# Levels of perceptual content

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The main thesis I shall try to defend in this paper is that, although Dretske's distinction between simple perception and cognitive perception constitutes an important milestone in contemporary theorizing on perception, it remains too coarse to account for a number of phenomena that do not seem to fall squarely on either side of the divide. I shall argue that what is needed in order to give a more accurate account of perceptual phenomena is not a twofold distinction of the kind advocated by Dretske but a threefold distinction allowing for an intermediate level of perceptual content that is structured and yet non-conceptual.

In the first section, I discuss Dretske's distinction between sensory perception and cognitive perception as well as a number of attendant notions. In section 2, two sets of phenomena that seem neither to constitute instances of sensory perception nor instances of cognitive perception as defined by Dretske will be presented. I argue that they are evidence in favor of the existence of an intermediate level of perception. In section 3, I defend the view that this intermediate level of content is a level of structured non-conceptual perceptual content and I attempt to provide criteria for distinguishing among the three levels of content.

## 1

This section offers a brief review of the successive stages in the elaboration of the distinction between simple perception (non-epistemic seeing) and cognitive perception (epistemic seeing), first introduced by Dretske in *Seeing and Knowing* (1969). When he introduced the distinction in 1969, Dretske's main aim was to isolate and describe a way of seeing, non-epistemic seeing, that does

not depend on an organism's higher-level cognitive and conceptual abilities. What he meant to capture was the purely sensory dimension of our mental life, of our experience of the world. Non-epistemic seeing was characterized in terms of two criteria, one positive, the other negative. The negative criterion states that non-epistemic seeing is devoid of cognitive content. In other words, non-epistemic seeing, as opposed to epistemic seeing, is an ability whose successful exercise does not involve, in any essential respect, a particular belief or set of beliefs on the part of the perceiver.[1] According to the positive criterion, a seer $S$ sees non-epistemically something $D$ if and only if $D$ is visually differentiated from its immediate environment by $S$. This positive characterization of non-epistemic seeing carries an important existential implication, namely, in Dretske's words: "if $S$ sees$_n$ $D$, then there must be something satisfying the description or having the name, '$D$', which $S$ sees$_n$" (1969, p. 43). In this regard, seeing$_n$ $D$ is like stepping on $D$, both relationships require that $D$ exists.

In later writings (1981, 1988), Dretske offers a treatment of his distinction between simple perception and cognitive perception in information-theoretical terms. The key notions introduced by Dretske in *Knowledge and the Flow of Information* (1981) are the analog versus digital modes of coding information. According to Dretske's use of the terms, a signal (structure, event, or state) will be said to carry the information that $s$ is $F$ in digital form if and only if the signal carries no additional information about $s$, no information that is not already nested in $s$'s being $F$. Otherwise, the signal will be said to carry information in analog form. Dretske contends that the difference between our perceptual experience, the experience that constitutes our seeing and hearing things and the perceptual knowledge (or belief) that is normally consequent upon that experience is, fundamentally, a coding difference. Simple perception is the process by means of which information is delivered within a richer matrix of information (hence in analog from) to the cognitive centers for their selective use. Cognitive activity, on the other hand, is the conceptual mobilization of incoming information, and this conceptual treatment is fundamentally a matter of ignoring differences, of abstracting, classifying, generalizing, hence, a matter of analog to digital conversion.

It should be noted, however, that although the contrast between an analog and a digital encoding of information can be used to distinguish between sensory and cognitive processes, it does not give us the whole story. The informational story must be supplemented with a functional story. According to Dretske, for a system to count as a perceptual system, it must also make this information available to the larger system to which it belongs in order to shape its responses.[2] Similarly, no structure qualifies as a concept unless it has both an informational aspect and a functional aspect. According to Dretske, a semantic structure – a structure that carries information in completely digitalized form – qualifies as a conceptual structure (hence as a belief) only insofar as its semantic content is a causal determinant of output in the system in which it occurs. Hence it does not qualify as a concept until there has been an alignment of its representational and functional roles. Although Dretske insists on the distinction between a semantic structure that need not have an executive function and a conceptual structure that qualifies as such only insofar as it has a control duty over behavioral output, his account of the development of semantic structures almost automatically ensures, at least in the case of natural systems of representations, that those structures have a control duty over behavior, and hence qualify as conceptual structures. This appears most clearly in Dretske's (1988) account of the acquisition by a structure of an indicator function.[3] On that account, a state type's acquiring an indicator function is conditional on its being recruited for a control duty. Therefore, a semantic structure cannot fail to have a functional aspect and hence to qualify as a concept.

Dretske's latest elaboration on the distinction is to be found in his 1995 book, *Naturalizing the mind*. In this book, Dretske proposes that we identify perceptual states as those states whose representational properties are systemic and whose function it is to supply information to a cognitive system for calibration and use in the control and regulation of behavior. A state is said to have a systemic indicator function in case it derives its function from the system of which it is a state. Such indicator functions are conceived as phylogenetically determined and are therefore fixed. By contrast, thoughts and conceptual representations in general are identified with states whose representational properties are acquired and whose executive

function it is to control behavior. A state is said to have an acquired indicator function if it derives its indicator function not from the system of which it is a state, but from the type of state of which it is a token. The representational properties of these states are ontogenetically determined and, through learning, can change.

Critics have pointed out a number of difficulties raised by Dretske's account. Some philosophers (for instance, Heil, 1991) have denied that there exists such a thing as simple seeing and have contended that all seeing involves some form of seeing-as. Others have put forward reasons for doubting that Dretske's account of (conceptual) content in terms of the notion of an indicator function is successful. For the moment, I won't pursue those lines of criticism. Indeed, for the sake of argument, I shall grant that we enjoy both sensory and conceptual representations, as characterized in Dretske's account. What I shall dispute is the idea that the two categories of sensory representations and conceptual representations thus defined exhaust the realm of mental representations.

## 2

In order to motivate the need for at least a third category of mental representations, a category that is irreducible either to the category of sensory representations or to the category of conceptual representations, I shall introduce and discuss two sets of examples.

The first type of case I want to discuss[4] is that of certain optical illusions such as the famous Müller-Lyer illusion (see Figure 1), where a perceiver is presented with two lines of equal length, one with arrows going in, the other with arrows going out. It is a well known fact that, even though the perceiver knows that the two lines are of equal length, she cannot help seeing them as unequal in length. Thus, although the perceiver may believe that the two lines are of equal length, the content of her perceptual experience is that one is longer than the other.

Prima facie, this seems to pose a difficulty for Dretske. If he contends that seeing one line as longer than the other is an instance of cognitive perception, he must attribute two contradictory beliefs to the perceiver: one belief with the content that one line is longer than the other and another with the content that the two lines are
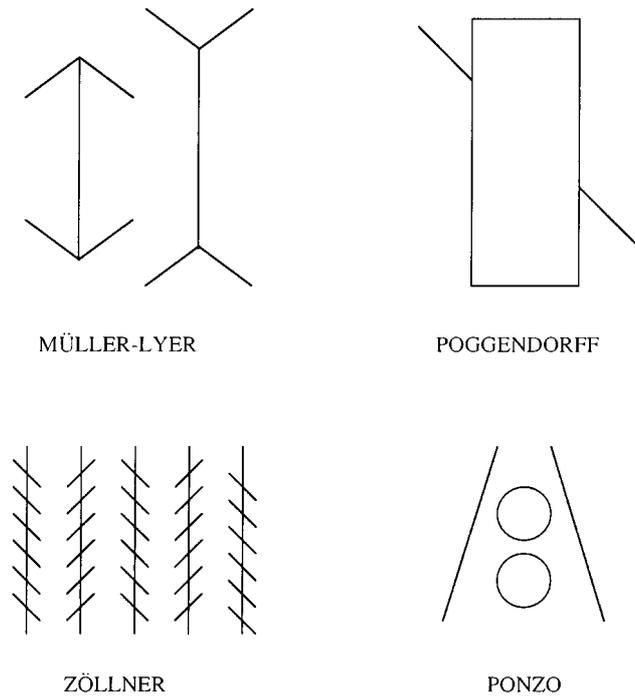
*Figure 1.*  Optical illusions.

of equal length. But this is implausible. It is surely more plausible to describe the situation as one where the perceiver is in two states with both different modes and different contents: a perceptual state with the content that one line is longer than the other and a belief state with the content that the two lines are of equal length. As remarked by Tim Crane (1992, pp. 150–151), it will not do to explain the illusion in terms of a 'prima facie but suppressed' inclination to believe that one line is longer than the other, for what such an account fails to explain is the difference between this state and other, non-perceptual, inclinations to believe. Perceptions are resilient to conclusive counter-evidence in a way that non-perceptual inclinations to believe are not. Measuring the length of the lines won't make me see them as equal in length.

But can Dretske say that perceiving one line as longer than the other is an instance of simple seeing? One difficulty with this view is related to Dretske's information-theoretic characterization of simple seeing. To see *s* simply is characterized as being in a perceptual state

that carries information about *s*. But when we see the Müller-Lyer figure, the resulting perceptual state cannot contain the information that the lines are of unequal length for the irresistible reason that they are not. We seem to be left with the following two options. Either we grant that the visual experience of the perceiver carries information about the respective lengths of the two lines, and then we must say that the perceiver sees simply two lines of equal length. Or we can deny that the visual experience of the perceiver carries definite information about the length of the two lines, and hence what he sees simply are two lines of indeterminate length. What the two options have in common is that they attribute three different types of states to the perceiver and not just two: (1) an informational state that encodes information about the two lines in an analog way, information that defines what the perceiver simply sees, (2) a belief state with the content that the two lines are of equal length, and (3) a state with the content that the lines are of unequal length, a state for which there is no room in Dretske's taxonomy of mental states.

This criticism may be seen as unfair insofar as the notion of a systemic indicator function developed in Dretske (1995) can be thought to provide a simpler explanation of cases such as the Müller-Lyer illusion. By identifying the content of a sensory state with what it is the function of the state to carry information about, and not, as he did earlier, with what it carries information about, Dretske seems to make room for the possibility of sensory misrepresentation. A state type can have the function of indicating that *F*, without all its tokens carrying the information. Thus, we might say that the sensory state a perceiver has when he sees the Müller-Lyer figure is a token of a type whose function it is to carry, among other things, the information that one line is longer than the other, but, as it happens, a token that does not itself carry that information.[5] Thus, Dretske would not need to attribute contradictory beliefs to the perceiver. He might say that the perceiver is both in a sensory state that represents the two lines as unequal in length and in a belief state that represents the two lines as of equal length. But such an answer also raises problems.

First, one may wonder what becomes of the relation between simple seeing and sensory experience. If Dretske wants to maintain the claim that what is simply seen is what is sensorily represented,

he must either abandon or revise the existence condition put forth in *Seeing and Knowing*. Recall that the existence condition states that if $S$ sees$_n$ $D$, then there must be something satisfying the description. To take the Müller-Lyer illusion once again, if Dretske wants to claim that what is simply seen is what is sensorily represented, he must say that the perceiver sees simply two lines of unequal length. What he simply sees cannot be the length of the lines in the figure for they do not satisfy the description, the two lines are of equal length. If he wants to maintain the existence condition, he must posit the existence of some other (presumably mental) item that fits the description. This seems unpromising and, moreover, it runs counter to the doctrine of direct perception advocated by Dretske.

The second difficulty with the answer that exploits the notion of systemic indicator function is that it does not achieve what it is meant to achieve, namely to dispense with the need to posit a third level of content. For it seems that just as, to borrow one of Dretske's favorite examples, one can see an American flag without noticing all fifty stars on it, one can see the Müller-Lyer figure without noticing the length of the lines. So it appears that seeing simply the Müller-Lyer figure and seeing the two lines in the figure as unequal in length are two different things after all.

We shall have to spell out in detail what the difference consists in. But first, let us examine a second set of examples, namely the phenomena referred to by the Gestalt psychologists as "grouping".[6] Grouping phenomena can be illustrated by the fact that we sometimes perceive arrays of dots as arranged in rows or in columns (see Figure 2). In some cases we can perceive one and the same array as differently grouped in successive experiences.

What would Dretske say about such phenomena? He cannot say that seeing an array of dots as arranged, say, in rows is an instance of simple seeing because, once again, a perceiver could see the dots without noticing their particular arrangement. Moreover, the same array can sometimes be perceived as differently grouped in successive experiences and yet it seems that there is something that remains constant in the successive experiences, in other words it seems that there is some level of classification at which the successive experiences fall under the same type. Presumably, the idea of simple seeing should rather be used to capture what the
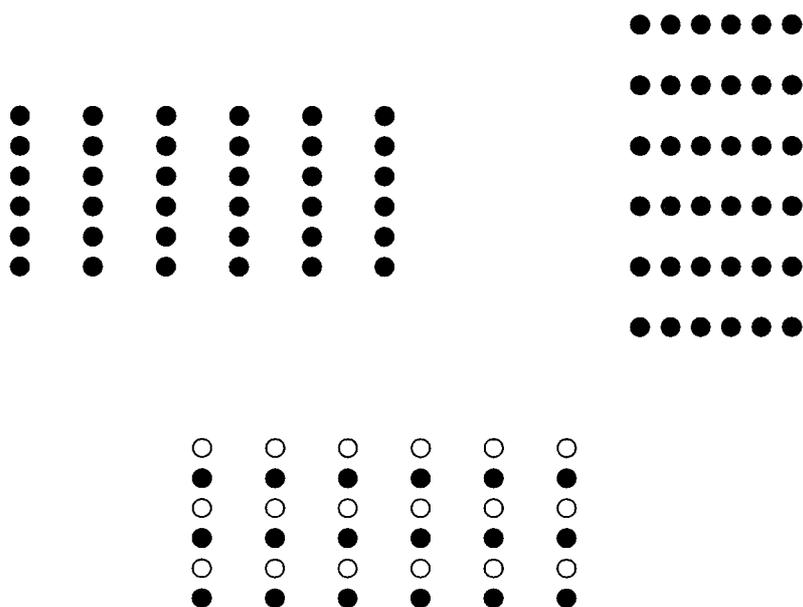
*Figure 2.* Groupings.

successive experiences have in common. Should we say then that seeing an array of dots as arranged in rows constitutes an instance of cognitive seeing? Now it is true that in the very description of the case, I made use of the concept of a row, and it is also true that normal mature humans possess the concept of a row. These two facts may incline us to consider the case as a case of cognitive seeing. However, as pointed out by Peacocke (1983), Gestalt psychologists have also given numerous examples of grouping phenomena in which there are distinctive grouping properties, groupings in particular curves and shapes, and in which the subject of the experience has no concept in advance with which to pick out the curve or shape in question.[7] Given those examples, it seems that although, presumably, normal mature humans possess the concept of a row, possessing the concept is not a necessary condition for being able to perceive an array of dots as arranged in rows.

Another reason for doubting that we are confronted with an instance of cognitive seeing in Dretske's sense is that a subject could perceive an array of dots as arranged in rows without thereby believing that they are in fact arranged in rows. He may, for instance, believe that his seeing the array as arranged in rows depends on his

particular viewpoint, and that, were he to change his viewpoint, he would not perceive the array as arranged in rows anymore. Think, for instance, of constellations. Traditionally, stars that look close to one another have been grouped in constellations and sometimes named after the pattern they seem to form. Yet, the stars that are grouped together are sometimes very far away and can even belong to different galaxies. The Big Dipper (*Ursa Major)*, for instance, contains both stars from galaxy M81 and from the planetary nebula M97. Thus, an astronomer may see star $\beta$ as half-way between star $\alpha$ and star $\gamma$, and yet fail to believe that star $\beta$ is indeed half-way between star $\alpha$ and star $\gamma$. It appears then that seeing elements in a scene as arranged in a certain way can neither be considered as an instance of simple seeing nor as an instance of cognitive seeing. Rather, it should be conceived of as a third way of seeing things, intermediate between those two modes of perceiving.

3

It is now time to get more precise as to what this intermediate way of seeing consists in. Let us note first that, although optical illusions may be infrequent encounters, Gestalt phenomena of organization are ubiquitous features of visual experiences. They include not only groupings, but also figure/ground organization, the fixing of reference frames, as well as various perceptual constancies, apparent motion, induced motion, and a host of other contextual effects.[8] When we perceive a visual scene as organized in a certain way, certain structures, properties or relations in the scene are made salient. Those features of the scene are given special emphasis in our perceptual representation. This level of representation differs from sensory representation as characterized by Dretske in that some of the information is, so to speak, pre-digitalized. However, predigitalization of information can result from the operation of built-in bottom-up processes of visual analysis. Work in the field of computational vision provides evidence for the existence of such processes.

For instance, in his recent book on high-level vision (1996) Shimon Ullman discusses a number of processes that may be supposed to be operating in the construction of such intermediate
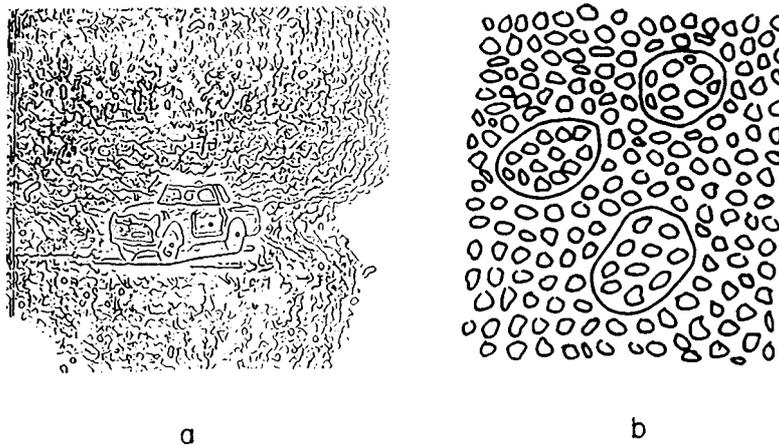
a                                                    b

*Figure 3.*    Salient structures. Reprinted with permission from S. Ullman,
*High-Level Vision*, Cambridge, MA: MIT Press, 1996, p. 244.

perceptual representations. Ullman's discussion of visual routines
and of the related notions of a processing focus and of selective
visual attention may help us give a more precise characterization
of what is involved in the idea of an intermediate level of percep-
tual content. Ullman defines visual routines as those operations
that, when applied to a set of early visual representations, yield
a representation of spatial properties and relations. The resulting
representations can then be used not only for the tasks of object
recognition and classification, but also for other tasks – tasks that do
not require object recognition, such as manipulating objects, plan-
ning and executing movements in the environment, selecting and
following a path, and so on. Among the candidate basic operations
discussed by Ullman is the capacity to control the location at which
certain operations take place, that is to direct the processing focus.[9]
Of direct relevance to the characterization of intermediate percep-
tual representations is the evidence in favor of task-independent,
stimulus-driven shifts of attention. For instance, if we look at images
such as those of Figure 3, it appears that our attention is somehow
immediately drawn to the main object(s). In Figure 3a, our attention
is immediately drawn to the car, which we then recognize as a car,
without the need to scan the image systematically. Moreover, struc-
tures that attract our attention need not be recognizable objects, as
illustrated in Figure 3b.

This way of directing the processing focus is based on the extraction of certain salient locations in the image, and then shifting the processing focus to one of these distinguished locations. According to Ullman, simple differences in a small number of properties – properties such as motion, orientation, color, contrast, binocular disparity, that are processed "pre-attentively" in a parallel and a bottom-up manner – can be used to define distinguished locations that will automatically draw attention, thus leading to further processing of information at these locations. The perceptual representations resulting from the operation of such processes are structured representations in the sense that information at certain distinguished locations is further processed, thereby allowing for the establishment of certain spatial properties and relations of the layout. Yet those perceptual representations may not be cognitive in Dretske's sense insofar as the processes producing them can operate in bottom-up fashion, yielding a way of perceiving that is devoid of cognitive content.

It is now time to give a more systematic account of what the differences are between this intermediate level of content and sensory content on the one hand and conceptual content on the other, and of what role this content can play in our cognitive life. Recall that, according to Dretske, what characterizes sensory states is that they are states (1) whose representational properties are systemic, (2) whose content is encoded in analog form and (3) whose function it is to supply information to a cognitive system for calibration and use in the control and regulation of behavior. Intermediate perceptual representations differ from sensory representations in Dretske's sense in that they do not satisfy condition (2). In intermediate perceptual representations, part of the information provided by the sensory representations is predigitalized: certain spatial properties and relations of the perceived layout are made salient, while more specific pieces of information about the layout are ignored.

Yet, intermediate perceptual representations may be said to satisfy both conditions (1) and (3). The ubiquity of Gestalt phenomena of perceptual organization suggests that, to a certain extent, they also reflect built-in processes of visual analysis. For instance, psychological studies of infant perception (Spelke, 1990; Spelke et al., 1993; Spelke et al., 1995) provide evidence that

the ability to perceive figure-ground relations as well as object unity and boundaries exists at an early age and that infants are sensitive to constraints of cohesion, boundedness, rigidity and no action at a distance. If infants have unlearned abilities to perceive figure-ground relations and to organize surface arrays into bodies that are cohesive and bounded, the representational properties of intermediary perceptual states may be said to be systemic or phylogenetically determined in Dretske's sense.

Intermediate perceptual representations also seem to satisfy the third condition laid out by Dretske for sensory perception, namely to have the function of supplying information to a cognitive system for calibration and use in the control and regulation of behavior. The information supplied by those representations can be used by the cognitive system for multiple purposes. It is useful for tasks such as manipulating objects, planning actions, navigating in the environment. It also plays an important role in memory, as well as for object identification and classification. Moreover, depending on what the task is, the information can be recalibrated in different ways. For instance, classifying shapes according to the type of hand grasping they afford will not yield the same results as classifying those shapes for the purpose of object-categorization. The fact that intermediate perceptual representations involves a predigitalization of sensory information does not imply that this predigitalized information cannot be further digitalized to serve various functions in the control and regulation of behavior.

On the other hand, Dretske characterizes cognitive perception as the having of cognitive, belief-like, states with conceptual content, that is, states whose representational properties are acquired, whose content is encoded in digital form and whose function it is to control and regulate behavior. One reason why intermediate perception does not qualify as cognitive perception in Dretske's sense is that intermediate perception is not belief-like. One important feature of beliefs is that they are normally revisable in the light of other, contrary, beliefs. But, as the Müller-Lyer illusion shows, intermediate perceptions are not revisable in the way beliefs are. Thus, although intermediate perceptions can give rise to beliefs, they should not be confused with the beliefs they give rise to.

But what of the respective contents of the two types of states? Do we have any reason to think that these contents are of different types, that cognitive perceptions but not intermediate perceptions are states with conceptual content? Prima facie, the fact that the contents of the two types of states can be reported using the same construction, 'perceiving ... as ... ', may tempt us into thinking that both encode the same content in the same way. But I think the temptation should be resisted. What is true is that both types of states make certain properties or relations salient. But this would be conclusive evidence that both states have conceptual content only if conceptualization were the only way to achieve saliency. Now, the notion of intermediate perceptual content is precisely meant to capture the idea of a form of perceptual saliency that can be manifested prior to and independently of the exercise of conceptual abilities. The 'perceiving as' construct can be used as a way of describing what is made salient in a representation, without its use implying anything as to how this representational saliency is achieved.

But what is it that distinguishes conceptual saliency from non-conceptual saliency, and hence, conceptual content from non-conceptual content? First, conceptual representations as conceived by Dretske are digital in two different senses. They are digital both in the particular sense Dretske gives to this notion – i.e. as a specific mode of representation of a fact – and in the more common sense of the term – i. e. as a specific way of encoding information about a property. By contrast, intermediate perceptual representations are indeed partially digitalized in Dretske's sense, but they remain analogical representations in the ordinary sense. In other words, some properties are made salient, but they are still encoded analogically. Second, although, as Dretske himself acknowledges, this dimension of beliefs is not emphasized in his theory, it is characteristic of beliefs to be holistically related to one another by inferential relations. As Tim Crane (1992) suggests, it is reasonable to view concepts as the constituents of belief content that account for these inferential relations. But, as the non-revisability of perception shows, perceptions are not subject to the inferential dynamics typical of beliefs. This suggests that the content of perceptions is not a type of conceptual content.

What distinguishes intermediate perceptual states from sensory states though, is that the former involve a predigitalization of information, hence information that can sometimes be used in the control of behavior by the cognitive systems without recalibration being necessary. It may be thought that in acquiring certain simple observational concepts, such as perceptual shape concepts, cognitive systems take advantage of this predigitalization of information. In such cases, the conceptualization process might be described as a process through which certain perceptually salient spatial properties and/or relations become endowed with behavioral significance. Indeed, as Peacocke (1992) argues, it may be the case that we need to posit such an intermediate level of perceptual content if we are to have a noncircular and individuating account of mastery of certain perceptual concepts. For that mastery must be related to some features of experience that do not have to be explained in terms that presuppose possession of the concepts. But it will not do to relate the mastery to experiences with only sensory content in Dretske's sense. For although the sensory content of an experience may carry information about the relevant properties of the layout, it can do so without those properties being noticed or attended to by the perceiver.

In this paper, I tried to argue in favor of the existence of an intermediary level of perceptual content, a content that is structured yet non-conceptual. But it is possible to put forward a more radical claim, namely that this so-called intermediary level of perceptual content is in fact *the* level of perceptual content. As a conclusion, let me offer some considerations in favor of this more radical claim. If, as I tried to show, seeing-as is not to be taken as synonymous with conceptualizing, the traditional motivations for resisting the view that all seeing is seeing-as are largely undermined. One may wonder whether simple perception conceived as a purely analogical matrix of information really provides an adequate characterization of our conscious sensory experience. It may seem more appropriate to conceive of it as a characterization of what Ullman (1996) calls low-level representations – i.e. subpersonal representations computed at the early processing stages of perception – and hence, as suggested by Meini (1996), to conceive of it as a form of pre-perception rather than as perception properly so-called. On the other hand, despite

their name, cognitive perceptions as described by Dretske may be more appropriately characterized as belief-states – namely, a type of belief that is based on perceptual evidence – than as perceptual states. This is not to deny that our cognitive expectations and conceptual abilities can influence the way we perceive things. It may be mistaken to think, however, that when, for instance, as a result of our prior expectation that there are dogs around, we come to see something as a dog, the concept *dog* must figure as a constituent of the content of our perception. Another possibility, consistent with the view of perceptual content as structured non-conceptual content put forward here, is that mastery of (partly) observational concepts consists in part in their being associated with a set of perceptual processing routines designed to extract specific spatial relations or shape properties. Hence seeing something as a dog as a result of prior expectations concerning dogs would not mean that the content of our perception has the concept *dog* as a constituent, but that certain shape properties of the visual scene are made salient as a result of the application of a particular set of processing routines. In the case at hand, application of these routines is indeed influenced by our cognitive expectations, but this does not provide sufficient ground for claiming that the content of the perception is conceptual, since, in other circumstances, the very same routines could have been applied in the absence of specific cognitive expectations. The fact that we had prior cognitive expectations and that these expectations influenced the application of perceptual processing routines may explain why, in most cases, our perceptual experience immediately gives rise to a perceptual belief involving the concept *dog* as a constituent, but it does not make the content of the perception conceptual content.

## NOTES

[1] As Dretske himself insists, this should not be taken to mean that seeing *X* non-epistemically is incompatible with beliefs about *X*, but rather that seeing *X* non-epistemically is compatible with having no beliefs about *X*.

[2] One important reason why Dretske needs a functional story for perception is that he wants his account of simple seeing to be an account of visual experience. He needs therefore to distinguish those informational states that somehow

constitute our visual experience from a variety of other intermediate stages in the processing of visual information that lack this experiential quality.

[3] Although Dretske (1988) introduces a new terminology, the distinction between what a state indicates and what a state has the function of indicating corresponds to his former distinction between the information a state carries and the semantic content of a state, and the development of an indicator function corresponds to the development of a semantic structure.

[4] For a discussion of the Müller-Lyer illusion along similar lines, see Meini (1996).

[5] Michael Tye's (1996) explanation of the Müller-Lyer illusion and other similar optical illusions runs precisely along those lines.

[6] Although the examples to be discussed are borrowed from Peacocke in the first chapter of *Sense and Content* (1983), my aim is rather different from his. Peacocke (1983) marshalled those examples in order to support his claim that concepts of sensations are indispensable to the description of the nature of sense experience and thus that we should distinguish between the sensational and the representational properties of experience. In contrast, my aim is to distinguish between two different types of perceptual representational content. It must be said, however, that Peacocke has changed his views. In *A Study of Concepts* (1992), he argues in favor of two levels of perceptual content: scenario content and proto-propositional content. Indeed, there are important similarities between the notion of proto-propositional content he advocates and the notion of intermediate perceptual content I am arguing for.

[7] See for instance Köhler (1947) and Rock (1975).

[8] See for instance Rock (1983) and Palmer (1992).

[9] In support of his view, Ullman adduces a number of psychological and physiological studies which suggest that the focus of visual processing can be directed, either voluntarily or by manipulating the visual stimulus, to different spatial locations in the visual input. For psychological evidence, see for instance Eriksen and Schultz (1977), Pomerantz et al. (1977), Posner (1980), Posner et al. (1978), Shiffrin et al. (1976), Shulman et al. (1979), Sperling (1960), Treisman (1977, 1982), Treisman and Gelade (1980), Tsal (1983). For neurophysiological evidence, see for instance Goldberg and Wurtz (1972), Mountcastle (1976), Wurtz et al. (1982).

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