

Attention and perceptual organization

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Abstract How does attention contribute to perceptual experience? Within cognitive science, attention is known to contribute to the organization of sensory features into perceptual objects, or “object-based organization.” The current paper tackles a different type of organization and thus suggests a different role for attention in conscious perception. Within every perceptual experience we find that more subjectively interesting percepts stand out in the foreground, whereas less subjectively interesting percepts are relegated to the background. The sight of a sycamore often gains the visual foreground for a nature lover, whereas the sound of a violin often gains the auditory foreground for a music lover, but not necessarily vice versa. How does the perceptual system organize early sensory processing according to the subject’s interests? The current paper reveals how this subject-based organization is brought about and maintained through top-down attention. In fact, the current paper argues that top-down attention is necessary for conscious perception in so far as it is necessary for bringing about and maintaining the subject-based organization of perceptual experience.

Keywords Attention · Perception · Siegel · Phenomenal contrast · Treisman

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1 Introduction

The ultimate claim of this paper is that top-down attention¹ is necessary for conscious perception.² More specifically, this paper argues that top-down attention is necessary for bringing about and maintaining the subject-based organization that we find in every instance of conscious perception. “Subject-based organization” is a phrase introduced in this paper, and stands in for the structural features of conscious experience that correspond with and are based on the subject’s goals and interests. That is, subject-based organization is organization by the subject according to the goals and interests of the subject. The paper makes use of empirical findings in order to make this claim, including the finding that sensory processing is first organized in terms of perceptual features, and only later re-organized into perceptual objects. This discovery paves the way for the claim that subject-based organization is a late development in perceptual processing that requires explanation. This paper also makes use of background assumptions, including the assumption that conscious perception shares some structural correspondence with its physical underpinnings and that each instance of conscious perception depends for its existence on the processing of sensations. These assumptions allow for evidence from empirical science to be brought to bear on evidence from phenomenological reflection, which is essential to the arguments in this paper. Once one accepts these starting conditions, the ultimate claim of the paper hinges on findings from phenomenological reflection, which are discussed in the next section. Before presenting those findings, I will briefly provide some empirical context for the paper, starting with the work of Anne Treisman and Garry Gelade.

Anne Treisman put forward the feature-integration theory (FIT) with Garry Gelade in order to explain the organization of perceptual objects (Treisman and Gelade 1980). This explanation was deemed necessary because of their finding that certain visual features (e.g. color and orientation) can be detected with little to no interference from other features and/or objects. Since this is thought to reveal the early sensory processing of features, before the processing of multi-feature objects, it then became a problem to explain how the features are perceived together as individual objects. That is, it became a problem to explain how the color and orientation of the trunk of a sycamore in a long row of sycamores become bound to that particular trunk, given the supposition that color and orientation are first processed separately. In FIT, so-called “focal attention” is claimed to bind the features of each object through spatial location codes. The idea is that focal

¹ I focus on top-down attention because the term “attention” has come to be applied to such a wide range of phenomena and because a bottom-up distribution of resources, sometimes called “attention,” occurs in all neural processing. I thus use the more specific “top-down attention” to mean “the task-dependent direction of cognitive and neural resources by the subject.” This does not mean that the ultimate distribution of cognitive and neural resources is completely controlled by the subject, but only that this distribution has been influenced by the subject through top-down feedback.

² In this paper I isolate conscious perception as a whole experience to avoid looking at it piecemeal. That is, I want to avoid arguments about whether some part of perceptual experience has benefitted from attention and focus on whether attention is necessary for the essential structural features of conscious perception.

attention brings together just those features that have same spatial location code as the attended spatial location. When I focally attend to the location of the trunk of a sycamore, for example, only the color that has the same location code as that particular trunk will be bound to it. Early critics of FIT noted that object-based organization sometimes occurs with little to no attention for objects with particularly salient features, “salience” being the outcome of pre-attentional resource distribution (Wolfe et al. 1989). Mature FIT holds that bottom-up salience guides top-down focal attention in this process and even allows the binding of multi-feature objects to occur by virtue of bottom-up salience on its own (Treisman 1988, 1998).

Although FIT has been widely criticized in philosophy and cognitive science (Wolfe et al. 1989; Singer and Gray 1995; Watzl 2011; Mole 2011), some of its claims withstand those criticisms. Specifically, it is generally accepted that certain visual features are first processed in relative isolation and only later grouped into objects, in part because of supporting work that demonstrates early neural specificity for these features (e.g. color in Hadjikhani et al. 1998 and orientation in Haynes and Rees 2005), reviewed by Kalanit Grill-Spector and Rafael Malach (Grill-Spector and Malach 2004). Moreover, it is generally accepted that salience information is processed alongside this feature-based information, enabling visual search (Li 2002). Top-down attention, whether focal or otherwise, is generally thought to stimulate and/or suppress this salience information, according to the current goals of the subject (Reynolds and Heeger 2009).

These claims leave open the question of how early sensory processing relates to perceptual experience. That is, if we assume that perceptual experience is rooted in early sensory processing, we might ask whether that processing is sufficient for perceptual experience (e.g. Lamme 2004; Block 2008) or whether some further processing, such as the top-down feedback of attention, is required to bring about conscious perception (e.g. Dehaene and Naccache 2001). The ultimate claim of this paper is that top-down attention is necessary for conscious perception, but the arguments proceed differently from those of other authors in this debate (e.g. Prinz 2012). Namely, in the arguments presented here top-down attention is shown to be necessary for subject-based organization, and subject-based organization is argued to be essential to conscious perception. Importantly, although subject-based organization is argued to be essential to conscious perception, it is not here argued to be essential to consciousness, in general. It is my view that there are forms of consciousness that do not have subject-based organization and thus do not require the work of attention.

2 Perceptual organization

Conscious perception is organized in many different ways. Why think that subject-based organization is essential to conscious perception, as opposed to other forms of organization or no form of organization at all? Conceptual reasoning inspires this line of thinking, but the main argument turns on findings from phenomenological reflection. The conceptual reasoning comes down to this: the concept of perception

essentially includes the concept of subject-based organization. That is, the concept of perception is normally understood in contrast with the concept of sensation, and the key difference between these is that perception, unlike sensation, is informational to the subject of perception. Philosophers have worded the point in different ways: for Husserl, “perception consists in the ‘interpretation’ (*Auffassung*) of intrinsically non-representational sensations” (Hopp 2008, p. 219), whereas for Reid, sensation is the feeling that causes and “goes along with” the “apprehension” of perception (Buras 2009, pp. 330–332). In these and other accounts of perception, perception is informational in a sense that sensation is not, involving “interpretation,” “apprehension,” “understanding,” etc. But in what sense? Hamlyn distinguishes between a sense of “information” used in Dretske, Evans, and Crane, in which “the stimulation of our sense-organs produces an informational state” by simply corresponding with structures in the world, and the sense of “information” used by Gibson and others, in which “perception provides us with information about the world,” the first of which he claims is “parasitic on” the second (Hamlyn 1994, pp. 143 & 151). Perception appears to be distinct from sensation in being informational in the second sense—it provides *us* with information *about* the world, instead of merely corresponding with the world. But in order for perception to be informational to the subject, perception must include some minimal degree of organization that accords with the outlook of the subject. In other words, it must have *subject-based organization*.

Following this conceptual reasoning, one might be led to wonder whether conscious perception carries experiential markers of this subject-based organization. I believe that it does. To see this, perform the following experiment in *phenomenal contrast* (a method introduced in Siegel 2006): imagine that you are in a room with dark gray walls, ceiling, and floor and a single source of dim overhead light. In that room is a sitting cushion and a small table. On the table is a steaming pot of tea. Imagine that you are sitting on the cushion facing the teapot with your eyes open, fixated on the teapot, breathing steadily and slowly. To yield the phenomenal contrast, compare two versions of this experience in your mind. In the first version of this experience, imagine that you are interested in observing the steam from the pot of tea. In the second version of this experience, imagine that you are interested in observing your breath, as in a session of yogic meditation. Nothing else about the situation should be different except for this difference in interest. In that case, does your perceptual experience differ between these two scenarios?

If conscious perception carries experiential markers of subject-based organization, then they should reveal themselves in experiments such as this. The only difference in the two scenarios is thought to be a difference in the subject’s interests. Thus, the phenomenal contrast brought about by that difference in interest is a candidate instance of subject-based organization in experience.

So what is yielded by this phenomenal contrast? I suspect that most experience the stimulus of interest to be in the foreground, and the other stimulus to be in the background. That is, I suspect that most experience the steam in the foreground when interested in the steam, and the breath in the foreground when interested in the breath. This is not to say that most people experience the stimulus of interest to be in the spatial foreground; the stimulus of interest is experienced as though in the

foreground of the mind. One might experience this in terms of epistemic proximity: the stimulus of interest might appear more available for knowledge, whereas the background stimulus might appear less available for knowledge. Or one might experience it in terms of importance, meaningfulness, or richness: the background stimulus might seem less subjectively important, meaningful, and rich than the foreground stimulus. However one experiences the difference between foreground and background in this experiment, the difference itself reveals a structural feature of experience that corresponds with the subject's interests.³ As I will claim below, this structural feature of experience is an essential feature of conscious perception.

The above experiment in phenomenal contrast took place across modalities (visual and haptic), but the contrast also occurs within modalities. Consider the following example from taste: imagine that while drinking scotch with friends, one of your friends remarks on the buttery flavor of the scotch while another notes its smokiness. Imagine that in one scenario you are interested in the buttery flavor, whereas in the other scenario you are interested in the smoky flavor. Is there a difference between these perceptual experiences? Or consider this example from audition: imagine that while listening to the symphony you are, in one scenario, interested in the oboe, while in the other you are interested in the cello. What difference in experience corresponds with this difference in interest, if any? I contend that, for most people, the difference in both of these examples will come down to the felt prominence of the stimulus of interest in comparison with the other stimulus, as in the cross-modal example.

What I have said so far might be enough to convince the reader that conscious perception has subject-based organization, at least in some cases. Why think that this form of perceptual organization is both fundamental and universal to conscious perception? There are other forms of perceptual organization—why can't these other forms of organization provide the minimal structure that distinguishes perception from sensation?

Let's start with feature-based organization. Feature-based organization is the organization of sensory input into sensory features. In vision, it divides colors from orientations, reds from greens, and verticals from horizontals. This type of organization, seemingly basic, actually presupposes other forms of organization: we perceive a bright red line or a dull gray cross, but not simply redness or dullness. Further, conscious perception does not always involve feature-based organization. When we smell vanilla, hear our mother's voice, or recognize a friend's handwriting, our perceptual experience might not include the spiciness of the vanilla, the pitch of our mother's voice, or the shape of the written letters—it might come as a whole percept without decomposable parts. Thus, some other form of

³ Similar structural differences are described at length in the work of Aron Gurwitsch (1964, 1985) and in a paper by Sebastian Watzl (2011), although both authors discuss the differences in terms of consciousness, rather than conscious perception. The focus of these other works is also distinct from that of the current paper: Gurwitsch aims to characterize consciousness ("We shall establish and substantiate the thesis that every total field of consciousness consists of three domains"), whereas Watzl aims to characterize attention ("This paper defends and develops the structuring account of conscious attention"). The current paper instead argues for a dependency relation between conscious perception and attention.

organization will have to account for the informational content of these types of percepts.⁴ In any case, we do not normally perceive sensory features on their own, but organized according to their proper objects, which requires a new form of organization.

Object-based organization, introduced at the start of the paper, is the organization of sensory features into perceptual objects. Although an important feature of conscious perception, this form of organization is neither universal nor fundamental to conscious perception. It isn't universal to conscious perception because there are perceptual experiences that do not have object-based organization—think of the visual experience of a cloudless, orb-free sky. Object-based organization is not fundamental to conscious perception because it presupposes other forms of organization—to perceive an object is to perceive its relations to other stimuli, objects or otherwise.

One type of organization that could provide for the relations between objects and other stimuli is space-based organization. Space-based organization is the organization of features, patterns and objects into a common space–time matrix. This form of organization is nearly universal to conscious perception, although I think we can imagine conscious perception without it: imagine someone who perceives two pains—the pain of recent heartache and the pain of a hangover—without localizing these pains in a common space–time matrix. Even if space-based organization were universal to conscious perception, it would not be the most fundamental form of perceptual organization, since it cannot account for whether a percept is or is not perceived when viewing, for example, a bistable stimulus. That is, space-based organization cannot account for the difference between one's experience of a duck and one's experience of a rabbit while perceiving the duck-rabbit, because there is no change in space-based organization from one to the other percept (i.e. the same features, patterns, and objects are organized in the same way relative to a common spatial matrix). Since object-based organization also stays the same (i.e. the same features are organized according to the same proper object), some further form of perceptual organization is needed to account for this change.

One possible solution to this problem is to propose the existence of internal organization, or field-based organization. Field-based organization is the organization of parts of a perceptual field by other parts of the perceptual field or by the perceptual field as a whole. Depth perception is likely influenced by field-based organization, for example, in the Moon illusion, where the moon appears closer and larger by virtue of other parts of the perceptual field (e.g. buildings on the horizon). Bistable percepts might self-organize into one or the other percept through some combination of neural fatigue and field-based organization. However, even if field-based organization can explain organic switching between bistable percepts, it fails to explain the subject's apparent control over this switching. In some cases the duck or the rabbit seem to simply emerge from the duck-rabbit, but in others we seem to bring about the change from one to the other, such as when we are trying to see one

⁴ Admittedly, I do not know what form of organization could account for this type of perception, the informational content of which seems merely ostensive.

or the other percept. Thus, field-based organization does not offer a complete account of bistable switching.

The limited explanatory power of field-based organization is even clearer in more complex cases of perceptual competition, where a cross-subject comparison is required. One such example is the difference between a “split” experience and a “switch” experience. Imagine that good friends Abbie and Bennie are trying to read the same section of identical newspapers when a group of friends nearby start to have a conversation about some other topic in the news. Imagine that Abbie has a *split* experience: the onset of the conversation causes tension with the reading of the paper, such that both are present in her perceptual experience but in a competitive, split fashion. Imagine that Bennie has a *switch* experience: the onset of the conversation causes him to stop reading the paper (or vice versa). If perceptual organization was limited to feature-based organization, object-based organization, space-based organization, and field-based organization, we would expect the perceptual experiences of two subjects looking at (approximately) the same stimuli in the same conditions to be (approximately) the same. Instead, their perceptual experiences are radically different. Thus, some further form of perceptual organization is required to explain these differing outcomes of perceptual competition.

This further form of perceptual organization is organization according to the subject’s interests, or subject-based organization, introduced above. Recall the example of observing the breath in yogic meditation versus observing the steam of a teapot. In one scenario the breath is central to the subject’s interests, so the steam of the teapot is experienced in the background, whereas in the other scenario these roles are flipped. The layering of experience into foreground and background (and all that lies between) according to the current tasks and interests of the subject is the purview of subject-based organization. As shown above, this layering sometimes makes a difference to what is or is not perceived, as in the bistable percept case and in the case of auditory switching. What’s more, the difference between split and switch experiences is best explained by a difference in the subject’s interests: Abbie must have had similar levels of interest in the conversation and in the paper, causing a split experience, whereas Bennie must have had more differential interest between these stimuli, causing a switch experience.

Thus, unlike feature-based organization, object-based organization, and space-based organization, field-based organization and subject-based organization can potentially account for whether or not something is perceived, making the latter two forms of organization more fundamental than the former three. Further, of field-based organization and subject-based organization, the latter can account for differences that the former cannot, such as the difference between a split experience and a switch experience, and seems to be present even in those cases better explained by the former, such as when the switching between bistable percepts is controlled by the subject. Thus, subject-based organization is the best candidate for the most fundamental and universal form of perceptual organization.

The sheer variety of percepts also makes this point: conscious perception can occur without feature-based organization (e.g. your mother’s voice), object-based organization (e.g. a cloudless, orb-less sky), space-based organization (e.g. two

pains that are not localized in space), and field-based organization (e.g. the smell of a rose), revealing the need for a more basic, primary form of perceptual organization. It is hard to imagine a more basic form of perceptual organization than subject-based organization, which is present in all of the above cases: your mother's voice, the cloudless, orb-less sky, the two pains, and the smell of a rose were all called by your imagination to the foreground of your experience, against some experiential background. Subject-based organization requires only that the sensory input makes some difference to the subject, but does not specify what sort of difference that has to be—any interest⁵ of the subject can bring about the organization it takes to make sensory input perceptual. In sum, the other forms of organization make a difference to how the sensory input is sorted, but do not make a difference as to whether the sensory input is informational to the subject, which is an essential contribution to conscious perception.

3 Top-down attention

Once one accepts that subject-based organization is an essential feature of conscious perception, the link to top-down attention is only a few logical steps away. In this section, I will set out the argument linking top-down attention to conscious perception in six steps.

First, I claimed in the section above that subject-based organization is an essential feature of perceptual experience. That is, every perceptual experience must have some degree of subject-based organization to count as an instance of perception. This type of organization normally manifests itself in a division of the perceptual field into layers of subjective importance, wherein some parts of the perceptual field are experienced as more subjectively important than others. In many cases, a single task or interest shapes the perceptual field, resulting in a foreground/background structure, but other structures are possible, depending on the full set of the subject's current interests. One such alternative structure is that of a split experience, discussed above, in which two interests that are in tension result in the experience of competing percepts, rather than the clear prominence of one or the other percept.

Second, early sensory processing does not have subject-based organization. This claim is based on background empirical work reviewed in the introduction. Namely, early stages of sensory processing organize sensory input according to sensory features and salience, but salience can be seen, at best, as reflecting the subject's past interests. For instance, in vision, those stimulations that are brightest, fastest, and largest are the most salient (this is effectively modeled in Itti et al. 1998), which can be explained in terms of our common biological or evolutionary past. But, also, those visual stimulations that look like the subject's name receive more processing resources than those stimulations that look like other words or names (Mack and

⁵ That is, any interest of the subject that can be satisfied or partly satisfied through conscious perception can bring about the organization it takes to make sensory input perceptual. The subject's interest in sleeping, for example, is not such a candidate.

Rock 1998). This is not explained through biology or evolution, but through the subject's personal history: the subject's name has more stable value for the subject than other words or names. In both cases, the first-wave organization of salience in terms of past, stable interests, like the organization of features, occurs irrespective of the subject's current interests.⁶ As Robert Desimone and John Duncan put it, salience derives from "the intrinsic or learned biases of the perceptual systems towards certain types of stimuli. We describe them here as bottom-up processes, not because they do not involve feedback pathways in visual cortex (they may well do so) but because they appear to be largely automatic processes that are not dependent on cognition or task demands (Desimone and Duncan 1995, p. 201). As I described subject-based organization, it tracks the subject's current interests. Since salience does not do that, I conclude that subject-based organization is missing from early sensory processing.

Third, some process is required to bring about subject-based organization for sensory input in order to bring about conscious perception. Two background assumptions, introduced at the start of the paper, enable this step. First, early sensory processing is the causal precursor to conscious perception. That is, without the early processing of sensory input, there would not be conscious perception (at least in the known, natural world). Second, conscious perception shares some structural correspondence with its physical underpinnings, so a structural feature found in conscious perception, such as subject-based organization, ought to be shared by its physical underpinnings, or in early sensory processing. Thus, since early sensory processing does not provide the structure required for conscious perception (i.e. subject-based organization), but is causally necessary for conscious perception, something is required to bring about this structure to enable conscious perception.⁷

Fourth, only top-down attention can organize sensory input according to the current tasks or interests of the subject. Recall that I defined top-down attention as "the task-dependent direction of cognitive and neural resources by the subject," where the presence of top-down attention can be established by showing that the ultimate distribution of cognitive and neural resources has been influenced by the subject through top-down feedback. The task-dependent direction of cognitive and neural resources just is organization according to the tasks and interests of the subject. The reason that this has to be done by the subject, in my account, is that only the subject is going to be able to accomplish this organization according to its current interests, because it is the subject that has these interests. That is, to achieve information for the subject, we need organization by the subject. Once early sensory processing responds to the top-down feedback of attention, it no longer reflects mere salience, but also value to the subject through the subject's current tasks or interests. That is, whether more forcefully representing a particular color is more valuable to the subject than more forcefully representing a particular orientation will depend on

⁶ This is sometimes described as a "bottom-up attention," in contrast with the type of attention that this paper is concerned with, which is a "top-down" attention.

⁷ Note that this does not entail Representationalism, since some properties or aspects of the input may be retained despite this imposition of an organizational structure.

what the representations might be used for, and this task-relevant information is applied through the top-down feedback of attention. Without that feedback early sensory processing does not reflect value to the subject, but with this feedback it can develop subject-based organization.

Fifth, top-down attention is required to bring about subject-based organization for sensory input in order to bring about conscious perception. This claim synthesizes claims three and four: some process is required to bring about subject-based organization for sensory input in order to bring about conscious perception, and the bringing about of subject-based organization for sensory input can only occur through top-down attention.

Therefore, the sixth and final claim: attention is necessary for conscious perception. This is not merely a causal claim, since I am not simply claiming that attention causes conscious perception by organizing sensory input; it is a constitutive claim, since I am also claiming that conscious perception is made up of sensory input together with an organization maintained by the subject, which is what grants this sensory input the quality of being informational to the subject. Note that the scope of this necessity is grounded in the first premise; to the extent that subject-based organization is an essential feature of perceptual experience, top-down attention is necessary for conscious perception.

This conclusion can be seen as a tempered version of one provided in William James' *Principles of Psychology*: "without selective interest, experience is an utter chaos. Interest alone gives accent and emphasis, light and shade, background and foreground—intelligible perspective, in a word. It varies in every creature, but without it the consciousness of every creature would be a gray chaotic indiscriminateness, impossible for us even to conceive" (James 1981, p. 403). Although I do not agree with James that all of conscious experience is organized according to the subject's interests, nor with his claim that interest is the only organizational principle in conscious experience, we have similar views on the contribution of attention to conscious experience. I hope that I have said enough here to convince the reader that this contribution is an important feature of conscious perception, if not an essential one.

4 Objections

The above account faces numerous objections. These objections can be grouped into two types. First there are objections internal to the account given above. Second, there are objections based on evidence external to the account. After briefly discussing some of these objections I will present a first-stage response, although in a few cases the response will require research beyond this paper.

Starting with the first type of objection, it is reasonable to wonder whether I have fairly characterized perception in this account. One might think that perception is defined in contrast to both sensation and judgment, and that I have not gone far enough to show that this account truly concerns perception, rather than judgment. Perhaps conscious perception is transparent to its objects in such a way that these

issues need not affect perceptual content, since they occur at the level of perceptual judgment.⁸

Turning from definitions to assumptions, one might question the requirement of structural correspondence, which supports the third premise. The subject-based organization of perceptual experience need not correspond with anything in early sensory processing if, for instance, it exists in the world, outside the body of the perceiver.⁹ One might even question the assumption that early sensory processing is the causal precursor to perceptual experience; in the case of hallucinations, memories, and dreams, conscious perception may not require early sensory processing of the type described here.¹⁰

Moving on to inferences, one might worry that the work I ascribe to the subject in this account could be accomplished through other means. Perhaps differences in context can account for the supposed differences in experience without the need for a subject.¹¹ Perhaps the differences in experience could emerge bottom-up, making attention and the subject a result of other factors, rather than the cause.¹²

Finally, on the second type of objection, several forms of evidence could cause trouble for my account. There is gist perception, which appears to be a form of conscious perception that occurs outside of attention.¹³ There are the parts of one's experience that one does not attend to, but nonetheless appear a certain way to you.¹⁴ Conscious perception is sometimes dominated by percepts antithetical to our interests, such as the dripping of the tap when one is trying to sleep¹⁵ or the perseveration of a traumatic image in day-to-day life.¹⁶ Finally, the perceptual experiences of other creatures are unlikely to depend on the existence of a subject, such as in the case of honeybees.¹⁷

I consider all of the above objections to be serious ones, although I think the account already has the resources to give a satisfactory answer to some of them, which I address in order of presentation. First, the contrast between perception and judgment is meant to be established by the phenomenal contrast method, used in the second section (this method is justified in, e.g., Siegel 2006). Beyond this reasoning, a further reason to suppose that attention alters percepts, rather than judgments of percepts, can be found in the work of Marisa Carrasco (e.g. Carrasco et al. 2004, discussed in Treue 2004).

Second, empirical evidence supports the claim that visual input is first divided into features, which are only later re-grouped into objects, patterns, and other

⁸ Thanks to Ned Block for suggesting this objection.

⁹ Thanks to Katalin Farkas for suggesting this objection.

¹⁰ Thanks to Dan Dahlstrom for suggesting this objection.

¹¹ Thanks to John Campbell for suggesting this objection.

¹² Thanks to Jeff Yoshimi for this objection.

¹³ Thanks to Brian McLaughlin and Christopher Hill for this objection.

¹⁴ Thanks to Michael Tye for suggesting this objection.

¹⁵ Thanks to David Chalmers for this objection.

¹⁶ Thanks to Hallie Liberto for this objection.

¹⁷ Thanks to Brian McLaughlin, Peter Graham, and Catherine Kendig for this objection.

structural elements of conscious perception (see Sect. 1). If this is correct, then any structures found in the world would have to be re-established within visual processing. Other empirical evidence reveals that visual imagery corresponds with early visual processing despite the absence of visual input, suggesting that early sensory processing is the causal precursor to all forms of visual perception (Stokes et al. 2009; Cichy et al. 2012). Whether these findings in vision extend to other sensory modalities is an open question.

Third, it may be possible for the subject and attention to emerge “bottom-up,” so long as we are talking about an emergence that transcends any particular perceptual experience and has top-down powers or control. I think this is necessary to explain the difference between switch and split experiences, described in the second section.

Fourth, advocates of gist perception have not yet established the presence of conscious perceptual gist in the absence of attention, but only the ability to answer questions about the gist percept (e.g. Reddy et al. 2004). The latter is consistent with the idea that the gist percept is not consciously perceived by participants in the dual-task paradigm, even if it is consciously perceived in those cases in which it benefits from attention (e.g. Cohen et al. 2011).

Although there is evidence that perceptual experience includes elements that are not the target of (either focal or diffuse) attention (e.g. Schwitzgebel 2007), I do not know of any evidence that perceptual experience includes elements that are not structured in terms of the subject’s interests. Elements of perceptual experience in the periphery and margins, for example, that are not the target of attention, are nonetheless structured in terms of the subject’s interests in *being* in the periphery or margins.

It is possible for the subject to have opposed interests in my account, which is what generates the split experience. The question of the dripping tap and traumatic perseveration is whether these correspond with interests of the subject at all. I admit that I do not have a satisfactory account of what determines whether something counts as an interest of the subject nor how the interests of the subject are structured relative to one another. This is an aspect of the account that is weak and requires more research.

With regard to creatures unlike ourselves, I am tempted by two different responses. First, some of these creatures probably do not have conscious perception, but either sensation or the equivalent of unconscious perception in humans. The ability of bees to perceive the Kanizsa triangle, for instance, may come as a result of early sensory processing, without entailing conscious perception (Nieder 2002). Second, some of these creatures may have sensory consciousness (see, e.g., Edelman and Seth 2009), without this sensory consciousness exhibiting the defining features of conscious perception.¹⁸ Of course, these responses depend on the facts of the case, which will require further research.

¹⁸ Note that this response might also be used for certain types of sensory consciousness in humans.

5 Conclusion

In this paper I have developed an account of perceptual organization that ties conscious perception to the act of attention, or the organization of sensory input according to the subject's current interests. I found that such attention is necessary for conscious perception, at least in the known, natural world for creatures like us. This conclusion is based on the finding that subject-based organization is an essential feature of conscious perception, that the causal precursors of conscious perception do not have this type of organization, and that top-down attention is necessary to bring about such organization.

In future work I hope to discuss non-perceptual consciousness, which will help to further explicate the connection between top-down attention and conscious perception and how it differs from the connection between top-down attention and consciousness, more generally.

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References

- Block, N. (2008). Consciousness, accessibility, and the mesh between psychology and neuroscience. *Behavioral and Brain Sciences*, 30(5–6), 481–499.
- Buras, T. (2009). The function of sensations in Reid. *Journal of the History of Philosophy*, 47(3), 329–353.
- Carrasco, M., Ling, S., & Read, S. (2004). Attention alters appearance. *Nature Neuroscience*, 7(3), 308–313.
- Cichy, R. M., Heinzle, J., & Haynes, J. D. (2012). Imagery and perception share cortical representations of content and location. *Cerebral Cortex*, 22(2), 372–380.
- Cohen, M. A., Alvarez, G. A., & Nakayama, K. (2011). Natural-scene perception requires attention. *Psychological Science*, 22(9), 1165–1172.
- Dehaene, S., & Naccache, L. (2001). Towards a cognitive neuroscience of consciousness: Basic evidence and a workspace framework. *Cognition*, 79, 1–37.
- Desimone, R., & Duncan, J. (1995). Neural mechanisms of selective visual attention. *Annual Review of Neuroscience*, 18(1), 193–222.
- Edelman, D. B., & Seth, A. K. (2009). Animal consciousness: a synthetic approach. *Trends in neurosciences*, 32(9), 476–484.
- Grill-Spector, K., & Malach, R. (2004). The human visual cortex. *Annual Review of Neuroscience*, 27, 649–677.
- Gurwitsch, A. (1964). *Field of consciousness*. Pittsburgh: Duquesne University Press.
- Gurwitsch, A. (1985). *Marginal consciousness*. Ohio: Ohio University Press.
- Hadjikhani, N., Liu, A. K., Dale, A. M., Cavanagh, P., & Tootell, R. B. (1998). Retinotopy and color sensitivity in human visual cortical area V 8. *Nature Neuroscience*, 1(3), 235–241.
- Hamlyn, D. W. (1994). Perception, sensation, and non-conceptual content. *The Philosophical Quarterly*, 44(175), 139–153.
- Haynes, J. D., & Rees, G. (2005). Predicting the orientation of invisible stimuli from activity in human primary visual cortex. *Nature Neuroscience*, 8(5), 686–691.
- Hopp, W. (2008). Husserl on sensation, perception, and interpretation. *Canadian Journal of Philosophy*, 38(2), 219–245.
- Itti, L., Koch, C., & Niebur, E. (1998). A model of saliency-based visual attention for rapid scene analysis. *Pattern Analysis and Machine Intelligence, IEEE*, 20(11), 1254–1259.

- James, W. (1981). *The principles of psychology*. Cambridge: Harvard University Press.
- Lamme, V. A. (2004). Separate neural definitions of visual consciousness and visual attention; a case for phenomenal awareness. *Neural Networks*, 17(5), 861–872.
- Li, Z. (2002). A saliency map in primary visual cortex. *Trends in Cognitive Sciences*, 6(1), 9–16.
- Mack, A., & Rock, I. (1998). *Inattention blindness*. Cambridge: MIT Press.
- Mole, C. (2011). The metaphysics of attention. In C. Mole, D. Smithies, & W. Wu (Eds.), *Attention: Philosophical and psychological essays*. Oxford: Oxford University Press.
- Nieder, A. (2002). Seeing more than meets the eye: Processing of illusory contours in animals. *Journal of Comparative Physiology A*, 188(4), 249–260.
- Prinz, J. (2012). *The conscious brain: how attention engenders experience*. New York: Oxford University Press.
- Reddy, L., Wilken, P., & Koch, C. (2004). Face-gender discrimination is possible in the near-absence of attention. *Journal of Vision*, 4(2), 4.
- Reynolds, J. H., & Heeger, D. J. (2009). The normalization model of attention. *Neuron*, 61(2), 168–185.
- Schwitzgebel, E. (2007). Do you have constant tactile experience of your feet in your shoes?: Or is experience limited to whats in attention? *Journal of Consciousness Studies*, 14(3), 5–35.
- Siegel, S. (2006). Subject and object in the contents of visual experience. *The Philosophical Review*, 115(3), 355–388.
- Singer, W., & Gray, C. M. (1995). Visual feature integration and the temporal correlation hypothesis. *Annual Review of Neuroscience*, 18, 555–586.
- Stokes, M., Thompson, R., Cusack, R., & Duncan, J. (2009). Top-down activation of shape-specific population codes in visual cortex during mental imagery. *The Journal of Neuroscience*, 29(5), 1565–1572.
- Treisman, A. (1988). Features and objects: The fourteenth Bartlett memorial lecture. *The Quarterly Journal of Experimental Psychology*, 40(2), 201–237.
- Treisman, A. (1998). Feature binding, attention and object perception. *Philosophical Transactions of the Royal Society B*, 353(1373), 1295–1306.
- Treisman, A. M., & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive Psychology*, 12(1), 97–136.
- Treue, S. (2004). Perceptual enhancement of contrast by attention. *Trends in cognitive sciences*, 8(10), 435–437.
- Watzl, S. (2011). Attention as structuring the stream of consciousness. In C. Mole, D. Smithies, & W. Wu (Eds.), *Attention: Philosophical and psychological essays*. New York: Oxford University Press.
- Wolfe, J. M., Cave, K. R., & Franzel, S. L. (1989). Guided search: an alternative to the feature integration model for visual search. *Journal of Experimental Psychology*, 15(3), 419–433.