Attention, fixation, and change blindness

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Abstract: The topic of this paper is the complex interaction between attention, fixation, and one species of change blindness. The two main interpretations of the target phenomenon are the 'blindness' interpretation and the 'inaccessibility' interpretation. These correspond to the sparse view (Dennett 1991; Tye, 2007) and the rich view (Dretske 2007; Block, 2007a, 2007b) of visual consciousness respectively. Here I focus on the debate between Fred Dretske and Michael Tye. Section 1 describes the target phenomenon and the dialectics it entails. Section 2 explains how attention and fixation weigh in these debates, and argues that Dretske's hyper-rich view fails precisely because he overlooks certain effects of attention and fixation. Section 3 explains why Tye's view is also unsatisfying, mainly because he misconceives the degree of access. Section 4 then puts forward the positive model COVARIANCE, which has it that the degree of cognitive access tracks the degree of phenomenology, and contrasts it with Block's view on the Sperling iconic memory paradigm. The paper ends with a discussion of levels of seeing, which involve crowding, indexing, and other visual phenomena. Change 'blindness' is a set of phenomena that was discovered about two decades ago, yet an entirely satisfying understanding is still lacking. To move forward, a more detailed understanding of attention and fixation is called for.

Keywords: attention; fixation; change blindness; cognitive access; covariance.

1. *Change 'blindness' and its interpretations*

'Change blindness' refers to a relatively new set of phenomena that was only discovered in recent years. The phenomena are so controversial that theorists cannot even agree on a name, as we shall see presently. We are confronting a *set* of phenomena, rather than a single phenomenon: respectively, they focus on saccades (Grimes 1996), on attention (Simons and Chabris 1999), and on masking (Rensink, O'Regan, and Clark 2000), among others. Here we will focus on the attentional variants, so let's take Simons and Chabris (1999) as an example. In one study, the experimenters asked participants to count how many times a basketball were passed by people in white t-shirts. Another team in black t-shirts serve as distracters. During the task, an experimenter either in a gorilla

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suit or in normal outfit with an opened black umbrella crosses the scene. Since the participants concentrate on the basketball if they follow the instructions, about half of them do not detect the experimenter with the gorilla suit or the umbrella.

Figure 1. For a demo, see http://www.youtube.com/watch?v=vJG698U2Mvo.

What happens in this kind of scenario? There are at least two hypotheses. The first has it that the participants literally do not see the gorilla suit or the umbrella; the second has it that the participants did see the target, but for some reason the phenomenology becomes inaccessible, or is at least not accessed. If one holds the former hypothesis, one is willing to call this a case of change *blindness*. If, on the contrary, one holds the latter hypothesis, one should call this a case of change *inaccessibility* or *amnesia*. Inaccessibility and amnesia are not identical: pieces of information can be inaccessible *because of* amnesia, but they do not have to be. We can say that change amnesia is a version of change inaccessibility. In what follows I focus on the contrast between change blindness and inaccessibility, for the sake of argument. This distinction roughly corresponds to Daniel Dennett's distinction between "Starlinesque" and "Or-

wellian" interpretation (1991) and Michael Tye's distinction between "representational' and "comparison" failure (2010). For the sake of clarity, in what follows I utilise this terminology alone, since after all they are not exactly the same given different theoretical presuppositions of individual philosophers.

Again, in this paper I focus on the attentional variant. Attention is involved in many debates in philosophy of perception and mind. Here I provide a framework to incorporate two recent ones. The first is Block's position (2007a; 2007b; 2008; 2011; 2014) that phenomenology overflows cognitive access based on the Sperling iconic memory paradigm; the second is the debate between Dretske (2007; 2010) and Tye (2007; 2010) on the texture of conscious experience based on speckled-hen-style examples. Although these two contexts do not invoke exactly the same terms and methodologies, both concern the relation between phenomenology and cognitive access. We can then place these views on the same spectrum:

Hyper-Rich (Dretske) – Rich (Block) – Sparse (Tye) – Hyper-Sparse (Dennett)

As we shall see, this is an over-simplification, since not all philosophers mean the same thing when they talk about *cognitive access*, but let's bracket that for now and come back to it later. A rough and ready way of understanding the disagreement is this: the rich and hyper-rich views hold that phenomenology *overflows* or outstrips cognitive access, while the sparse and hyper-sparse views deny this. In section 2, I will explain how attention and fixation weigh in these debates, and argue that Dretske's hyper-rich view fails precisely because he overlooks certain effects of attention and fixation. Section 3 explains why Tye's view is also unsatisfying because he misconceives the degree of access. In sections 4 and 5 I sketch my positive account and contrast it with Block's proposal.

2. *A Critique of Excessive Phenomenology*

In this section I will criticise Dretske's hyper-rich view via some reflections on attention and fixation. But before going into detail, some explanations of terminology are required. 'Phenomenology' in this context refers to a way in which philosophers talk about the conscious aspect of our mental lives. Here I treat it as interchangeable with 'phenomenal character' and 'what-it-is-likeness', among other terms. 'Cognitive access' needs to be treated more carefully. It is often related to our control of actions, rational deliberations, and reportability. Block provides a useful framework for thinking about varieties of access. In 2007a, he formulates his main concern as follows: "How can we disentangle the neural basis of phenomenal consciousness from the neural ma-

chinery of the *cognitive access that underlies reports* of phenomenal consciousness" (Block 2007a: 481, my emphasis)? What's important here is that access is separated from reportability: in locked-in syndrome, for example, patients have certain amounts of cognitive access, but nevertheless fail to report to a large extent. In 2007b, Block further distinguishes between demonstration, identification, and comparison as different types of access – he considers these *acts* of access. What underlie these acts are psychological *capacities* such as working memory and attention. In a series of papers (2007a; 2007b; 2008), Block is mainly concerned with *identification sustained by working memory*, and he points out that "whereas identification can take place without attention or with limited attention, *demonstration requires attention*" (Block 2007b: 539, my emphasis).[1] But since our main target here is the Tye-Dretske debate, our discussion can take place relatively independently of Block's concerns. Now it should be clear why the spectrum provided in the first section is only a rough one: by 'access' Block means identification, whereas Tye means demonstration. Now let's turn to Dretske. Dretske has been arguing for the hyper-rich view for many years and gives many examples; here I focus on his example of collections of balls (2010: 66, 67; figures 2 and 3 in the opposite page). Take a look at the following two figures for an idea of how speckled-hen examples appear; more specific descriptions of the case will be given presently.

Dretske believes that we consciously see "a lot of the detail" (*ibid*., 54), and he substantiates this claim by referring to our experiences in viewing figures 2 and 3. The first point to be stressed is that in this kind of folk experiment (i.e., readers see the figures by themselves and reflect upon their own experiences), as opposed to real empirical experiments done in laboratories, we need to be extremely careful about how we describe the situation. As Bence Nanay complains, however, in many cases the folk experiments are simply "under-described" (Nanay 2009: 501). I share this view with regard to Dretske's description of the cases. He asks readers to "look, for just a moment", at the figures he offers, and claims that "a quick glance (one or two seconds) is enough to see *all* the balls…" (Dretske 2010: 59, my emphasis). This is highly problematic. In two seconds, we will have six to eight saccades, and we can do many voluntary eye movements if we want to. Presumably Dretske is flexible in his descriptions because he thinks that even if we only glance at the figures we will still see much of the detail, but this causes a problem: Dretske provides absolutely no constraint on fixation points or guidance regarding where one should direct

[1] The first half of this assertion might be debatable, but the tight relation between demonstration and attention is relatively uncontroversial. See also Christopher Mole (2009), section 3.2 "Attention and Demonstrative Reference", and Campbell (2002). More on this when I discuss Tye's position.

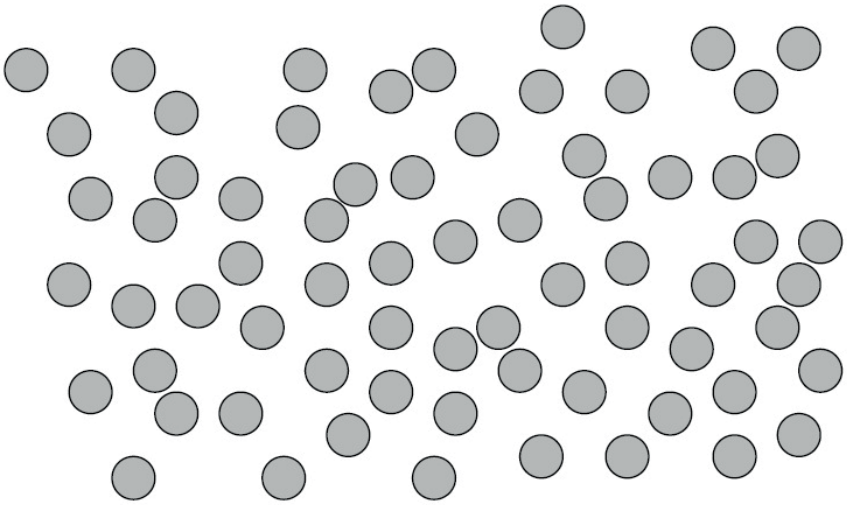

Figure 2, from Dretske 2010

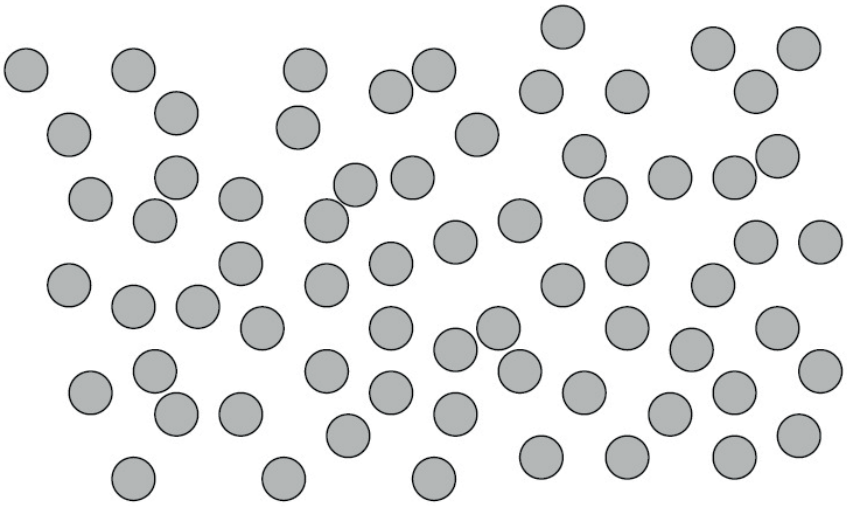

Figure 3, from Dretske 2010

one's attention, and in two seconds we can see rather a lot just by moving our eyes and directing our attention. Given this flexibility, no wonder we see so much detail even though there are more than forty balls in front of us. What's more, the distance from which we should view the figures is not specified. As Nanay (2009: 501-502) points out, distance does matter: if you view these figures from, say, two feet away, the texture of your experience will be very different from the experience you get when viewing it from five inches away. Given Dretske's presumption that we read the book from normal reading distance for two seconds, it might be fair to say that we see much of the detail – probably every ball. This is not controversial, but at the same time it is *not substantial*: given that you have two seconds with no required fixation point, no wonder you can see all the details. Even a sparse theorist would agree with this.

Although Dretske's discussion is based on insufficient constraints, the figures he uses do provide a good basis for further discussion. Let's first make the folk experiment more precise by introducing the following stipulations: fixate at the middle of figure 2 or 3, with both eyes, from ten inches away, for as long as you like. The reason for *not* constraining the time is this: given where you fixate and how the array is arranged, the visual phenomenology is roughly fixed, no matter how long you look at it (let's stipulate for the moment that your attention follows your fixation in this case). I criticised Dretske for not making clear how long we should look at the figures *because* he does not require his readers to fixate at a given point, such that readers can move their eyes a lot during the given time (e.g., two seconds), and thereby see almost all the details. In my stipulations, given that we fixate at one point, the temporal dimension becomes unimportant since simply prolonging the timescale will *not* enhance peripheral vision. This point needs to be qualified, though: there could be a difference between a fixation of 30 seconds and a fixation of 500 milliseconds (say). It is well known that no absolute fixation is possible. Saccadic movements change frequently the point of fixation and the number of shifts increases with time. Therefore, since more saccades are made during a long time fixation, it could be that more details are available to the observer. Now, this does not affect the argument here, since in all visual experiments like this, researchers all recognise the fact that there is no absolute fixation, and the present argument is compatible with that basic fact, as we shall see presently.[2]

Given these stipulations, some readers might consciously see the difference: figure 2 has an additional ball on the right hand side. But consider a case in which we fixate at the left edge of the figures. In this case, even if we now know where the difference lies, we are not able to see it consciously. We cannot even

[2] I am indebted to a reviewer for this point.

consciously see the middle part of the balls clearly: if we could, we could count them, but we cannot, so we do not consciously see them individually. It should be clear that if we had more satisfying descriptions of how to conduct the folk experiments, Dretske's case for rich phenomenology could not be made. This stipulation is not idiosyncratic: for one thing, it is not uncommon in experiments to be told to fixate at a certain point, and the point does not have to be in the middle. For another, counting is only a way to bring out the point of conscious seeing. In the task described above, readers are not asked to count the balls. So the potential worry that counting is incompatible with the original task (i.e., fixating at a point to the left) is a red herring.

Maybe what Dretske has in mind is a thin notion of conscious seeing. Consider an object in the periphery of your visual field. Perhaps you cannot report its shape, colour, or other properties accurately, but you can still report its rough location, e.g., upper or lower. If the notion of conscious seeing is so tenuous, maybe we can grant Dretske a more detailed visual phenomenology. However, this still cannot give Dretske what he wants, namely that we "see *all* the balls" (quoted above), since at the periphery many balls simply collapse together in our visual phenomenology, and we cannot even report a *specific* ball's location, let alone its more fine-grained properties. Of course, if a given ball is in a very different colour, say red, then we will be able to consciously see it. Nevertheless, while we will definitely see that particular ball, we will still not be able see the other balls separately. If we turn all the balls red, then no ball pops out; as a result, we will not see any of them individually again. Even with this thin notion of seeing, Dretske's proposal of excessive phenomenology should be rejected.

In addition to putting forward his own positive proposal, Dretske also argues against positions like mine. Let me consider the major argument. Dretske thinks that positions like mine fail to see the distinction between seeing *facts* and seeing *objects*. Here is the alleged fallacy:

> 1. S does not see (detect, notice) the difference between A and B.
> 2. Therefore, S does not see (the fact) that they differ.
> 3. The difference between A and B is x (some object) or P (some property).
> 4. *Therefore*, S does not see x (or P) – the object or property that makes A and B different. (Dretske 2010: 58; my emphasis)

Dretske argues, correctly I believe, that 4 does not follow from the previous steps, given the distinction between seeing facts and seeing objects. However, my case for the view that we do not consciously see many things in our visual

fields does not rely on this inference. I agree with Tye that given a certain fixation point, even if we direct our attention to the periphery, many details still do not enter our phenomenology (more on this in next section). In other words, there are some independent reasons for my position; the change blindness fallacy is not invoked in the above argumentation. I shall now turn to Tye's view.

3. *Fixation, Attention, and Visual Demonstratives*

Tye provides a phenomenological test: "if I am conscious of [a thing] then it must be marked out or differentiated in the phenomenology of my experience" (Tye 2010: 413). This is congenial to my point that in the case of figures 2 and 3: since we cannot mark out the crucial difference, we are not conscious of individual balls on the periphery. This seems to be perfectly intuitive. In Tye's terms, we can consciously see the things in our peripheral visual field *collectively* but not *distributively* (*ibid*.: 415-416): we cannot consciously see the individual balls, since we cannot consciously mark them out. Again, Dretske might reply that we see that all the balls are grey, since if one ball were red, we would surely be able to distinguish it. In addition to the explanation offered at the end of the last section, this might also be explained by inferential knowledge: *if* there were a red ball, the overall phenomenology will be drastically different; *since* this does not happen, we naturally infer that every ball in the periphery is grey. Dretske needs to provide independent reasons to rule out this natural explanation.

Now consider the following figure:

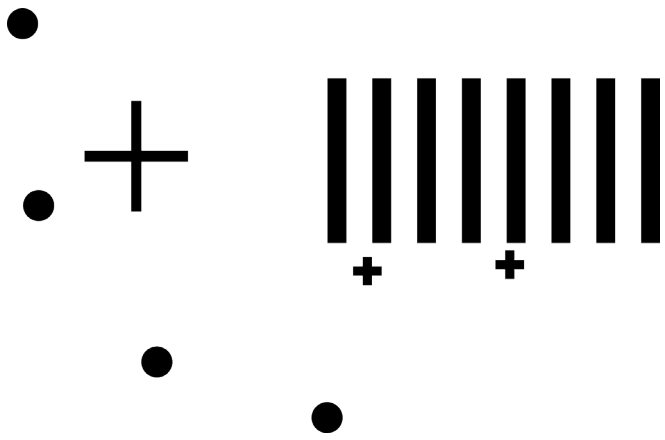

Figure 4, from Tye 2010

Tye argues, correctly I believe, that what you consciously see depends crucially on where you fixate and where you attend. If "your eyes track down from the top black spots to the lower black spots" (*ibid*.: 417), what you consciously see in relation to the bars on the right hand side will be very different from the case in which your eyes track the plus signs from left to right. Fixations matter, and if we bear this in mind, Dretske's excessive phenomenology picture can be firmly resisted.

In what sense, then, is my view different from Tye's? To see this, we need to consider his response to the Sperling paradigm when criticising Block. For our purposes here there is no need to understand the paradigm itself. Tye says:

> [W]ith respect to each letter in the array, the subject's experiences enable them at least to wonder "what is that letter?" Their experiences thus put them is a position with respect to each letter, to bring the letter under the demonstrative concept *that*. (Tye 2007: 527-528).

He then concludes from this that "cognitive accessibility […] *outstrips* phenomenology, not the other way around" (*ibid*.: 528, my emphasis). Let's apply this view to figure 4 above. If you fixate on any spot, as opposed to fixating on the pluses, you will find your peripheral experiences of the bars indeterminate. But with respect to certain bars, say the most remote one, you could still ask yourself the question, "what is that?" That is, you could differentiate it in your peripheral phenomenology. According to Tye, given that you could ask this question at least with respect to particular bars, you have access to those bars. However, your phenomenology with respect to those bars is arguably very sparse; thus it follows, Tye urges, that access overflows phenomenology.

But it does not follow. Accessibility and access, like phenomenology, come in degrees. We can agree with Tye that when we are able to ask the "what is that?" question, we have certain amounts of access with respect to those objects. However, this does not mean that our access at the periphery is the same as our access within the fovea region: we can also ask the "what is that?" question with respect to objects falling within the centre of our visual fields, but that does not mean that our access there is the same as our access at the periphery. Arguably, access to the periphery is much lower than access to the centre, but if so, then Tye's contention that access overflows phenomenology is ungrounded.

Worse still, the very idea that "cognitive accessibility overflows phenomenology" is problematic conceptually, no matter how we understand accessibility. To access something is to access something out there; in the present case, what is out there is phenomenology. Now what does it mean to say one can access more than what is actually out there? This does not make sense: one can access O only if O is actually out there in the relevant sense. To insist that cognitive ac-

cessibility overflows phenomenology is like saying that epistemology overflows metaphysics, e.g., one can see more than what is out there in the world. In this case, we say that the subject is hallucinating, not genuine seeing. If the subject reports more than his phenomenology, then we should say that he misreports or confabulates, not that his cognitive accessibility overflows phenomenology.

This completes my discussion of the Dretske-Tye debate. In sections 4 and 5 a positive model will be provided.

4. *Covariance: Matching Cognitive Access and Phenomenology*

In this section I will elaborate my own view, which can be formulated as follows:

> COVARIANCE
> The degree of cognitive access tracks the degree of phenomenology.

The first thing to be clarified is how I use the term 'access'.- I want to recommend another sense of the term, a sense between demonstration (Tye) and identification (Block). On the one hand, demonstration seems to be too loose: if you see something in your peripheral vision, though you cannot identify most of its properties, you can still mark it out, and by Tye's usage this involves a sense of access. There is no problem intrinsic to this usage, but one wonders about its significance. After all, it is so weak that even in cases where you cannot say *anything positive* about an object, there is still a certain access to it. On the other hand, identification seems to be too strict: in Block's usage, identification requires subjects to report which specific characters there are (2007a). Again, there is no intrinsic problem with this usage, but there should be a weaker yet still significant notion. Call this 'fragmentary identification' (FI). In experiments in which stimuli flash up very briefly, sometimes subjects see something but cannot identify exactly what they see. They fail to qualify as having identification in Block's sense. However, they can *identify* the stimuli as, say, "having a shape defined by simple lines" (Stazicker 2011: 171). In this sense the term is stronger than mere demonstration. I am arguing that the degree of fragmentary identification co-varies with the degree of phenomenology.

Why do we need this sense of access? One main motivation is to capture the fact that like phenomenology, cognitive access comes in degrees (Van Gulick 2007). Consider the fovea region. Within that region of visual field, we find that our phenomenology, as it were, is crystal clear. This chimes well with what physiologists and neuroscientists tell us: within that region, the

density of rods and cons are the highest. That brings us the highest resolution we can hope for. As for access, the situation is similar. We have the highest access, visually speaking, within the fovea region. When we direct our covert attention to the periphery, though we gain more access there, it is still much lower than the central region. Moreover, when we exert covert attention, both access and phenomenology drop off (i.e., both what we visually aware of and what we can identify about the fovea region go down). So at the centre of our visual field, we have both the highest access and the richest phenomenology, and when they go down because of covert attention on somewhere else, they go down together. Besides, both start to drop off when we go from the centre to the periphery. All of this seems rather uncontroversial.

That might be relatively easy. What's more challenging is to show that when access drops to zero, phenomenology drops to zero too. Sufficiently addressing this question would go far beyond the scope of this paper, but let me try to address some initial worries. One might think that blindsight is a clear case of access without phenomenology: one standard interpretation of blindsight is that patients have certain access (often characterised in informational terms) but lack phenomenology. If so, then COVARIANCE is undermined. My tentative answer is that it is not clear that blindsight patients' access is of the *relevant* sort: their access is definitely not visual, since that's what makes them blindsighted. But if so, it is not clear that blindsight constitutes a genuine counterexample of COVARIANCE. If you close your eyes, and hence have (more or less) no visual phenomenology, but still have *auditory* access, will we say that this is a case of access without phenomenology? Arguably not, since the access in question is not of the right kind: it is not relevant to the kind of phenomenology in question. Likewise, although blindsight patients can report some stimuli in their blind fields, their access to them is not *visual* in the ordinary sensory sense. Therefore, blindsight is not a clear counterexample of COVARIANCE.

Here is a potential objection: the claim above seems to be at odds with one of the most credited explanations of blindsight. Starting from the early studies by Poeppel, Held, and Frost (1973), it seems that there are two streams of vision, one striate path and one extra-striate path. While the former is functionally involved in identification tasks, the latter is functionally involved in localisation tasks (Schneider 1969; Trevarthen 1968). The best hypothesis might be that patients suffering from blindsight have damages in the striate visual path, but not in the extra-striate path. This explanation regards blindsight as a *visual* process, contra my assertion above. To answer this objection, we need only to differentiate different notions of 'visual'. Scientists tend to be liberal about their notion of vision. For them, since blindsight patients are

using their eyes to receive relevant information, it counts as visual for them. I do not dispute this usage, but for my purposes above, what is at issue is visual "in the ordinary sensory sense". to quote myself. Therefore the fact that one plausible empirical hypothesis calls those pieces of information "visual" is no objection to the point made above.[3]

But what about the other direction, that is, phenomenology without any access? In this context, a passage from William James is often quoted (for example, Mole 2011: 156-157):

> Attention […] is a condition that has a real opposite in the confused, dazed, scatterbrained state […] the sounds of the world melt into confused unity […] until […] an energy is given […and] enables us to gather ourselves together, we wink our eyes, we shake our heads, the background-ideas become effective, and the wheels of life go round again. (James 1890: 382)

Now, *maybe* James describes this kind of experience correctly, but again it is not clear that this is a case of phenomenology without *any* access. This kind of dissociation should be done in laboratories with careful controls (and it is arguably very difficult to ensure that participants have no relevant access whatsoever); folk descriptions may be a starting point for empirical investigation, but they cannot be the whole story. Hence this description from James does not by itself constitute any real challenge to COVARIANCE.

Let us now consider Block's view. For this purpose a minimal understanding of the Sperling paradigm is required. At the beginning of the experiments, subjects look at a blank screen with a fixation point in the middle of the screen. An array of letters constituting a grid then comes in as stimuli for 15-500 milliseconds. After the stimuli disappear, there is a delay, during which the screen is blank; the period of delay depends on specific experimental settings for different purposes. Then crucially, a cue tone comes in signifying which row the subjects are supposed to report (high tone for the high row, etc.). Since there is a delay between the stimuli and the cue, one might not expect the cue to have any significant effect, since it comes too late. Surprisingly, however, subjects are actually very good at reporting the given row accurately, even though the cue comes much later than the stimuli.

What is crucial is the distinction between generic and specific phenomenology (2007b). Block writes:

> For the Sperling experiment, the relevant generic/specific difference would be that between a phenomenal presentation *that there is* an array of alphanumeric characters and a phenomenal presentation of specific shapes of all or most items in the array. […]

[3] I am indebted to a reviewer for this point.

My argument was that before the cue, there is specific phenomenology for all or almost all items. (Block 2007b: 531; italics in original)

I believe something along these lines is correct.[4] However, I do not agree with Block's specific way of conceiving this distinction and the relevant disagreements, which are crucial to his rich view.

He argues that "the objectors *have to agree* that before the cue, there are specific visual representations of all or almost all […] items […]. The locus of controversy is whether those specific representations are phenomenal" (*ibid*.: 531, my emphasis). I demur. Here I quote James Stazicker's recent response:

> Suppose that you're first conscious of a letter-like shape in the bottom corner of the grid, and that when you shift your attention to that shape, you become conscious of the shape as an "F" [contra Block]. How could you distinguish this from a case in which you were conscious of the shape as an "F" all along, though you weren't attending to this aspect of it [Block's view]? Attention to what you see is required if you're to report on changes in the determinacy of your visual consciousness. But if attention to what you see *affects* changes in the determinacy of your visual consciousness, keeping track of the changes will be difficult at best. (Stazicker, 2011: 176; italics in original)

I believe the reason why Block cannot accept this picture is that he has a wrong view of generic phenomenology. The distinction between generic and specific phenomenology, I submit, should be understood as a matter of degree, contra Block. Consider again Dretske's figures of balls. When you fixate at a given point, the phenomenology of the fovea region is most specific, and it becomes more and more unspecific, i.e., generic, when we move from the fovea to the periphery. This change from the specific to the generic, and the other way around in the Sperling experiment, is very smooth. In the Sperling case, it is hard to report or even detect the change since the stimuli in question present so briefly. If we regard generic phenomenology as propositional ("that there is…"), as Block does, it is hard to see how this change of phenomenology can fail to be subjectively obvious (Block mentions that subjects do not report such a dramatic change). However, a more natural way of understanding the generic/specific distinction is the present one, which admits of degrees. This fits well with COVARIANCE, which demands that phenomenology comes in degrees.

But what about cognitive accessibility? Robert van Gulick (2007) offers a view similar to mine, and to this Block objects that "there is experimental evidence to the contrary mentioned by Sergent & Rees (e.g., Sergent & Dehaene 2004). Cognitive access appears to be more of a binary phenomenon than

[4] I have argued for the weaker overflow view in detail in Cheng 2017.

Van Gulick supposes" (Block 2007b: 533). This is not the place to go into the details of the literature on cognitive access, but it is enough to say that what I mean by 'cognitive access/accessibility' when it comes to the covariance view, i.e., fragmentary identification, is not what psychologists mean when they conduct those studies. In the letter F example, accesses to F as random stripes and as a specific letter are a matter of degree, not all or nothing.

To say exactly how two things co-vary, one needs well-established theoretical methods to measure both, which goes beyond the scope of this paper. However, I suggest that we might be able to use extrapolation to infer there relations, in the same way that physicists extrapolate absolute zero from the relationship between molecular Brownian motion and temperature in gases (and from the fact that the graphs relating the two converge on the same temperature for different gases), as figure 5 illustrates:

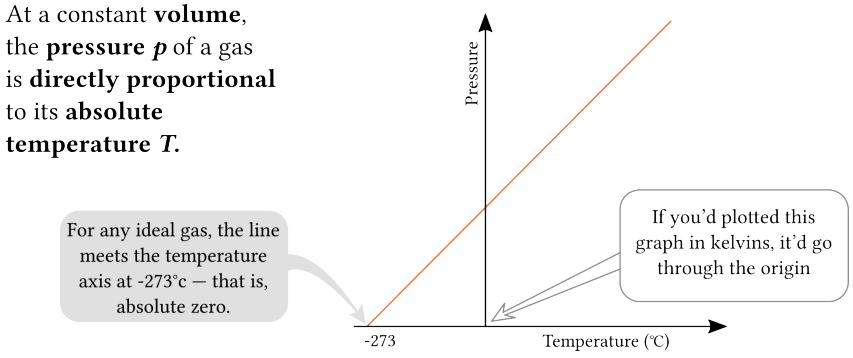

Figure 5

That said, it must be admitted that this analogy is far from adequate, and much work is required to give it more empirical content. The positive case in this section is not by itself satisfying, but the aim of this paper is to put COVARIANCE on the table and defend its initial plausibility. To understand this analogy, there is no need to understand Brownian motion and relevant physics. The key point is that for something not directly measurable, we can use established relations in other parts of the story to extrapolate the rest of the relations. Again I do not pretend that there is a satisfying case here, but as an analogy only, what's being said here should be minimally adequate. The arguments for the current view are independent of how successful the analogy is.[5]

[5] I am indebted to David Carmel for this analogy.

5. *Levels of Seeing*

Finally, I would like to address different levels of seeing – a topic highly relevant to the current discussion. Normally, when philosophers say a person *sees* something, they mean that the person has a full-fledged visual experience. This usage is fine as long as we remember that visual perception has multiple levels. There are different ways of carving the territory, but here is a reasonable one. Outside of our foveal vision, both the information and its conscious properties become very far from crystal clear. There is much to be said about non-foveal vision, but a very prominent phenomenon is the 'crowding effect': objects of vision seem to collapse together when they fall outside of the foveal region. In this case, we cannot even assign any visual index in Pylyshyn's sense (1989): visual indexes are automatic mechanisms that track visual items. According to Pylyshyn himself, this "FINST" (Fingers of Instantiation) mechanism is pre-attentive, but as Brian Scholl (2002) points out, most other theorists regard visual indexes as versions of attention. Let's go with Pylyshyn's version for a moment. This gives us at least three levels of seeing:

> Level 1: Crowding – Seeing without visual indexes (and without attention)
> Level 2: Indexing – Seeing without attention
> Level 3: Attending – Full-fledged seeing

There are some complications, to be sure – for example some will argue that there is no perfect correlation between attending and full-fledged seeing, since there are cases such as blindsight in which subjects try their best to attend but fail to have full-fledged visual experience. That is, attention is not sufficient for conscious experience. If this is right, we may adjust our level 3, and add a further level:

> Level 3: Attending – Full-fledged seeing in the informational sense
> Level 4: Attending + X – Full-fledged seeing in the phenomenal sense

What X is depends on different theories of consciousness. According to some theories, attention is not a necessary condition of consciousness either, so their level 4 will not include attention. Higher-Order Thought (HOT) theory of consciousness is an example (Rosenthal 2005). Here I do not provide my own candidate for X. I simply want to conclude the paper by offering a preliminary distinction between different levels of seeing, involving the main topics of our

discussion; that is, attention and fixation in vision. This final section does not add substance to the conclusion made plausible in the previous section, but it is important to have it in place given the intertwined relations between attention, fixation, conscious phenomenology, and visual indexes, among other things.

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