Ambiguous figures and representationalism

Nicoletta Orlandi

Abstract Ambiguous figures pose a problem for representationalists, particularly for representationalists who believe that the content of perceptual experience is non-conceptual (MacPherson in Nous 40(1):82–117, 2006). This is because, in viewing ambiguous figures, subjects have perceptual experiences that differ in phenomenal properties without differing in non-conceptual content. In this paper, I argue that ambiguous figures pose no problem for non-conceptual representationalists. I argue that aspect shifts do not presuppose or require the possession of sophisticated conceptual resources and that, although viewing ambiguous figures often causes a change in phenomenal properties, this change is accompanied by a change in non-conceptual content. I illustrate the case by considering specific examples.

Keywords Representationalism · Non-conceptual content · Duck–rabbit · Mach's square/diamond · Phenomenal properties

Non-conceptual Representationalism (NCR) holds that the phenomenal properties of experience are identical with (or supervene on) representational properties of experience, where the content of experience is non-conceptual (Dretske 1995; Lycan 1996; Tye 1995). A consequence of holding NCR is that any phenomenal difference in experience, that is, a difference in the phenomenal properties of the experience, should be accounted for by a difference in the non-conceptual content of the experience. Derivatively, two experiences cannot differ in phenomenal properties without also differing in non-conceptual content. In this paper, I defend NCR from recent criticism. Some philosophers of perception have thought that ambiguous figures pose a special problem for NCR because, in viewing them, we can have perceptual experiences that differ in phenomenal properties without differing in non-conceptual content (MacPherson 2006; Peacocke 1983). I argue that ambiguous figures pose no such

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problem. By considering specific examples like the duck–rabbit and Mach's square/regular diamond, I show how, in each case, we can identify a difference in non-conceptual content that corresponds to the difference in phenomenal character.

In Section "The problem," I explain why ambiguous figures seem to pose a problem for NCR. In Section "Two unsatisfactory solutions," I discuss two unsatisfactory solutions to the problem. In Section "The solution: multistable visual experience without concepts," I offer a new solution by proposing a way of understanding shifts that does not make reference to the subject's conceptual resources. Sections "The square/regular diamond and NCR" and "Rejoinder" are dedicated to considering specific examples of ambiguous figures and replying to objections raised by Fiona MacPherson.

The problem

Ambiguous figures seem to pose a difficulty for representationalists, particularly for those who believe that the content of experience is non-conceptual.[1] Representationalists hold that the phenomenal properties of experience are either identical with or supervene on representational properties of experience. The phenomenal properties of experience, sometimes also called qualitative properties or qualia (Goodman 1951), are thought to be properties inhering in a sensory state, like a visual or auditory perception. Examples of phenomenal properties are the color or shape of an after-image, or the color or shape of a more ordinary patch in one's visual field, or the pitch or volume of a heard sound, or the smell of an odor. Since we will be talking primarily about visual perception and visual experiences, we can take the shape of an after-image as a paradigmatic example of a phenomenal property. Representationalists hold that phenomenal properties like the squareness of an after-image are (or supervene on) representational properties, that is, they are represented properties of represented objects. In the after-image example, they are properties of the intentional object of the experience, that is, properties of the after-image.

Understanding phenomenal properties as representational allows the representationalist to provide an explanation of what phenomenal properties are, which is compatible with materialism about the mind. The problem for materialists is that phenomenal properties seem to be irreducibly psychic properties (Smart 1959). Take the squareness of an after-image: This property doesn't seem to be a property of any existing object. And it can't be a property of the experience *if* the experience is identical with some brain state (nothing in the brain is square). But, since intuitively, there is something square that one is experiencing when one sees a square after-image, this must be a property of something immaterial. The anti-materialist proposal is that this is a property of the immaterial experience.

Representationalism solves this problem by holding that the squareness is not a property of experience but a represented property of what is represented by the

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[1] There are other challenges to non-conceptual representationalism that do not involve ambiguous figures (Block 2010; Vosgerau et al. 2008). I think that these other challenges deserve separate treatment and I will not address them here. For this reason, this paper constitutes an only partial defense of NCR, namely a defense against those who think that ambiguous figures in particular pose a problem for the view.

experience, in this case, a non-actual intentional object. Squareness is, in most ordinary cases, a property of real objects: In some cases, it is a property of non-actual intentional objects (after-images). Provided that we can then offer an account of non-existent intentional objects that is compatible with materialism, we have also solved the problem posed by phenomenal properties.

Now, it is a consequence of representationalism that no two experiences can differ in phenomenal properties without also differing in what is represented by the experiences, that is, without also differing in content. For example, the difference in phenomenal character between seeing a square after-image and seeing a rectangular after-image is explained by the fact that, in one experience, a square is represented, in the other, a rectangle is represented. The difference in phenomenal character is always reflected in a difference in content.[2]

Some representationalists hold further that we should be able to specify the content of experience in non-conceptual terms. This is particularly true for perceptual experiences, that is, those conscious mental states that we paradigmatically are in as a result of contact between our sensory organs and the world. To say that we should be able to specify the content of perceptual experience in non-conceptual terms means that we should be able to say what the content of the experience is by using concepts that the subject of experience need not herself possess. In the square after-image example, we should be able to describe a subject as experiencing a square after-image even if the subject lacks the concept of a square or the concept of an image.

For present purposes, we can think of concepts as mental representations that subjects possess and that figure in the subject's propositional attitudes, paradigmatically beliefs and thoughts (Margolis and Laurence 2007). If, for example, S believes that something square-shaped is present, then the concept of a square is one of the constituents of S's belief. Accordingly, attribution of concepts to a subject is motivated by the exhibition of certain abilities on the part of the subject, in particular, the ability to think about what's in the concept's extension. If, for example, S is able to think about (or have beliefs about) squares, then she counts as having the concept of a square.

This condition reflects the idea, popular in many areas of cognitive science, that concepts are introduced to do some explanatory work: In particular, they are introduced to explain the behavior of agents whose actions seem to be determined by internal representations (ideas and thoughts) of the environment rather than by the environment itself (Fodor 1987 chapter 1; James 1950). Accordingly, concepts are often taken to be mental representations that are not bound to the stimulus, in the sense that they can be tokened and guide the organism's behavior even in the absence of their environmental referents. Possession of the concept of a square, for example, generally comes with the fact that one is able to think of squares in their absence and to produce behavior that is explained by making reference to that thought.

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[2] In this paper, I use the expression "the phenomenal character of experience" to refer to the phenomenal properties of the experience. But it is not uncommon to find this expression used to refer to what it is like for a subject to have the experience (Block 1995; Dretske 1995; Tye 1995). Since I find the issue of accounting for the phenomenal properties of experience separate from the issue of accounting for what it is like for a subject to have it, I will only mean the former when I use the expression "the phenomenal character of experience".

Those who think that experience has non-conceptual content maintain that we have good reasons to ascribe an experience with a given content to a subject even if the subject lacks the concepts necessary to specify that content. What this means is that we should be able to say that a subject visually experiences a square—e.g., can detect and distinguish a square from other figures—even if the subject is not yet able to think about, or have other propositional attitudes, concerning squares. The subject may not, for example, be able to think of squares in their absence even if she is able to see them. Visual representations are stimulus-bound in a way that concepts are not. The reasons for favoring this view have to do both with the ascription of content to creatures that, arguably, do not possess concepts (children and animals) and with the idea that we acquire (at least some of) our concepts from perceptual experiences, so having the experiences should not presuppose already having the concepts.[3]

Ambiguous figures seem to pose a problem for NCR because, in viewing them, a subject can have visual experiences that differ in phenomenal properties without differing in non-conceptual content. Fiona MacPherson (MacPherson 2006) identifies at least one such ambiguous figure: the square/regular diamond first discussed by physicist Ernst Mach (Figs. 1 and 2):

Like the famous duck–rabbit (Wittgenstein 1953), Mach's figure seems to be liable to two different "interpretations". The figure looks different while also staying the same. And the properties of the visual experience change accordingly: For example, in both figures, the shape of the perceived object seems to change. One can first experience something duck-shaped and then experience something rabbit-shaped. A popular way to account for how this shift is possible and for how the two experiences are produced, is by appeal to the conceptual resources that the viewer deploys when looking at the figure. Since the figure itself stays the same, what changes must be something about the subject, in particular, it must be that the subject interprets the figure differently and, in so doing, "drives" the way the figure looks. The further suggestion is that the interpretation involves the deployment of conceptual resources on the part of the subject. The concepts DUCK, RABBIT, SQUARE, and REGULAR DIAMOND are at play in interpreting Figs. 1 and 2. Thus, one cannot see a regular diamond or a square (or a duck or a rabbit) in the figure unless one has the corresponding concepts.

This conclusion is intuitively plausible: To say of a subject that they see a square in the figure is to say that it *seems to them* that a square is present, and *seeming to them* that a square is present plausibly comes with some conceptual abilities, such as the ability to think thoughts about squares. This suggests that we can specify two different contents of experience corresponding to the ways of seeing Figs. 1 and 2 only by appeal to concepts that the subject of experience possesses, that is, only in conceptual terms. And this leaves us with conceptual representationalism. But, if this is true, then NCR is false: In viewing Figs. 1 and 2, we have perceptual experiences that differ in phenomenal character without differing in what is represented by the visual experiences non-conceptually specified.

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[3] And this is a reason even for those who are comfortable with the idea that many of our concepts are innate (Fodor 2006). Innate concepts, according to Fodor, need to be triggered by experiences that have the corresponding non-conceptual content.

Fig. 1 Square/regular diamond
(Mach 1897/1959)
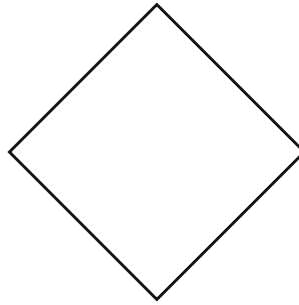
Now, why is this bad? It is bad because it constitutes an argument against a very plausible version of representationalism: There are good reasons for preserving the idea that perceptual experience has non-conceptual content. The reasons have to do both with the ascription of content to conceptually unsophisticated creatures and with the idea that we acquire at least some of our concepts from our perceptual experiences. In so far as seeing in the presence of reversible figures constitute a case, and a very clear case, where we can have perceptual experiences with different contents, we should be able to specify the contents in non-conceptual terms. But, the prospects of doing so are grim: If the standard way of understanding aspect shifts is right, then concepts are required to experience them. So, at least in the case of ambiguous figures, NCR is wrong. There can be a phenomenal difference without a non-conceptual representational difference. Accordingly, one plausible (and natural-istically viable) account of the phenomenal character of experience is threatened.

Two unsatisfactory solutions

In the previous section, I presented an argument against Non-conceptual Representationalism based on the phenomenon of multistable perception. The argument is roughly the following: In viewing ambiguous figures, we typically have visual experiences that differ in phenomenal character, e.g., we experience something that looks duck-shaped and then we experience something that looks rabbit-shaped. The experiences differ also in content, that is, in what they represent. But, because the different experiences are produced by an act of interpreting, which requires concepts, the contents can be specified only in conceptual terms, that is, by appeal to concepts that the experiencer possesses. Thus, Non-conceptual Representationalism is false. There are visual experiences that differ in phenomenal properties but not in non-conceptual content.

Fig. 2 Duck/rabbit
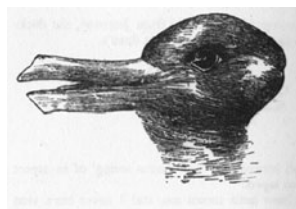
In this section, I briefly present two ways of reacting to this line of reasoning and argue that they are unsatisfactory. One way to respond to the argument is to hold that concepts play a merely causal role in the shift and not a constitutive one. This is the approach favored by Michael Tye (2000). According to Tye, it may be true that seeing figures in different ways involves an interpretation where conceptual resources are at play. But, concepts play a merely causal role. They cause the subject to have experiences with different contents, but the contents themselves can be specified in non-conceptual terms because concepts play no constitutive role in the experiences. Accordingly, we can identify two contents corresponding to the ways of seeing a figure non-conceptually. In this picture, it is true that one needs the concept of a duck in order to see something duck-shaped in Fig. 2, but this only means that the concept causes the relevant experience to occur, not that the concept is a constitutive part of the content of the experience.

The main problem with this way of arguing is that it is strikingly ad hoc. Once one accepts that concepts are required to have a given visual experience, it is hard to see what could decide between a causal and a constitutive view. It seems that the only reason to favor the former is the desire to preserve NCR. Notice that the other motivations for keeping the idea of non-conceptual content would be unable to play any role. In Section "The problem," I mentioned that there are good reasons for holding the view that perceptual experience has non-conceptual content. The reasons have to do both with the ascription of content to creatures that lack them (children and non-human animals) and with the idea that we acquire our concepts from perceptual experiences, so having the experiences should not presuppose already having the concepts. But, if concepts are required, even if only causally, to have visual experiences with given contents, then we wouldn't be able to ascribe content to creatures that lack them, and we wouldn't be in a position to give a story of how we acquire concepts. So, we lose track of why we should think that concepts play a merely causal role in seeing and of why we should preserve non-conceptual content in the first place, if not for preserving NCR. What's needed, it seems, is a more general way of understanding seeing something in a certain way that does not make reference to concepts at all. This understanding would give us a way to preserve Non-conceptual Representationalism and, at the same time, to respect the motivations for holding the view that the content of perceptual experience is non-conceptual.

A second way to respond to the argument presented above is to hold that ambiguous figures are a special case and require special treatment. Concepts may be required (either causally or constitutively) to have different visual experiences in the presence of reversible figures and to shift between them, but not required in more ordinary cases. In other words, concepts are required to see a duck shape in a figure when the figure can also be seen in other ways, but not required to simply see a duck, that is, to have a visual experience with that content in an ordinary situation where no other way of seeing the input is possible. According to this line of reasoning, NCR may be false only when it comes to reversible figures: When seeing in the presence of such figures, the phenomenal properties of experience are identical with (or supervene on) representational properties of experience where the content of experience is *conceptual* rather than non-conceptual.

But, the main worry with this way of arguing is that it requires at least some explanation of why ambiguous figures constitute a special case. Why is vision in the presence of reversible figures any different from vision in ordinary cases of stable

perception? In particular, why would the process that makes us see a duck in an ambiguous figure be any different from the process that makes us see a duck in an *un*ambiguous figure or in ordinary situations? It's not clear why the availability of alternative ways of seeing the figure would make a difference to the process: If concepts are not required in one case, they shouldn't be required in the other either.

This point is particularly pressing if we consider that the majority of vision scientists take vision in the presence of ambiguous figures to be a paradigm of what happens in vision more generally (Gregory 1970; Palmer 1999; Rock 1983). Multistable perception is taken to be evidence for the interpretative nature of visual processing and to exemplify what happens in ordinary cases, where the visual system moves from retinal stimuli that are ambiguous (compatible with a number of distal causes) to representations of objects and scenes. The system is said to *interpret* the stimulus in terms of the world of objects, just like the system interprets Fig. 1 as a square or Fig. 2 as a duck. Stephen Palmer writes:

> "The objects that we so effortlessly perceive are not the direct cause of our perceptions. Rather, perceptions are caused by the two-dimensional patterns of light that stimulate our eyes. […] To provide us with information about the three-dimensional environment, vision must therefore be an interpretative process that somehow transforms complex, moving, two-dimensional patterns of light at the back of the eyes into stable perceptions of three-dimensional objects in three-dimensional space. We must therefore conclude that the objects we perceive are actually interpretations based on the structure of images rather than direct registrations of physical reality." (Palmer 1999, p. 9)

The number of vision scientists that accept this kind of view is substantial enough to consider it the dominant way of understanding visual processing. Philosopher Jerry Fodor writes:

> "The current Establishment theory (sometimes referred to as the information processing view) is that perception depends, in several respects presently to be discussed, upon *inferences*." (Fodor and Pylyshyn 1981, p. 140).

Along similar lines, psychologist, Richard Gregory writes:

> "Perception involves a kind of inference from sensory data to object-reality. Further, behavior is not controlled directly by the data, but by the solutions to the perceptual inferences from the data. This is clear from common experience: if I put a book on a table I do not prod the table first to check that it is solid. I act according to the *inferred* physical object-table—not according to the brown patch in my eye. So perception involves a kind of problem-solving – a kind of intelligence. Helmholtz spoke of perception in terms of 'unconscious inferences'." (Gregory 1970, p. 30)

And neuroscientist Karl Friston (together with his collaborators) writes:

> "There is growing support of the idea that the brain is an inference machine, or hypothesis tester, which approaches sensory data using principles similar to those that govern the interrogation of scientific data. In this view, perception is a type of unconscious inference." (Hohwy et al. 2008, p. 2).

If this is true, then vision in the presence of ambiguous figures should not be considered a special case. All vision involves a kind of problem solving, a kind of interpreting. Ambiguous figures exemplify the problem that the visual system constantly faces: the problem of reconstructing a stable representation of the world from ambiguous retinal information. This suggests that if concepts are required in order to interpret ambiguous figures then they are likely required to interpret visual stimuli more generally. Again, what seems to be needed is a way to understand how the visual system may form a percept in the presence of reversible figures that does not appeal to concepts.

If the two ways of answering the problem discussed in this section are no good, then we are left with a difficult dilemma: We can either give up the idea that we should be able to specify the content of perceptual experience in non-conceptual terms, or we can give up representationalism and hold that there can be a difference in phenomenal properties without a difference in content. The first option threatens the idea of non-conceptual content; the second robs us of a naturalistically acceptable way to account for the 'intractable residue of consciousness'.

In what follows, I argue that we don't need to do any of these two things. The ambiguous figures under consideration pose no special problem for NCR. This is because we can make sense of how seeing them in different ways occurs in the absence of concepts, and we can provide the difference in content that's required by the difference in phenomenal character.

The solution: multistable visual experience without concepts

What emerged from the discussion in Section "Two unsatisfactory solutions" is that, if we don't want to give up the idea that the content of perceptual experience is non-conceptual, we need a story of how we could see Figs. 1 and 2 in their two different "interpretations" without possessing concepts. The present section is devoted to sketching such a story and to showing that the available empirical evidence supports it.

We can start by considering a piece of common knowledge: In seeing ambiguous figures, knowing that a figure is ambiguous, and what the terms of the ambiguity are, often helps. If a subject is told that a rabbit shape can be seen in Fig. 2, then this piece of knowledge generally increases the chances of her seeing it that way. This may be thought to support the hypothesis that concepts are involved because tokening the concept of a rabbit facilitates the experience. But, notice that this is by no means guaranteed. In some cases, particularly with more complex ambiguous figures, seeing them in any way is difficult, and informing the subject of the terms of the ambiguity does not help.[4] What seems to be happening in these cases is that the subject, given her knowledge, engages in a type of visual search that, in some cases, is unsuccessful.

This example introduces the idea that what is central to shifting is visual search rather than (or in addition to) concept tokening. Notice that the centrality of visual search would explain why informing subjects that a figure is ambiguous and that it can be seen in a certain way, increases the chances of them seeing it that way. When

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[4] Thanks to an anonymous referee for drawing attention to this fact.

subjects are informed, they undertake proper visual search of the figure. If one knows, for example, that a rabbit shape can be seen in Fig. 2, then they can properly look for rabbit parts (e.g., ears), and this increases their chances of experiencing the rabbit shape.

This hypothesis also explains the subjects' occasional difficulties: One can know about the ambiguity, but just not find the relevant shape in the figure, perhaps because the figure is too complex. And it further explains spontaneous reversals, i.e., cases where subjects are not informed at all that something is ambiguous and yet, by observing it for some time, can see it in multiple ways. The proposal that this section defends, then, is that visual search is central to switching and that concepts, although useful at times in directing search, are not required for it.

We can then contrast the hypothesis that switching involves a conceptual interpretation, with the hypothesis that it involves visual exploration. We can find this idea in the work of Richard Wollheim and Zenon Pylyshyn (Wollheim 1980; Pylyshyn 1999). In drawing a distinction between seeing-as and seeing-in, Wollheim remarks that seeing-as is a form of visual interest in, or curiosity about an object present to the senses (ibid., p. 222). Rather than involving acts of interpreting or creativity, seeing something in different ways is fundamentally a type of uncovering what is already present to the senses. As such, it does not require concepts but the capacity to engage in visual exploration. In particular, by paying attention to different features of a figure or object, we should be able to see them in different ways without the need for concepts.

Along similar lines, Zenon Pylyshyn proposes that the ability to see something in a certain way is not reflective of an interpretive process where background knowledge of the world (and concepts) intervene but rather prompted by shifts in attention. In describing how the visual system reconstructs whole figures from fragments Pylyshyn says:

"As fragments of familiar objects are found, the visual system can be directed to the relevant parts of the display, leading to a percept (…). This search, rather than the perceptual process itself, may then be the process that is sensitive to collateral information. This is an important form of intervention from our perspective because it represents what is really a preperceptual stage during which the visual system is indeed directed, though not in terms of the content of the percept, but in terms of the location at which the independent visual process is applied (…).
A very similar story applies in the case of other ambiguous displays." (Pylyshyn 1999, p. 358).

The idea introduced by Wollheim and Pylyshyn is that perceptual shifts, rather than showing the influence of concepts on perception, only show the importance of attentional mechanisms in reconstructing a percept. What percept a subject experiences when presented with a given stimulus depends, in important ways, on what features of a figure or object the subject focuses on initially. The percept is built incrementally starting from where attention is focused by, what Pylyshyn calls, the "independent visual process". By this, Pylyshyn means a process that is not affected by our conceptual repertoire. And this is true not just in the case of ambiguous figures but also in vision more generally (Pylyshyn 2009, p. 28).

In order to develop this initial idea in more detail, we can start by clarifying a point discussed in Section "Two unsatisfactory solutions." As we saw in that section, vision scientists often talk of vision as an inferential or interpretative process, inviting the idea that concepts may have a role in it. The visual system is said to perform inferences from low-level visual representations of the proximal stimulus to high-level visual representations of objects in the environment by following a number of principles (Marr 1982; Gregory 1970; Purves and Andrews 1997; Palmer 1999). It is generally agreed, however, that talk of interpretation is somewhat metaphorical and in need of qualification: For one thing, the interpretations are not performed consciously, and the principles that regulate them are not something that subjects are aware of or have knowledge about. The principles are not part of the subject's conceptual stock.

Rather than as interpreting, visual systems are then typically regarded as being built to automatically produce representations of objects in the environment in response to retinal stimulations (Pylyshyn 1999). Visual processing consists in the organization of retinal stimuli into representations of objects that share the usual properties of environmental objects: three-dimensionality, rigidity, retention of shape and size through motion, etc. The processes that produce such representations are fast, automatic, subpersonal, and immune to influence by one's conceptual repertoire. The subject of experience often has no control over how something appears: Perceptual illusions are a famous example of this fact. Despite the fact that one knows that they are illusory, their appearance does not change (Fodor 1988). In this and many other cases, visual systems are not vulnerable to the influence of beliefs, concepts, and contrary evidence (Kanizsa 1985).

If this is the case, then visual representations, although obtained from a process that happens in stages, are not produced in a way that involves concepts. For this reason, they can be thought to have non-conceptual content: Given a certain retinal stimulation, we can form visual representations of three-dimensional, rigid objects, positioned in a certain way, without possessing the relevant concepts. That is, we can visually represent something as a three-dimensional object without yet possessing the concept of three-dimensionality, i.e., without yet being able to think thoughts about three-dimensionality. Young children are supposedly in precisely this position.

These qualifications raise the question of whether it is appropriate to talk of visual systems as performing inferences or interpretations at all, a question that, for reasons of space, cannot be fully addressed here.[5] Some vision scientists, including those who believe that the interpretations are subpersonal and not influenced by concepts (Fodor 1988; Pylyshyn 1999), are inclined to preserve this terminology, partly because they think that visual processing is a computational process and thus describable as an inference (Fodor and Pylyshyn 1981, p. 140) and partly because, like in reasoning processes, the principles that regulate visual systems apply to (what are taken to be) representational states (Pylyshyn 1999, p. 344). I am unconvinced by these considerations and think that it would be preferable to adopt a non-inferential account of vision. But, the argument for this claim would take us too far astray and is not needed in the present dialectical situation. What's important is that, whether we call visual processing an inference, it doesn't require concepts. Visual

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[5] For a more detailed discussion of this point see Orlandi 2011, forthcoming and unpublished.

percepts are produced in stages of processing that are not influenced by, and do not require, the possession of conceptual resources on the part of the perceiver. The processes are insulated, fast, and automatic.

This suggests the first step for understanding vision in the presence of reversible figures without making reference to concepts. When we see something duck-shaped in a figure, what we see is due to an insulated process, a process that does not require that we possess the concept of a duck. But, now this explanation requires a second step, the step that explains the ability to also see the figure differently. If vision is fast, automatic, and hardwired, then why are we able to see different things in the same figure? This is where shifts in attention play a more crucial role. The idea is that visual representations are produced incrementally starting from where attention is focused. And the hypothesis is that paying attention to one part of a figure facilitates the processing of one percept rather than another. This parallels the fact that, in more ordinary cases, paying attention to one part of an object produces a visual experience that is different from the visual experience we would enjoy if we paid attention to a different part of the object. Seeing something duck-shaped in a figure, then, involves paying attention to those aspects of the figure that prompt insulated, fast, and automatic visual processing to issue non-conceptual visual representations of the duck shape.

This hypothesis is, in fact, corroborated by empirical results. In adult observers, the part of a reversible figure that a subject focuses on is found to determine which percept the viewer experiences (Chastain and Burnham 1975). The study shows that there are parts of ambiguous figures that favor one percept rather than another. For example, there may be parts of the duck–rabbit (e.g., its "eye") that favor seeing something duck-shaped in it, where this means that focusing on such parts increases the probability of experiencing the figure as duck-shaped. By contrast, other parts (e.g., the "mouth") may favor the perception of something rabbit-shaped.

Further empirical results support the idea that attentional mechanisms play a crucial role in shifts and that concepts may not be required. Although studies that test bi-stable perception in non-human animals are very scarce, the ones that we do have suggest that aspect shifts can occur in creatures that, arguably, do not possess concepts. For instance, a study with pigeons indicates that these animals can be trained to experience a shift between the apparent horizontal motion of two dots on a display and their apparent vertical motion (Vettel et al. 2000).[6] This result is not at odds with the data we have on children. A significant body of research shows that children aged 4 years or less have a hard time reversing ambiguous figures even when they are fully informed of the ambiguity and of its terms (Girgus et al. 1977; Rock and Mitchener 1992; Rock et al. 1994; Gopnik and Rosati 2001). The ability to reverse emerges fairly consistently at age 5 years (Mitroff et al. 2006; Sobel et al. 2005), and it is highly correlated with the capacity to direct and hold attention to different features of a figure or object. By focusing on different features, different kinds of visual operations are prompted that give rise to different percepts. The

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[6] Pigeons were trained to indicate which motion they perceived by pecking on a key. After a training period, pigeons are presented with the ambiguous display. Their pecking behavior suggests that they can experience reversals. This is practically the only study on bi-stable perception in non-human animals that I know of. There are a small number of other studies on binocular rivalry in cats and monkeys (Sengpiel et al. 1995; Sheinberg and Logothetis 1997) but they do not test animals specifically on ambiguous displays.

reason why young children cannot experience reversals is because the development of attentional mechanisms and of the capacity to control them is a relatively late achievement: Pre-frontal cortex, which is generally regarded as the *locus* of such mechanisms, develops relatively late in humans, reaching full maturation only during adolescence (Diamond 2002).

Neuroimaging studies show that pre-frontal areas are stimulated during reversals (Kleinschmidt et al. 1998), and patients with frontal damage have difficulty shifting compared to control subjects (Ricci and Blundo 1990). Further, bilingual children are more likely to experience reversals than monolingual peers (Bialystok and Shapero 2005). They also develop control over selective attention earlier than monolingual children (Bialystok 2001; Byalistok and Martin 2004.

Now, one may object that directing and holding attention is itself a cognitive process that requires some conceptual resources.[7] There is some truth to this claim: Attention is a cognitive phenomenon, at least, in the sense that, sometimes, it constitutes an intentional action that is accompanied and preceded by thought. But, the available empirical evidence does not support the view that it (always) requires concepts. Attentional mechanisms are often data-driven, that is, steered by intrinsic biases of the perceptual system (Remington 1980; Desimone and Duncan 1995; Blaser et al. 1999). Local inhomogeneities (like a single red item in a field of gray items), new objects, and objects that are larger, brighter, and faster moving are among the things that capture one's attention automatically and independently of the subject's concepts (Desimone and Duncan 1995).

Additionally, recent research on the mechanisms that allow us to track objects prior to visual processing found systems that automatically index and track objects in space (Pylyshyn 1999, p. 360; Pylyshyn 2009). These mechanisms, sometimes called "pre-attentive" in order to distinguish them from the operations of focal attention, can tag several objects in a field, providing the visual system with direct access to these objects for further visual analysis. Although, like in the case of focal attention, subjects can learn to influence these visual indexes, their operation is overwhelmingly stimulus-driven (Pylyshyn 2009, p. 3), confirming that concepts are not necessary to direct and hold attention to objects.

If this is true, then, we can understand perceptual shifts characteristic of ambiguous figures without appeal to concepts. Seeing a duck in Fig. 2 is seeing the figure in a way that is determined by the features of the figure one pays attention to. By specifically paying attention to certain features of the figure, e.g., its beak, the visual system gradually processes the proximal stimulation into a representation of a specific item, with a characteristic shape and orientation. What characteristic shape and orientation? That of ducks. The item is duck-shaped. Thus, by paying attention to the relevant features of a figure, one can see something duck-shaped without yet possessing the concept of a duck (or of shape). Something analogous can be said for the perception of the rabbit.

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[7] Thanks to an anonymous referee for raising this objection.

The difference between this view, based on visual search, and the more traditional, interpretative view, can then be described as follows: In the latter, whether a subject has a visual experience of something duck-shaped is determined by an interpretation, and correlatively, by the concepts that the subject possesses. By contrast, in the Wollheim/Pylyshyn-inspired picture, whether the subject has a visual experience of something duck-shaped is determined, first, by whether the figure is, in fact, duck-shaped, and, secondly, by whether the subject can find out that it is, that is, by whether the subject pays attention to the relevant features of the figure, e.g., its beak. Having a visual experience of something duck-shaped when looking at Fig. 2 involves finding out that the figure is duck-shaped rather than thinking of it that way.

We then have reasons to suppose that subjects can have visual experiences with different contents without possessing the concepts necessary to specify the contents. Such contents are non-conceptual. Concepts do not play a role, either causal or constitutive, in seeing a figure or object in multiple ways. Paying attention does. This view is then different from Tye's view that concepts may be involved but only causally: Concepts are just not needed in forming visual experiences of the world, even though, once the subject has them, they may help direct where attention is focused.

Notice further that the view just defended aligns well with general naturalistic accounts of mental representation, including Tye's causal covariation approach. According to Tye, a state represents some object or property if, when optimal conditions obtain, the state is tokened only if the object or property is present and because the object or property is present. When the conditions are not optimal, there can be misrepresentation. By looking at Fig. 2, one can have a visual experience of something duck-shaped because something duck-shaped is present. And since something rabbit-shaped is also present, one can also have an experience of something rabbit-shaped, depending on what features of the figure one initially focuses on.

We then have a proposal for specifying the non-conceptual contents of experience in the duck–rabbit case (Fig. 2). One can first have a visual experience of something duck-shaped and then a visual experience of something rabbit-shaped without possessing the concepts DUCK and RABBIT. The difference in phenomenal properties is reflected in a difference in non-conceptual content and NCR is safe.

The square/regular diamond and NCR

In a recent article, Fiona MacPherson grants all of this. She thinks it is plausible to suppose that concepts are not required to experience the duck–rabbit (and in any other case for that matter). Yet, she remains unconvinced that NCR is thereby safe. The reason why she remains unconvinced is because she thinks that the square/regular diamond (Fig. 1) poses a special problem for the theory. Suppose, again, that something like the causal covariation theory of representation is correct. The challenge for NCR is to specify two different non-conceptual contents A and B that constitute the contents of the subject's experience when looking at ambiguous figures.

MacPherson says that specifying such contents is difficult in the square/regular diamond case because there are no independent occurrences of squares and regular diamonds (while there are independent occurrences of, for example, ducks and rabbits). Squares *are* regular diamonds, so there cannot be independent occurrences of one without the other. A state that represents something square-like represents also, ipso facto, something regular diamond-like. By contrast, a state that represents something duck-like may fail to also represent something rabbit-like. As a result, it is difficult to think of how an experience could covary with squares but not with regular diamonds, while it is easy to see how an experience can covary with ducks without also covarying with rabbits.

The square/regular diamond figure is certainly a peculiar ambiguous figure. For one thing, it is not as clearly ambiguous as the duck–rabbit. But, assuming that it is indeed ambiguous, it poses a challenge for NCR. I think, however, that this challenge can be answered by looking at a proposal that MacPherson herself briefly considers in her paper. MacPherson discusses a study by Irvin Rock (Ferrante et al. 1997) the result of which is that orientation skews people's ability to judge whether an angle is a right angle. Subjects are fairly good at recognizing right angles when they are oriented "normally" (sitting on a side) but fairly bad at recognizing right angles when they are oriented "abnormally" (forming an apex). MacPherson seems to take this result to be primarily about our judgment of right angles, but the study is more pertinently understood as being about orientation and its significance for people's perception. Things oriented differently appear different. This is true in general for geometrical figures: They look different if oriented differently regardless of whether they contain right angles (Fig. 3).

There is, in fact, ample evidence of the distorting effects of orientation on visual perception, especially when it comes to face perception (see the Thatcher illusion, Thompson 1980). Things oriented differently are processed differently by our visual system, just like things at different distances are processed differently (size constancy), and this engenders a number of visual illusions like the Muller–Lyer.

But, if this is true, then we have a suggestion for specifying the two contents in non-conceptual terms: When looking at the square/regular diamond, one can see a regular diamond "normally" oriented (content A) or a square "abnormally" oriented (content B). By "normally" here I just mean that squares are typically seen and visualized as resting on their side and as having their side up or on top. Vice versa, diamonds are generally seen as resting on their apex and as pointing up. The difference between a square and a regular diamond (of the same dimensions) is, in fact, *merely* a difference in orientation. A square is a regular diamond oriented "abnormally" (resting on the side when regular diamonds normally rest on an apex). Vice versa a regular diamond is a square oriented abnormally (resting on the apex when squares normally rest on a side). But, since orientation makes a difference to how one perceives a figure, a square and a regular diamond (of the same

Fig. 3 Geometrical figures look different depending on orientation
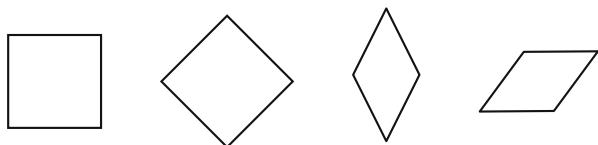
dimensions) can be perceived to be different figures and not just as rotational variants of one another.

If this is true, then it seems that we have a way to account for the gestalt shift in the square/regular diamond case: One can first see a regular diamond "normally" oriented and then a square "abnormally" oriented as if these were two different figures and not rotational variants of one figure. But then, we have the two non-conceptual contents we were looking for: Just like there are independent occurrences of ducks and rabbits, there are independent occurrences of squares in different orientations. Given that squares oriented differently appear different there can be occurrences of something square-like without there being occurrences of something regular diamond-like. In this sense, a state that represents a square does not ipso facto represent a regular diamond. Orientation makes a difference in such a way that looking at a square that rests on the side typically gives rise to an experience of something square-like, not of something diamond-like: Vice versa, looking at a square that rests on its apex typically gives rise to an experience of something diamond-like. If this true, then, the square/regular diamond poses no special problem for NCR.

Rejoinder

It may seem as though the view I have sketched in the last section is unable to explain why certain figures are not ambiguous at all even when they are oriented abnormally (MacPherson 2006 p. 107). Consider, for instance, the following figure (Fig. 4):

Figure 4 may strike one immediately as just a rotated "A," and this seems to be a striking dissimilarity with the square/regular diamond. In the square/regular diamond case, one can have an experience of a square and then of a regular diamond as if the two were different figures. Figure 4, by contrast, is not an ambiguous figure: It is perceived in just one way, namely as a rotated "A". This result may fly in the face of the idea that orientation makes a difference to how something looks.

But, there are a few things to say about this rejoinder. For one thing, it is not clear that Fig. 4 is not itself an ambiguous figure. The rotation of the A invites additional percepts: The figure now looks like the beak of a bird, or the tip of a pencil. But, most importantly, notice that it is not the burden of NCR to have a general theory of how orientation affects visual processes. There may be stimuli that, for whatever reason, are more prone to being distorted than others. But, this is a puzzle for everyone not just for proponents of NCR. The burden of NCR is to explain cases where there is a difference in phenomenal character that does not seem to supervene on any difference in content. If NCR can do so in accordance with the present state of research, then NCR is safe. And if Fig. 4 does not cause experiences with

Fig. 4 Rotated A: is it ambiguous?

different phenomenal characters, it does not pose a problem for NCR. The further question of *why* Fig. 4 doesn't cause experiences with different phenomenal characters is a question for everyone. But, if this is true, then again, ambiguous figures, including the square/regular diamond, pose no special problem for NCR, for it seems that we can, in each case, specify in non-conceptual terms the difference in content that corresponds to the phenomenal difference. And this is all that's required to preserve non-conceptual representationalism as a viable account of the phenomenal character of visual experience.

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