unified wholes. While the Principle of Proximity accounts for why a grid of black dots in which each dot is closer to the dots immediately above and below it than to the dots to the left and right is more apt to be seen as columns than rows, Palmer and Rock argue that some prior explanation is needed for how the separate elements of the grid first come to be distinguished from one another and from the background against which they are viewed. UC provides this explanation, as it predicts that the parts of each dot will be grouped together as components of the same basic visual element because they project to a connected region of the retina and share the same visual features. The same principle likewise explains why each dot is distinguished from other dots in the display (*viz.* because it is not connected with them), and why each dot is distinguished from the grid’s background (*viz.* because although each dot is adjacent to certain parts of the grid’s background and thus connected with it, the background differs from the dots in color).

Together with classical Gestalt principles, UC explains how our perceptual experiences come to be organized into distinct elements grouped together on the basis of their similarity, proximity, continuity, and relative motion, despite the fact that any such experience is produced by proximal stimuli that could in principle be organized in an infinite number of different, incompatible ways. Our visual system's use of these principles to impose a determinate structure on ambiguous stimuli has a notable impact on the phenomenal character of perceptual experience. Indeed, it was primarily on the basis of their phenomenal effects that Wertheimer (1938) first identified the classical Gestalt principles, and appeals to phenomenology likewise figure prominently among Palmer and Rock's (1994, 31-2) reasons for postulating UC.

As in the case of attention, here too it seems plausible that in altering our perceptual experience, Gestalt principles and UC<sup>9</sup> thereby exert a corresponding influence on the content of perception as well. Due, e.g., to UC and the Principles of Good Continuation and Closure, the Kanizsa triangle is apt to appear to us as (a) a white triangle superimposed on three black dots, rather than as (b) three pac-man shapes on a uniform white background. The strength of this effect is attested by the fact that the white triangle appears brighter than the white background it is seen against, even though their reflectance is actually the same (Palmer, 1999, 292). Given how strongly inclined we are to experience the Kanizsa triangle as (a) instead of (b), it seems reasonable to suppose that our perception of the figure in fact *represents* it as (a) rather than (b). Such an assumption indeed seems necessary to explain why the difference between the apparent brightness of the triangle and its background is apt to strike us as illusory, as illusions require a mismatch between the contents of our perceptions and the states of affairs that they purport to represent. To justify our classification of the triangle's apparent brightness as illusory, we thus seem compelled to treat our perception of the figure as having (a) as its content, rather than (b).

Yet it is difficult to see what could give our perception of the figure this content if not the phenomenal character of our experience of it. Judging from this example, the impact that grouping principles have on perceptual experience may thus be taken to play an important role in fixing perceptual content.

How does the impact of grouping principles on the phenomenal character and content of perception relate to the attentional effects discussed in the previous section? The typical situation seems to be as follows: principles of perceptual grouping organize our perceptual experience into distinct object-defined regions, and attention then selects one of the various coinstantiated objects within one of these regions, which object thereby becomes the representational target of our current perceptual state. Viewed in this way, grouping principles can be seen as performing the necessary pre-attentive structuring work of distinguishing between objects in adjoining or overlapping spatial regions in such a way as to enable attention to select one without also selecting the other.<sup>10</sup>

Support for this idea can be drawn from various studies reported by Prinzmetal (1995, 92-3)<sup>11</sup>, who reasons that:

[Insofar as i]t is reasonable to assume that the mechanisms responsible for the Gestalt laws describe how the visual system forms objects...[, t]he laws of perceptual organization should constrain feature integration in the following way: Features from different perceptual groups should be less likely to form illusory conjunctions than features from the same perceptual group.

In other words, if the role of Gestalt principles is to establish perceptual boundaries between objects and thereby make them potential targets of attention, then we should expect erroneous conjunctions of features that are located within the same Gestalt grouping to be more common



than erroneous conjunctions of features that are located in different Gestalt groups, since conjunctions of the latter sort require combining features across Gestalt-induced perceptual boundaries.

After gathering data on the likelihood of illusory conjunctions within and across perceptual groups established by means of the Principles of Proximity, Similarity, and Good Continuation, Prinzmetal (1995, 93) concludes that “[i]n all of these cases, the visual system avoids combining features from different perceptual groups.” As predicted by the hypothesis that Gestalt principles define potential targets for attention by organizing the perceived environment into object-defined regions for attention to fixate on, illusory conjunctions of visual features thus *do* seem to occur more frequently within Gestalt groupings than across Gestalt-induced perceptual boundaries. This lends at least some support to the view of the relation between attention and Gestalt principles proposed above.

In describing the relation between attention and principles of perceptual grouping, I suggested that the latter serve mainly to pre-attentively segment the perceived environment into distinct regions, and that among the various coinstantiated objects that fall within one of these regions, attention then selects the object that thereby becomes the representational target of our current perceptual state. I now want to suggest that grouping principles might also play a further role in inclining attention towards the selection of certain of the coinstantiated objects that fall within a given perceptually segmented region over others. As a result, attention may not be completely free to fix on any of the various possible targets that are coinstantiated at a given location. Grouping principles may influence how attention is allocated even within the perceptual boundaries that they establish.

Assigning grouping principles this additional attention-constraining function could help explain why we're so inclined to perceive rabbits as rabbits rather than as rabbit stages or undetached rabbit parts. For even if (as argued in the previous section) different patterns of attention are sufficient to distinguish perceptual representations of rabbits from perceptual representations of rabbit stages or undetached rabbit parts, some explanation is still needed for why we almost always attend to rabbit stimuli in such a way that we perceive them as rabbits. Grouping principles can be helpful here, for while rabbits, rabbit stages, and undetached rabbit parts all have the same effect on our sense organs, the grouping principles that structure our visual experience are not indeterminate between such entities. Due, e.g., to the Principles of Closure and Good Continuation, the fact that the outline of a rabbit's body is continuous makes it likely that the rabbit's parts will be grouped together as unified components of a bounded whole (even in cases the rabbit's body is partly occluded by an intervening object). This explains why we tend to attend to rabbit stimuli in such a way that they appear to us as unified, coherent objects, rather than as assemblages of distinct rabbit parts. This grouping is reinforced by UC and the Principles of Similarity and Proximity, which group the various parts of the rabbit together insofar as they are closer and more similar to one another in color and texture than objects in adjoining regions of the perceived environment. Due, moreover, to the Principle of Common Fate, the fact that a rabbit's parts all move together (so that, e.g., when the rabbit's front half moves off to the left, its back half moves left along with it) make it likely that our successive perceptions of the rabbit will be grouped together as perceptions of a unified object persisting through time. This explains why we tend to attend to rabbit stimuli in such a way that they appear to us as continuous, enduring objects, rather than as series of discrete rabbit stages.

Palmer and Rock (1994, 38) suggest that once a set of basic “entry-level units” has been constructed by UC, these basic units can then be further structured “by putting several units together via [classical Gestalt] grouping processes”, or “by dividing a basic level unit into subparts via parsing processes.” The application of such parsing processes could explain how, once a rabbit has been perceptually distinguished from its surroundings, we can then selectively attend to different parts of the rabbit (e.g. its ears, or tail), insofar as these parts can themselves be distinguished from the rest of the rabbit’s body by grouping principles (e.g. by virtue of the fact that the components of that part are bounded by a more-or-less continuous outline, or are more similar in color or texture to one another than to adjoining parts of the rabbit’s body). The fact that the parts we selectively attend to nevertheless remain bound by grouping principles to the rest of the rabbit’s body (which is treated by those same principles as a unified, enduring object rather than as a collection of distinct rabbit parts or series of rabbit stages) can help further explain the aforementioned fact that when we attend to a rabbit’s nose, we are apt to perceive it as the nose of a rabbit rather than as a nose attached to various undetached rabbit parts or a nose at the center of a series of nose-less rabbit stages. Even if we are so fixated on the rabbit’s nose that our attention hasn’t spread to any other parts of the rabbit’s body, the operation of grouping principles outside the scope of attention may account for why we are still inclined to perceive the rabbit’s nose as part of a larger, unified, enduring object.

## **6. Is phenomenal consciousness epiphenomenal with respect to content?**

An objection must now be considered that questions whether the effects that attention and grouping principles have been suggested as having on perceptual content are indeed attributable to the impact that they have on perceptual experience. Against this, one might hold that while

attention and grouping principles have some effect on both the phenomenal character and contents of perception, it is nevertheless not *by virtue of* the effects that they have on perceptual experience that they determine perceptual content in the way that they do. Such phenomenal effects may, in short, be *epiphenomenal* with respect to the determining influence that attention and grouping principles have on perceptual content. In support of this idea, one might argue that the impact that these factors have on perceptual content can be fully explained in terms of the effects they have on how the information that our perceptual systems receive from the environment is processed at the sub-personal level, without appealing to perceptual experience at all. If such an account proves viable, then any appeal to phenomenal consciousness as a means of lending further determinacy to the contents of perception might seem explanatorily idle.

While it is difficult to think of any empirical data that could conclusively decide this issue, there are at least two considerations that suggest that perceptual experience is *not* epiphenomenal, but instead plays an important role in the determination of perceptual content. First, there would be little (or at least far less) reason to think that the attention and grouping principles have any impact on perceptual content if it weren't for the influence that they have on perceptual experience. Consider again the Kanizsa triangle. The main reason we have for thinking that we perceptually represent the figure as a white triangle superimposed on three black dots (rather than as three pac-man shapes on a uniform white background) is that the figure *appears* this way to us in visual experience. While we could perhaps arrive at the same verdict about the content of our perception of the figure by other means (e.g. by making inferences from our behavior with respect to it), in doing so we would overlook what seems clearly to be the most relevant factor: viz. the phenomenal character of our experience of the figure. Indeed, were it not for the impact that the various principles of perceptual grouping have on perceptual

experience, it is unclear how we could ever have become aware of their existence, let alone the effects they seem to have on perceptual content. Similar remarks apply to attention. Whether attending to an object alters its apparent low-level features, or instead merely makes it more phenomenally salient, in the absence of phenomenal consciousness, attention seems incapable of selecting objects in such a way as to enable us to refer to them by means of perceptual demonstratives, or indeed form any (personal-level) perceptual representations of them at all (Campbell, 2002, 223). In order for attention to determine the contents of our perceptual representations, it thus needs to have some impact on perceptual experience. Contrary to the aforementioned objection, the phenomenal effects of attention and grouping principles hence seem essential to, and not mere epiphenomenal side effects of, the determining influence they have on perceptual content.

Second, evidence that seems to tell against assigning any content-determining role to perceptual experience can be dealt with by distinguishing between different forms of perceptual content. Interpreted in one way, e.g., the abilities of blindsight patients might seem to indicate that perceptual experience plays no role in the determination of perceptual content. For while blindsighters have no visual experience of objects in their blind region, their ability to reliably guess (when forced) whether a line presented in their blind region is vertical or horizontal suggests that there must be *some* accurate representation in them of the line's orientation. This might be taken to show that phenomenal consciousness doesn't bestow any added determinacy on our perceptual representations, but at most gives us more immediate *access* to certain representations whose content has already been fixed by subconscious neurocomputational processes. While phenomenal consciousness thus may not be *completely* epiphenomenal (as it may make perceptual representations that are phenomenally conscious more accessible to central

processing than those that are not), on this view, it nevertheless plays no role in the determination of perceptual *content*.

The evidence that blindsight seems to provide against the claim that phenomenal consciousness determines perceptual content can be dealt with by distinguishing between two forms of perceptual representation and content, one of which (representation<sup>+</sup>/content<sup>+</sup>) is (a) personal-level, (b) determined by perceptual experience, and (c) reflected in our verbal reports about what we perceive, and the other of which (representation<sup>\*</sup>/content<sup>\*</sup>) is (a) sub-personal, (b) determined (at least partly)<sup>12</sup> by neurally implemented computational processes, and (c) reflected in actions guided by phenomenally unconscious perceptions and other indirect measures, e.g. masked priming effects, and blindsighters' guesses in forced-choice tasks. Drawing this distinction enables us to account for both the accuracy of blindsighters' guesses (as due to the accuracy of their sub-personal representations<sup>\*</sup> of certain objects or features in their blind region) and their claims to be unable to see anything that falls within their blind region (as due to the fact that they have no personal-level representations<sup>+</sup> of the objects in their blind region). With this distinction in place, blindsight gives us no reason to deny perceptual experience a role in the determination of perceptual content<sup>+</sup>. The abilities of blindsighters just show that individuals can sometimes have a representation<sup>\*</sup> of a stimulus without having any corresponding representation<sup>+</sup> of that stimulus.

Putting things this way may, however, merely seem to dodge the point at issue. For one might object that the personal-level representations<sup>+</sup> whose content I've suggested must be determined by phenomenal consciousness are in truth just meta-representations of certain first-order, sub-personal representations<sup>\*</sup> whose content is in no way dependent upon phenomenal consciousness. There would then be no reason to treat phenomenal consciousness as playing any

role in determining the content of our personal-level representations+, as their content would instead be fixed by the contents of the sub-personal representations\* that they are representations of.<sup>13</sup>

To meet this objection head-on, it seems to me that Plists must hold that no *determinate* content can be assigned to phenomenally unconscious, sub-personal representations\* unless we treat such representations\* as deriving their content from the roles they normally play in producing certain phenomenally conscious personal-level representations+ whose content is determined by their phenomenal character. If we want to fix the content of sub-personal representations\* by other means (i.e. *without* appealing to the content of the personal-level representations+ that they help to produce), the most promising way of doing so would presumably be to invoke some externalist theory of content of the sort discussed in Section 2. Yet if the problems that such theories were noted as facing are legitimate, then pursuing this route will leave us unable to assign any *determinate* contents to our sub-personal representations\*, in which case we cannot use those representations\* to fix the contents of our personal-level representations+ in the way that the foregoing objection suggests. For we cannot explain how our representations+ come to have the determinate contents that they do by saying that they are representations of sub-personal representations\* if there is no determinate fact of the matter as to what the latter represent.

With this point in mind, Plists might hold that while determinate contents *can* be assigned to sub-personal representations\*, such ascriptions of content can only be made on the basis of certain relations that the sub-personal states to which content is ascribed bear to certain personal-level representations+ whose content is determined by their phenomenal character. This implies that the content of sub-personal representations\* is a form of *derived* (as opposed to

*original*) intentionality, at least insofar as we want to treat such content as *determinate*. In support of this idea, one might suggest that when we assign content to phenomenally unconscious states involved in the sub-personal processes that give rise to a certain phenomenally conscious perceptual representation+ P, our ascriptions of content to those states are guided by our knowledge of P's content (which derives from our knowledge of P's phenomenal character) and the role that each of those states plays in producing P. Thus, when we treat the activity of certain neurons as representing a horizontal line in the center of our visual field as opposed to a line stage or collection undetached line parts, this is at least partly because the sub-personal process in which that activity figures typically gives rise to a personal-level perception whose phenomenal character is such that it represents a horizontal line in the center of our visual field (as opposed to a line stage or collection undetached line parts).

A similar account can be given of cases wherein we ascribe content to certain sub-personal states that don't give rise to any phenomenally conscious representation+ whatsoever, e.g. blindsighters' representations\* of stimuli in their blind region, or subjects' representations\* of masked stimuli in masked priming studies. When a blindsight patient correctly reports that a line presented in their blind region is horizontal, we assume that there is some sub-personal state of their visual system that represents\* the presence of a horizontal line in that area, rather than a line stage or a collection of undetached line parts. On the account under consideration, this is because (a) in normal perceivers, the same stimulus produces a phenomenally conscious perception that, by virtue of its phenomenal character, represents the stimulus as a horizontal line (rather than a line stage or collection of undetached line parts), (b) we take the blindsighter to be in some of the same sub-personal states that a normal perceiver is in when having a phenomenally conscious perception of a horizontal line, and (c) in both cases, the contents



assigned to those sub-personal states depend on the contents of the phenomenally conscious perceptual states that they normally help to produce. Thus, even in cases where we have sub-personal representations\* of a given stimulus without any phenomenally conscious representation+ of it, the content we ascribe to those representations\* may depend on the content of the phenomenally conscious representation+ that we think they *would've* helped produce were they not prevented from doing so by masking, neural damage, or some other cause. If this is correct, then contrary to the foregoing objection, we can't treat the content of personal-level representations+ as fixed by certain sub-personal representations\* that they are representations of. If we want there to be a determinate fact of the matter as to what our sub-personal representations\* represent, the content of those representations must be explained at least partly in terms of the phenomenally determined content of the personal-level representations+ that they help to produce, rather than the other way around.

This brings us to one final objection that one might raise to the line of thought pursued in this paper, which is that the same Quinean considerations that have traditionally been used to cast doubt on the determinacy of mental content apply with equal force to the factors that I've suggested help fix the contents of perception.<sup>14</sup> Even if we possessed the full body of actual and possible evidence and non-intentional scientific theory, Quine (1960, ch.2) argues that we would still be left with multiple, incompatible ways of ascribing content to the utterances and mental states of individuals, and that there is no further fact that could determine which of these overall ascriptions of content is correct. If Quine is right about this, then there's no obvious reason why we shouldn't also be able to provide multiple, incompatible interpretations of subjects' reports of how things seem to them, each of which is paired with a correspondingly different interpretation of the grouping principles, attentional effects, and other theoretical notions that psychologists

appeal to in explaining such reports. If there is no way of determining which of these interpretations is correct, then we can hardly use attention and grouping principles to fix perceptual content in the way I've suggested, for the nature of these principles and attentional effects will *themselves* be indeterminate, in the sense that there will be multiple, incompatible ways of interpreting what psychologists mean when they describe them, none of which has any more claim to objective validity than another.

In response, Plists might argue that Quine is only able to arrive at his conclusion that the totality of actual and possible evidence underdetermines ascriptions of mental content by excluding first-personal data about the phenomenal character of our experiences from the body of evidence relative to which such ascriptions are made (Searle, 1987). This begs the question against Plists, who will hold that to disregard such data in deciding what the contents of our mental states are is to leave out the very thing that determines such content. No wonder, then, if mental content *seems* indeterminate when the body of evidence that we use to determine it is restricted in this way! Plists will consequently *agree* with Quine (*against* externalist theories of content) that no amount of *third-personal* evidence and non-intentional scientific theorizing will enable us to assign any determinate content to our mental states. Unlike Quine, however, Plists take this to show *not* that mental content is indeed indeterminate, but rather that there are other determinants of such content besides the third-personal factors that Quine and externalists restrict their attention to, viz. the subjective experience of the individuals that are in the mental states to which content is attributed.

Similar considerations apply to the grouping principles and attentional effects that I've suggested help determine mental content by way of the impact that they have on perceptual experience. Since these factors are identified at least partly in terms of their phenomenal effects,

it should again be no surprise if we can't provide any determinate characterization of them when such effects are excluded from the body of evidence relative to which such characterizations are made. Here too, Plists can agree with Quineans that no determinate characterization of such principles and effects can be given so long as our characterization of them is constrained only by third-personal evidence regarding their neural realizers and behavioral effects. For Plists, however, this shows not that such factors are indeterminate, but rather that our characterization of them must be further constrained by first-personal evidence regarding their impact on perceptual experience.

Faced with skepticism about the determinacy of mental content, one may begin to wonder whether our mental states really have any representational content at all. If there is no fact of the matter as to what any given mental state represents, then the very notion of mental representation may begin to seem at most a useful fiction. Externalist theories of content are unable to defuse such skepticism, as the content-determining causal and/or biological relations they posit cannot distinguish between necessarily coincident but distinct *representata*. Plists suggest that we can avoid this problem by assigning an additional content-determining role to subjective experience. Thus far, however, Plists have failed to specify what it is about subjective experience that enables it to confer determinacy on the contents of our mental states. This paper has suggested that an answer to this question can be found in attention and principles of perceptual grouping, both of which alter our perceptual experience in ways that thereby help determine the contents of perception. While we cannot conclusively rule out the possibility that the phenomenal effects of attention and grouping principles themselves play no role in the determination of perceptual content, reasons have been given for viewing this hypothesis as less likely than its alternative. If

these reasons are valid, then PI is vindicated: there is a form of mental content (viz. perceptual content) that is determined by phenomenal consciousness (more specifically, by the effects that attention and grouping principles have on perceptual experience). Building on these results, we may hope to develop a general PI-based theory of mental content that avoids any dubious appeals to cognitive phenomenology, and instead treats the contents of non-perceptual mental states as deriving their determinacy at least partly from the relations that they bear to perception. Taking this further step is, however, a task for another paper.

## Notes

<sup>1</sup> See, e.g., Strawson (2010), Kriegel (2011), and Horgan and Graham (2012). I sympathize with the objections to cognitive phenomenology raised by Lormand (1996) and Carruthers and Veillet (2011).

<sup>2</sup> Perhaps the most representative example of CTC is Fodor's (1987) Asymmetric Dependence theory.

<sup>3</sup> This line of criticism has been forcefully pressed by Gates (1996).

<sup>4</sup> The most extensive defense of TTC that I know of against these kinds of determinacy objections is Neander (2017, ch.7-9), but I don't think she fully addresses the problem raised here. Much of her defense relies on the claim that even in cases where  $F$  and  $G$  are "locally co-instantiated" and were moreover both "causally implicated in the selection of" a certain representation producing system  $S$ ,  $S$  can nevertheless still produce representations in response to instances of  $F$  "in virtue of their [ $F$ ]-ness" without likewise responding to the coinstantiated instances of  $G$  "in virtue of their [ $G$ ]-ness." In cases, though, where  $F$  and  $G$  are necessarily coincident, it is unclear what could entitle us to say that it is  $F$ -ness rather than  $G$ -ness that  $S$  is responding to. In a footnote, Neander (2017, 167fn21) acknowledges the problem that Gates' (1996) gavagai-style cases raise for TTC, but offers no response. Contrary to the general drift of her remarks there, I also see no reason why such cases shouldn't raise the same difficulties for externalist accounts of non-conceptual, sensory-perceptual representations that they do for conceptual representations.

<sup>5</sup> Prominent PLists include Horgan and Tienson (2002), Loar (2003), Strawson (2010), and Mendelovici (2018).

<sup>6</sup> The basic idea is to make use of Peacocke's (1992, 88-9) observation that certain concepts constitutively depend on perception, in that one cannot possess such concepts unless one is disposed to deploy them when in certain perceptual states. Insofar as the content of the perceptual states that figure in the possession conditions of such concepts is determined by perceptual experience, the same will likewise be true (albeit in a much more indirect sense) of the content of any non-perceptual mental states in which such concepts figure.

<sup>7</sup> Block (2010) offers a slightly different interpretation of Carrasco et al.'s (2004) study, arguing that while it *does* show that attention alters apparent contrast, the phenomenal effects of attention are *not* accompanied by any changes in perceptual content, because one's perceptions of a patch while attending to it and while not attending to it are both non-illusory. However, one might agree with Block that subjects' perceptions of the unattended and attended patch in Carrasco et al.'s study are both non-illusory while denying that this implies that both perceptions have the same content. For instance, one might follow Stazicker (2011) and Nanay (2010) in holding that attention alters perceptual content by making it more determinate (in the determinable-determinate sense) than it would otherwise be. When attending solely to one of two patches with the same specific, determinate contrast  $C$ , subjects may thus perceive the attended patch as having  $C$  while perceiving the unattended patch as having some determinable level of contrast  $C^*$  that has  $C$  as one of its determinates. Just as a perception of a scarlet surface as red isn't illusory, but merely less determinate than a perception of it as scarlet, so too neither of these perceptions of the patches need qualify as illusory despite their differences in content.

<sup>8</sup> Thanks to an anonymous referee for pressing me to address this issue. I return to it in the following section.

<sup>9</sup> I'll henceforth refer to these principles collectively as “grouping principles” or “principles of perceptual grouping.”

<sup>10</sup> Palmer and Rock (1994, 39) tell a slightly different story, according to which the classical Gestalt “grouping processes occur only after UC elements have been detected and after attention has been deployed to a set of such previously defined elements.” For evidence that Gestalt grouping is instead *pre-attentive*, see Lamers and Roelofs (2007), Lamy et al., (2006), and Russell and Driver (2005).

<sup>11</sup> See also Baylis and Driver (1992) and Duncan (1984).

<sup>12</sup> The reason for this qualification will be made clear below, where it is argued that ascription of *determinate* content to sub-personal representations\* depends ultimately on the role they normally play in producing personal-level representations+ whose content is determined by their phenomenal character.

<sup>13</sup> Many thanks to an anonymous referee for raising this objection.

<sup>14</sup> Thanks to an anonymous referee for drawing my attention to this objection.

## References

- Baylis, Gordon, and Jon Driver. 1992. "Visual Parsing and Response Competition: The Effect of Grouping Factors." *Perception and Psychophysics* 51: 145–62.
- Beck, Jacob, and Keith Schneider. 2017. "Attention and Mental Primer." *Mind & Language* 32: 463–94.
- Block, Ned. 2010. "Attention and Mental Paint." *Philosophical Issues* 20: 23–63.
- Campbell, John. 2002. *Reference and Consciousness*. Oxford University Press.
- Carrasco, Marisa, Sam Ling, and Sarah Read. 2004. "Attention Alters Appearance." *Nature Neuroscience* 7: 308–13.
- Carruthers, Peter, and Bénédicte Veillet. 2011. "The Case Against Cognitive Phenomenology." In *Cognitive Phenomenology*, eds. Tim Bayne and Michelle Montague. Oxford University Press.
- Davidson, Donald. 1979. "The Inscrutability of Reference." *Southwestern Journal of Philosophy* 10: 7–19.
- Dretske, Fred. 1988. *Explaining Behavior*. MIT Press.
- Duncan, John. 1984. "Selective Attention and the Organization of Visual Information." *Journal of Experimental Psychology* 113: 501–17.
- Fodor, Jerry. 1987. *Psychosemantics*. MIT Press.
- Gates, Gary. 1996. "The Price of Information." *Synthese* 107: 325–47.
- Horgan, Terence, and John Tienson. 2002. "The Intentionality of Phenomenology and the Phenomenology of Intentionality." In *Philosophy of Mind: Classical and Contemporary Readings*, ed. David Chalmers. Oxford University Press.



- Horgan, Terence, and George Graham. 2012. "Phenomenal Intentionality and Content Determinacy." In *Prospects for Meaning*, ed. Richard Schantz. De Gruyter.
- Kriegel, Uriah. 2011. "Cognitive Phenomenology as the Basis of Unconscious Content." In *Cognitive Phenomenology*, eds. Tim Bayne and Michelle Montague. Oxford University Press.
- Lamers, Martijn, and Ardi Roelofs. 2007. "Role of Gestalt Grouping in Selective Attention: Evidence from the Stroop Task." *Perception and Psychophysics* 69: 1305–14.
- Lamy, Dominique, Hannah Segal, and Lital Ruderman. 2006. "Grouping Does Not Require Attention." *Perception and Psychophysics* 68: 17–31.
- Loar, Brian. 2003. "Phenomenal Intentionality as the Basis of Mental Content." In *Reflections and Replies: Essays on the Philosophy of Tyler Burge*, eds. Martin Hahn and B. Ramberg. MIT Press.
- Lormand, Eric. 1996. "Nonphenomenal Consciousness." *Noûs* 30: 242–61.
- Mendelovici, Angela. 2018. *The Phenomenal Basis of Intentionality*. Oxford University Press.
- Millikan, Ruth. 1984. *Language, Thought and Other Biological Categories*. MIT Press.
- . 1989. "Biosemantics." *Journal of Philosophy* 86: 281–97.
- Nanay, Bence. 2010. "Attention and Perceptual Content." *Analysis* 70: 263–70.
- Neander, Karen. 2017. *A Mark of the Mental: In Defense of Informational Teleosemantics*. MIT Press.
- Palmer, Stephen. 1999. *Vision Science: Photons to Phenomenology*. MIT Press.
- Palmer, Stephen, and Irvin Rock. 1994. "Rethinking Perceptual Organization: The Role of Uniform Connectedness." *Psychonomic Bulletin and Review* 1: 29–55.
- Peacocke, Christopher. 1992. *A Study of Concepts*. MIT Press.
- Prinzmetal, William. 1995. "Visual Feature Integration in a World of Objects." *Current Directions in Psychological Science* 4: 90–4.

- Quine, W. V. 1960. *Word and Object*. MIT Press.
- Russell, Charlotte, and Jon Driver. 2005. "New Indirect Measures of 'Inattentive' Visual Grouping in a Change-Detection Task." *Perception and Psychophysics* 67: 606–23.
- Searle, John. 1987. "Indeterminacy, Empiricism, and the First Person." *Journal of Philosophy* 84: 123–46.
- . 1992. *The Rediscovery of the Mind*. MIT Press.
- Stazicker, James. 2011. "Attention, Visual Consciousness and Indeterminacy." *Mind & Language* 26: 156-84.
- Strawson, Galen. 2010. *Mental Reality*. 2nd ed. MIT Press.
- Treisman, Anne. 1998. "Feature Binding, Attention, and Object Perception." *Philosophical transactions of the Royal Society of London* 353: 1295-306.
- Treisman, Anne, and Garry Gelade. 1980. "A Feature Integration Theory of Attention." *Cognitive Psychology* 12: 97-136.
- Wertheimer, Max. 1938. "Laws of Organization in Perceptual Forms." In *Source Book of Gestalt Psychology*, ed. Willis Ellis. Harcourt, Brace, and Co.
- Wu, Wayne. 2014. *Attention*. Routledge.