
THE JOURNAL OF PHILOSOPHY

VOLUME CIX, NO. 10, OCTOBER 2012

VISION FOR ACTION AND THE CONTENTS OF PERCEPTION*

According to Milner and Goodale's theory of the two visual streams, the ventral stream, specialized for vision for object recognition, and the dorsal stream, specialized for vision for action, are functionally and anatomically dissociated.¹ The dorsal stream guides on-the-fly actions. The ventral stream stores longer-term information for object recognition. The two streams thus operate on different time scales. The ventral stream assists in the perception of object constancy across different viewing conditions, whereas the dorsal stream allows action in circumstances that are continually changing.

According to Milner and Goodale, processing in the dorsal pathway does not correlate with visual awareness. The dorsal pathway computes information about the absolute size and egocentric (viewer-dependent) properties of objects. This information is translated directly into action. The ventral pathway, on the other hand, computes information about the allocentric (or viewer-independent) properties of objects. This information sometimes correlates with conscious representations of objects. Milner and Goodale's dissociation hypothesis thus has two components: One component posits that different parts of the brain are involved in computing information relevant for action and information relevant for object recognition. The other component posits that only information relevant for vision for object recognition can contribute to the character of conscious visual experience.

*I am grateful to two reviewers and David J. Chalmers for their helpful comments on an earlier version of this paper.

¹Melvyn A. Goodale and A. David Milner, "Separate Visual Pathways for Perception and Action," *Trends in Neurosciences*, xv, 1 (January 1992): 20–25; Milner and Goodale, *The Visual Brain in Action* (New York: Oxford, 2006); Milner and Goodale, "Two Visual Systems Re-viewed," *Neuropsychologia*, XLVI, 3 (2008): 774–85.

The two-pathway hypothesis is supported by cases of optic ataxia (which occurs in Balint's syndrome) and visual agnosia. Optic ataxia occurs as a result of damage to structures in the dorsal stream. In optic ataxia patients, object recognition and delayed action proceed as normal, but on-the-fly action is impaired. For example, optic ataxia patients are unable to reach accurately to objects in their contralesional field, but they can make accurate judgments about the locations of objects relative to each other within the visual field.

Visual agnosia, on the other hand, occurs as a result of damage to structures in the ventral stream. In visual agnosia patients (for example, Goodale and Milner's D. F. and M. C.), object recognition through vision and action that requires a delayed response are severely impaired, whereas immediate action is intact. A number of studies have been done on patient D. F. She suffered brain damage to the ventral stream through carbon monoxide poisoning, which led to visual agnosia. After her injury she could consciously see some color and texture, but because of her agnosia objects appeared blurry, and she could not recognize shapes. However, she could accurately grasp objects whose shape she reported not seeing.

Other evidence for the dissociation hypothesis comes from the case of optical illusions. For example, studies have shown that the Ebbinghaus illusion, in which a central circle surrounded by large circles appears to be smaller than a central circle surrounded by small circles, led to a misperception of the size of the central circle but only marginally influenced grasping behavior directed at the central circle (Figure 1).

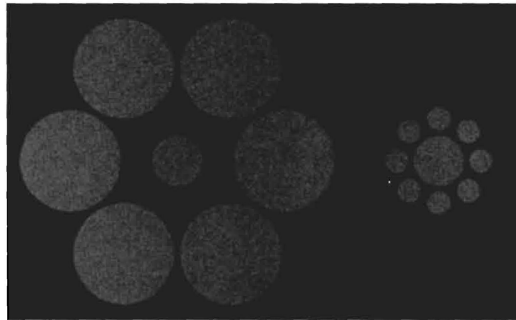


Figure 1. The Ebbinghaus illusion discovered by the German psychologist Hermann Ebbinghaus in the late 1800s.

Recent studies have called this evidence into question. The studies seem to show that optical illusions like the Ebbinghaus illusion affect

perception of size and grasping behavior to the same degree.² There is, however, a possible explanation of why some people respond in the same way to optical illusions whether they rely on vision for action or vision for object recognition. As Milner and Goodale point out, information computed by the ventral stream is required for delayed action. Hence, studies on optical illusions have to be carefully controlled to rule out that the action is a form of delayed action. More carefully controlled studies have later shown that once these factors are controlled for, grasping behavior is not influenced by optical illusions to nearly the same extent as visual experience.³

Milner and Goodale's theory of the two visual streams seems highly plausible. However, as it is usually characterized, it makes trouble for a plausible version of functionalism about intentionality.

I. A PROBLEM FOR FUNCTIONALISM ABOUT INTENTIONALITY

Milner and Goodale's dissociation hypothesis, as usually characterized, together with a widely shared intuition about perceptually grounded mental states, represents a potential threat to a highly plausible version of psychofunctionalism about intentionality (henceforth "psychofunctionalism").⁴

Psychofunctionalism takes inspiration from cognitive psychology. Unlike behaviorism and Freudian psychology, cognitive psychology seeks to offer a scientific explanation of behavior in terms of mental states and processes. Psychofunctionalism offers an account of a target mental feature, such as *being conscious* or *having a belief*, in

² V. H. Franz, K. R. Gegenfurtner, H. H. Bühlhoff, and M. Fahle, "Grasping Visual Illusions: No Evidence for a Dissociation between Perception and Action," *Psychological Science*, xi, 1 (January 2000): 20–25.

³ Peter M. Vishton and Edward Fabre, "Effects of the Ebbinghaus Illusion on Different Behaviors: One- and Two-handed Grasping; One- and Two-handed Manual Estimation; Metric and Comparative Judgment," *Spatial Vision*, xvi, 3–4 (September 2003): 377–92.

⁴ Defenders of various versions of psychofunctionalism include Jerry Fodor, Ned Block, Brian Loar, William Lycan, Terry Horgan, George Graham, and John Tienson. See for example Jerry Fodor, *Psychological Explanation* (New York: Random House, 1968), chapter 3; Block and Fodor, "What Psychological States Are Not," *Philosophical Review*, lxxxii, 2 (April 1972): 159–81; Loar, *Mind and Meaning* (New York: Cambridge, 1981); Lycan, *Consciousness* (Cambridge: MIT, 1987); Horgan and Tienson, "The Intentionality of Phenomenology and the Phenomenology of Intentionality," in David John Chalmers, ed., *Philosophy of Mind: Classical and Contemporary Readings* (New York: Oxford, 2002), pp. 520–32; Horgan, Tienson, and Graham, "Phenomenal Intentionality and the Brain in a Vat," in Richard Schantz, ed., *The Externalist Challenge: New Studies on Cognition and Intentionality* (Amsterdam, Netherlands: de Gruyter, 2004), pp. 297–318; Graham, Horgan, and Tienson, "Consciousness and Intentionality," in Max Velmans and Susan Schneider, eds., *The Blackwell Companion to Consciousness* (Malden, MA: Blackwell, 2007), pp. 468–84; Horgan and Graham, "Phenomenal Intentionality and Content Determinacy," in Schantz, ed., *Current Issues in Theoretical Philosophy: Prospects for Meaning* (Amsterdam, Netherlands: de Gruyter, 2009), pp. 321–44.

terms of what cognitive psychology would say is the explanatory role of that mental feature.

The version of psychofunctionalism I have in mind compels us to use cognitive psychology to determine whether certain types of intentional mental states (for example, perception, belief, desire, or sadness) are instantiated and what their content is on the basis of what the organism and the underlying realizer *do*. However, it does not extend to mental states that cannot be unconsciously instantiated (for example, pain states), and it remains neutral on the question of what consciousness and intentionality are. Call this view “weak metaphysical psychofunctionalism.”

To a first approximation, weak metaphysical psychofunctionalism holds that what makes a neural state (or some other underlying realizer in other creatures) an intentional mental state of a particular kind, for instance, a declarative memory state, depends on what our best cognitive psychological theories take declarative memory states to do. If our best cognitive psychological theories take declarative memory to store information that can later be recalled, then the neural states that store information that can later be recalled play the role of declarative memory states, and hence are declarative memory states.

The particular problem that Milner and Goodale’s theory raises for this variety of psychofunctionalism runs as follows. Let ϕ be a mental-state type that has inherited the content of a visual experience. According to cognitive psychology, states that satisfy this description include a wide range of beliefs, desires, short-term memory states, and working memory states. By Milner and Goodale’s hypothesis, dorsal-stream states but not ventral-stream states represent truly egocentric properties, but, by cognitive psychology, dorsal-stream states do not play the ϕ -role. It follows that ϕ -mental states cannot represent egocentric properties.

Below I will offer a more careful characterization of egocentric properties. For now, however, a simple characterization of egocentric properties as relational properties which objects instantiate from the point of view of believers or perceivers will do. On this simple characterization, my true, perceptually grounded belief that my partially illuminated but uniformly white-colored wall looks partially gray and partially white to me represents the egocentric property of looking partially gray and partially white to me—a property which my wall instantiates right now but not in five minutes. It seems enormously plausible that some of our perceptual beliefs represent properties of this sort.

Because this intuition is widely shared, it seems that we ought to give more credit to it than to any theory that is only partially confirmed by theoretical or empirical evidence. So, it seems that we must reject

either psychofunctionalism or Milner and Goodale's hypothesis, as it is usually characterized. At first glance, it may seem wiser to reject a philosophical theory, namely, psychofunctionalism, than a scientific theory supported by empirical data, namely, Milner and Goodale's hypothesis. So, at first glance, psychofunctionalism appears to be in trouble.

Psychofunctionalism is worse off in this regard than traditional functionalism about intentionality (behaviorism). Psychofunctionalism takes the question of whether person *A* instantiates a given mental state *R* to be resolvable by looking at what cognitive psychology would say about *R*. If *A* is in neurophysiological state *N*, and cognitive psychology states that *N* plays mental-state role *R*, then psychofunctionalism predicts that *A* instantiates mental state *R*. Traditional functionalism about intentionality, on the other hand, determines whether a mental state is present by looking at whether certain behavioral dispositions are manifested. Traditional functionalism about intentionality is thus free to reject what cognitive psychologists say about mental states (for example, they can accept what Milner and Goodale say and accept our intuition about egocentric properties but deny what cognitive psychology says about perceptual belief or visual memory, which is what they would do anyway). Psychofunctionalism cannot do this, because psychofunctionalism, by definition, takes inspiration from cognitive psychology as to what the role of the target mental state is.

It may be tempting to reject psychofunctionalism on the ground that it is in direct conflict with an appealing package consisting of Milner and Goodale's dissociation hypothesis and the intuition that at least some perceptually based mental states represent egocentric properties. If empirical research and strong first-person-based intuitions undermine psychofunctionalism, perhaps we should look for a better theory of how to determine whether a given mental state is instantiated. The problem with this line of thought is that while psychofunctionalism is a relatively controversial view when construed as a general theory of the mental (and consciousness in particular), it offers a highly plausible account of when a given intentional mental state in the target range is instantiated and what its content is. It offers a highly plausible account when so restricted because mental states in the target range sometimes are unconsciously instantiated and hence cannot be identified on the basis of introspection. Regardless of whether one considers introspection a reliable or unreliable method in general, introspection is also highly dubious as a way of coming to know the nature of one's weakly conscious states. Psychofunctionalism allows us to combine reliable introspective reports (when available) with other kinds of scientific reports in order to determine whether a person instantiates a given mental state and what its content is.

That said, there are alternatives to psychofunctionalism. The two most obvious alternatives are dispositionalism and interpretivism. Dispositionalism is a kind of role functionalism. It takes states such as belief to be associated with certain kinds of stereotypical behavior. To have a belief is to have enough of these dispositions. In psychology there has been a movement away from behaviorism and towards cognitive approaches. However, many philosophers advocate behaviorist theories of mental states. Dispositional accounts of belief have been developed by, for example, Gilbert Ryle, Ruth Barcan Marcus, John Searle, Robert Audi, and Eric Schwitzgebel.⁵ Some of these approaches (most notoriously Ryle's) are reductionist. They seek to reduce belief and other types of mental states to physically describable entities such as behaviors. Other approaches have no reductionist agenda. A recent account along these lines is that of Schwitzgebel.⁶ Schwitzgebel treats beliefs as clusters of dispositions. For me to believe that it is Tuesday is for me to be disposed to get into my car and drive to campus to meet with students, to avoid making plans to meet people for lunch in a nearby town, to react with surprise if someone says "It is Wednesday," and so on.

Interpretivism, or what Daniel Dennett calls "intentional stance theory," is an analysis of the meanings of such vernacular "mentalistic" terms as 'believe', 'desire', 'expect', 'decide', and 'intend'.⁷ On Dennett's view, attributing intentions to human beings is a bit like attributing intentions to computers and cars. When I say "You stupid computer! Do what I say!" I adopt an intentional stance towards my computer. I assume that it is an agent capable of rational behavior. For Dennett, attributing intentions to human beings is to adopt an intentional stance towards them. The intentional stance is the stance we use to interpret, explain, and predict the behavior of other human beings, animals, robots, and computers. Suppose you are a high-school student who has a crush on a girl in your class. You wonder if she likes you, but you do not want to ask her or her friends about her feelings towards you. How do you determine whether

⁵ Gilbert Ryle, *The Concept of Mind* (New York: Barnes and Noble, 1949); Ruth Barcan Marcus, "Some Revisionary Proposals about Belief and Believing," *Philosophy and Phenomenological Research*, L, Supplement (Autumn 1990): 133–53; John Searle, *Intentionality* (New York: Cambridge, 1983); Robert Audi, "Dispositional Beliefs and Dispositions to Believe," *Noûs*, xxviii, 4 (December 1994): 419–34; and Eric Schwitzgebel, "A Phenomenal, Dispositional Account of Belief," *Noûs*, xxxvi, 2 (June 2002): 249–75.

⁶ Schwitzgebel, *op. cit.*

⁷ D. C. Dennett, "Intentional Systems," this JOURNAL, LXVIII, 4 (Feb. 25, 1971): 87–106; Dennett, *Brainstorms* (Cambridge: MIT, 1981); and Dennett, *The Intentional Stance* (Cambridge: MIT, 1989).

she likes you? The only reasonable thing to do is to assume that if she likes you, she will act in certain stereotypical ways towards you; for example, she might look at you when she thinks you are not looking, dress up to impress you, or laugh extra hard at your jokes. By interpreting her behavior in this way to reach a conclusion about her mental states, you are adopting the intentional stance. The intentional stance is the strategy of interpreting the behavior of an entity by treating it as if it were a rational agent whose beliefs and desires govern its choice of action. In adopting the intentional stance we treat each other as intentional systems. We thereby use attributions of beliefs and desires to govern our interactions and generate our anticipations. We simply ignore the details of the processes in each others' brains.

At first glance, Dennett's view may seem to be a simple heuristic for determining whether a person instantiates a given mental state. But this is not how he intends it. For Dennett, there are no such things as intentionality and consciousness apart from the point of view of an interpreter who takes the intentional stance. There is nothing in perceptual experience or cognition which cannot be explained by a third-person point of view. Of course, it is plainly obvious to many of us that whether something is conscious does not depend on our stance towards it. But Dennett's interpretivism could perhaps be properly restricted to avoid this implication. For example, interpretivism could be employed in giving an account of the intentionality of unconscious states. This is the position adopted by Uriah Kriegel.⁸ This position seems fairly reasonable. On this view, our ability to make the right predictions about how people are going to act depends on our first-person experience with our own intentional states. The intentionality of unconscious intentional states thus derives from our own conscious mental states.

Milner and Goodale's theory of the two visual streams, together with the intuition that a wide range of mental states represent ego-centric properties, does not present a problem for dispositionalism or interpretivism. This is because dispositionalism and interpretivism do not look to cognitive psychology or neuroscience in order to determine whether person *A* is in mental state *R*. To the extent that they look to psychology at all to determine whether a particular mental state is present and what its content is, they look to social and clinical psychology. To illustrate: If I act as if I believe that there is a

⁸ Uriah Kriegel, "Cognitive Phenomenology as the Basis of Unconscious Content," in Tim Bayne and Michelle Montague, eds., *Cognitive Phenomenology* (New York: Oxford, 2011), pp. 79–102.

coffee mug to the left of me, then interpretivism predicts that I believe something with the content *there is a coffee mug to the left of me*.

Though dispositionalism and interpretivism may seem to offer plausible accounts of when a given intentional mental state is instantiated and what its content is, they ultimately fall short. The main trouble with these views, as I see it, is that they cannot account for cases of abnormal subjects. For example, one can be very strong willed and decide to act in ways that fit the stereotype for the belief that p (for example, that racism is bad). In virtue of having made that decision and being strong willed, one will have the dispositions to act in ways that partially fit the stereotype for the belief that p . Hence, given dispositionalism, one will count as partially believing that p . But intuitively it need not be the case that one believes that p at all. Deciding to act in certain ways does not by itself guarantee any degree of belief. Interpretivism, of course, encounters similar problems.

There is a standard reply to this sort of objection. *Pace* Dennett, we can restrict the relevant dispositions to phenomenal and cognitive dispositions. This avoids the most obvious counterexamples, because phenomenal and cognitive dispositions, unlike behavioral dispositions, are not under our direct voluntary control. However, there are other ways to create trouble for dispositionalism and interpretivism. Consider a subject who has all the phenomenal and cognitive dispositions that are associated with the stereotype for the belief that there is beer in the fridge. She shows surprise when she finds the fridge empty and exhibits distrust if people tell her that she is out of beer. Yet owing to deep irrationality her phenomenal responses are entirely disconnected from her cognitive judgments. Despite showing surprise upon finding the fridge empty, she simply does not believe that there is beer in the fridge.

Psychofunctionalism avoids these problems, because it takes mental states to supervene on underlying realizers, for example, certain brain processes, in a larger integrated system. A pretense belief state does not have the right sort of realizer for it to count as a belief. Hence, it is not a genuine belief. Psychofunctionalism thus seems to offer a more plausible account of whether a mental state is instantiated than the alternatives. But Milner and Goodale's theory, along with the intuition that some perceptually grounded states represent egocentric properties, entices us to reject psychofunctionalism.

II. DORSAL-STREAM PROCESSING AND EGOCENTRIC INFORMATION

However, there is hope for psychofunctionalism. On a plausible reformulation of Milner and Goodale's theory of the two streams, there is no conflict between psychofunctionalism and cognitive neuroscience.

Features of objects can be represented in relation to oneself. This type of representation is egocentric in the sense that it represents properties in relation to a visual perspective. Features of objects can also be represented relative to object-centered coordinates that are independent of the perceiver's current position. This kind of representation is allocentric in the sense that it is independent of the perceiver's position and represents the absolute properties of objects and relations between objects. Egocentric frames of reference make reference to spatial positions and orientation using the body, or a part of the body, as a point of reference. For example, in order to represent a tilted coin as having oval cross-sections, one must use one's own position as a point of reference. Allocentric frames of reference make reference to spatial relations between objects and rely on external points of reference to represent space. For example, in order to represent a tilted coin as circle-shaped, one cannot use oneself as a landmark but must use a landmark according to which the coin is not tilted.

The empirical findings supporting the dissociation hypothesis show that the information processed by the ventral stream represents properties of objects in allocentric space. The information processed by the dorsal stream, on the other hand, represents properties of objects in egocentric space. The ventral stream codes allocentric information relative to the external environment, whereas the dorsal stream computes egocentric representations. Unlike the allocentric representations computed by the ventral stream, the egocentric representations computed by the dorsal stream cannot be stored. They are highly transient and cannot be used for spatial memory tasks.

There is good reason for this division of labor. As Milner and Goodale point out, perceivers do not stay still.⁹ The position of our head, body, and eyes relative to external objects constantly changes. This constant movement produces changing patterns on the retina. To represent an object over time, we must be able to abstract away from our particular position at a given time. We must be able to represent objects irrespective of the changes in our position relative to them. For example, we must be able to represent a coin as circle-shaped even when it is seen obliquely. Hence, vision for object recognition requires information about size, shape, and location independently of the bodily position of the perceiver, the position of her pupils, her focus of attention, and so on.

Things are different when it comes to visually guided action. If we want to quickly grasp an object, we cannot rely on stored representations

⁹ Milner and Goodale, *The Visual Brain in Action*.

of the object. Visually guided action requires a determination of the relationship between our body and the object at a particular point in time. Hence, vision for action requires information about object size, shape, and location relative to our particular position. Of course, action also requires a representation of an object's absolute size. To be able to grasp a tilted coin we open our fingers and orient our hand in a way that reflects the absolute size of the object, but we can do this only by relying on egocentric representations of the object. If we do not perceive the coin as having a certain orientation relative to us, we cannot open our fingers or orient our hand correctly. Visually guided action thus requires a representation of the properties of objects in egocentric space, and information about the properties of objects in egocentric space is processed by the dorsal stream.

On the standard interpretation of the dissociation hypothesis, information about the properties of objects in egocentric space does not contribute to the character of conscious visual experience. This claim may at first seem implausible. I seem to be visually aware of the location of objects relative to myself. I see the coffee mug as being over *there*, not *here*. I see the clock to the right of *me*. I see the soda can as being two feet away from *me*.

However, there is a way to understand these perceived relations as allocentric. Peacocke has argued that visual representational content is a kind of scenario content.¹⁰ Scenarios are the result of assigning surface properties (colors, textures, orientations) to points in a spatial coordinate system that has axes that originate from the center of the perceiver's chest. As Milner and Goodale point out, allocentric information is scene-based information. So, scenario content arguably is allocentric content.¹¹ The information about an object's being over there or to the right of me which forms part of the content of visual perception is arguably allocentric in that it determines, for example, relative distances between an object and the perceiver. It importantly involves the perceiver in determining the axes of the scene, but it does not represent objects in egocentric space. As I perceive the scene in front of me, I perceive parts of my body, for example, my legs and my hands and fingers typing, and I can determine the relation of the clock over there or the soda can to the right relative to my hands and fingers. But my hands

¹⁰ Christopher Peacocke, *A Study of Concepts* (Cambridge: MIT, 1992), chapter 3.

¹¹ See also Andy Clark, "Visual Awareness and Visuomotor Action," *Journal of Consciousness Studies*, vi, 11–12 (January 1999): 1–18; Clark, "Visual Experience and Motor Action: Are the Bonds Too Tight?" *The Philosophical Review*, cx, 4 (October 2001): 495–519; and John Campbell, *Reference and Consciousness* (New York: Oxford, 2002).

and fingers are landmarks in the scene. So, awareness of the position of the clock relative to my hands and fingers is awareness of the allocentric properties of an object.

What then is egocentric information of the sort required for immediate action? Egocentric information, it seems, consists, as Andy Clark puts it, in “constantly updated, egocentrically specified, exquisitely distance- and orientation-sensitive encoding of the visual array.”¹² Egocentric information is not simply coarse-grained and largely scene-based information about an object’s spatial properties relative to body parts in a scene, but fine-grained information about an object that depends on numerous other unrepresented features including eye position, body position, selective attention, illumination conditions, and so on. As an example, consider the coffee mug on my desk. Suppose a perfectly skilled painter is to paint the coffee mug as I see it at a given time. For perfect representation, the distribution of colors on the canvas would need to be very different if my eye position, body position, selective attention, or the illumination conditions were just a tiny bit different. The ideal painter knows how to distribute the colors correctly on the canvas corresponding to my current position. But it is one thing to say that the painter knows how to distribute colors in such a way that they represent the coffee mug on my table as I see it now; it is quite another to say that I am visually aware of the exact distribution of tinge, shade, and illumination when seeing the mug. Milner and Goodale’s claim, I take it, is that egocentric information is quite similar to the fine-grained information about the distribution of tinge, shade, and illumination that the painter relies on when he represents the mug as I see it now. Clark notes that visual awareness cannot afford to represent every aspect of the precise and egocentrically defined coordinates required to support action.¹³ However, I will now argue, even if not every aspect of egocentric information is consciously represented, we are visually aware of at least some of this egocentric information.

III. PEACOCKE’S DUAL-LOOKS PROBLEM

Whether information about the properties of objects in egocentric space contributes to the character of perceptual states is an old problem in philosophy. Christopher Peacocke introduced the problem as follows.¹⁴ Two equally sized trees at different distances from the perceiver are normally represented as the same size, despite the

¹² Clark, “Visual Experience and Motor Action,” p. 501.

¹³ Clark, “Visual Awareness and Visuomotor Action.”

¹⁴ Peacocke, *Sense and Content* (New York: Oxford, 1983).

fact that the nearer tree phenomenally looks bigger (see Figure 2). The two trees look to be the same size. I have a visual experience as of the trees being the same size. But one tree takes up more of the space in my visual field. So, the two trees also look to me to be different in size. My experience is not illusory. The trees veridically look to be same-sized, and they also veridically look to be differently sized.



Figure 2. Peacocke's trees.

Peacocke presented the problem in terms of the relative size of two objects. However, the same sort of phenomenon arises with respect to the perceived shape of an object. My bracelet looks to me to be circle-shaped. I have a visual experience as of the bracelet being circle-shaped (see Figure 3). But as I am situated relative to the bracelet, the bracelet also looks to me to be oval-shaped. My experience is not illusory. The bracelet veridically looks to be circle-shaped, and it also veridically looks to be oval-shaped.



Figure 3. Tilted bracelet.

These scenarios should be familiar. Yet common sense tells us that things do not veridically look both to be one way and also not to be that way. For if something veridically looks to be *F*, then

it is F .¹⁵ So, it would seem that the bracelet is and is not circular, and that the two trees are and are not same-sized.

Peacocke argues on these grounds that visual experiences possess nonrepresentational phenomenal or “sensational” properties. If the two same-sized trees phenomenally look to be the same size, then the content of my tree experience represents the trees as being same-sized. What it is like to see the two trees is in part to see that one tree takes up more of the visual field than the other, but there is no corresponding property of different-sizedness in the content of the experience. Likewise, if the bracelet phenomenally looks circle-shaped, then the content of my bracelet experience represents the bracelet as being circle-shaped. What it is like to see the bracelet is in part to see that it is tilted, but there is no corresponding property of oval-shapedness in the content of the experience. On Peacocke’s hypothesis, then, perceptual experience does not represent properties such as the ovalness of my bracelet or the different-sizedness of the two trees. Rather, the non-constancy-looks of objects contribute to the phenomenal character of the experience. However, as we will now see, this line of argument runs into an empirical problem.

IV. ANOTHER SOLUTION TO THE DUAL-LOOKS PROBLEM

According to Peacocke, the non-constancy-looks of the two trees or the bracelet do not reflect any properties possessed by the trees or the bracelet. They reflect only phenomenal properties. But only the ventral stream is directly correlated with visual awareness. Visual awareness arises largely as a result of ventral-stream processes. So, if Peacocke is right in thinking that the non-constancy-looks of objects (for example, the nearer tree looking bigger or the obliquely seen bracelet looking oval-shaped) do not reflect the representational content of perceptual experience but reflect only the phenomenology, then the qualia associated with the non-constancy-looks supervene on information computed by the ventral stream.

But there is little empirical evidence in support of this latter hypothesis. Ventral-stream mechanisms process allocentric information for

¹⁵This is not to say that F is, say, a surface-spectral reflectance property but only that it is true to say that the thing has F . For example, in color-conversion cases, an object with the surface-spectral reflectance property green may perhaps be truly said to be red. In such cases phenomenal *red* represents the surface-spectral reflectance property green. Whether it represents correctly will depend on the application conditions for “phenomenal red.” For discussion, see Michael Tye, *Consciousness, Color, and Content* (Cambridge: MIT, 2000); and Chalmers, “Perception and the Fall from Eden,” in Tamar Szabó Gendler and John Hawthorne, eds., *Perceptual Experience* (New York: Oxford, 2006), pp. 49–125.

object recognition. They process information that can be stored and retrieved on later occasions. The ventral stream does not process any information that can explain why we have experiences that instantiate the qualia associated with the non-constancy-looks of objects.

Peacocke could perhaps respond to this objection that the recognition of complex images requires (*pace* Milner and Goodale) that egocentric information be stored in working memory and hence that Milner and Goodale are wrong to think that the ventral stream does not compute egocentric information. For example, I may not be able to recognize a face if the only stored information I have about it is information from exposure to the face seen obliquely. To be able to recognize the face properly, I may need to store information about the face as it looks when directly facing me.

However, there is a straightforward response to this sort of reply. Allocentric information is information about properties that objects have relative to scene-based landmarks. If I see a face obliquely, I may not receive enough allocentric information to determine those properties of the face required for face recognition. But face recognition does not require the storage of any particular kind of egocentric information. For example, in order to recognize a person's face I do not need to store detailed information about what the face looks like when the person smiles, raises her brows, or has her eyes closed. So, there is no good reason to think that egocentric information is required for object recognition. But if it is not, then there is little reason to think that the ventral stream is involved in processing it.

Fortunately, there is a different solution to the problem of dual looks. The solution is to allow that there is, as Michael Tye puts it, "a whole hierarchy of levels of perceptual representation."¹⁶ To avoid attributing contrary properties to objects, one can deny that the same-sizedness and the different-sizedness of Peacocke's trees or the circle-shapedness and the oval-shapedness of my bracelet are of the same kind.¹⁷ The circle-shapedness of the bracelet may be said to be an intrinsic property of the bracelet in allocentric space. The non-circle-shapedness (or oval-shapedness) of the bracelet, on the other hand, may be said to be a nonintrinsic property of the

¹⁶ Tye, "Perceptual Experience Is a Many-Layered Thing," *Philosophical Issues*, vii, Perception (1996): 117–26, at p. 123.

¹⁷ Tye, *Consciousness, Color, and Content*, p. 78; Alva Noë, *Action in Perception* (Cambridge: MIT, 2004); Susanna Schellenberg, "The Situation-Dependency of Perception," this JOURNAL, cv, 2 (February 2008): 55–84; Berit Brogaard, "Strong Representationalism and Centered Content," *Philosophical Studies*, cli, 3 (December 2010): 1–20.

bracelet in egocentric space. Properties in egocentric space are properties instantiated by the objects in question. Moreover, they do not depend on actual observation. The property of being oval-shaped is not a property my bracelet has in virtue of my perceiving it. It is a property it has relative to a particular perceptual situation (which others might occupy). On this view, then, the bracelet can be circle-shaped and non-circle-shaped as long as the former is a property in allocentric space and the latter is a property in egocentric space.

There are several ways to cash out this proposal. One is to treat properties in egocentric space as relational properties.¹⁸ If two trees of the same size appear both to be same-sized and different-sized, then this is because our visual experience represents two things of the tree. One is an intrinsic property: its size. The other is a relational property: the amount of visual angle the tree subtends relative to the perceptual perspective *P*. As Tye puts it:

The answer, I propose, is that the experience represents the nearer tree as having a facing surface that differs in its viewpoint-relative size from the facing surface of the further tree, even though it also represents the two trees as having the same viewpoint-independent size. The nearer tree (or its facing surface) is represented as being *larger from here*, while also being represented as being the same objective size as the further tree. There really are two different sorts of feature being represented, then, although they both are concerned with physical objects (or surfaces). Moreover, there is an associated difference in levels, at least insofar as the representation of viewpoint-relative features of surfaces is clearly more basic than the representation of viewpoint-independent features of objects like trees.¹⁹

The same approach applies to other cases of experiences with apparently contradictory content. My bracelet does not have the intrinsic property of being non-circle-shaped. Rather, as Tye puts it, the bracelet is represented as having boundaries “which would be occluded by an elliptical shape placed in a plane perpendicular to the line of sight of the viewer....In this sense, the [bracelet] is represented as being [oval-shaped] *from here*. But it is also simultaneously represented as being at an angle and as being itself circular. This is why the tilted [bracelet] both does, and does not, look like the same [bracelet] held perpendicular to the line of sight.”²⁰ In my terminology, the bracelet has the intrinsic property of being

¹⁸ Tye, *Consciousness, Color, and Content*, p. 78; Schellenberg, *op. cit.*

¹⁹ Tye, “Perceptual Experience Is a Many-Layered Thing,” p. 124.

²⁰ *Ibid.*, p. 125n10.

circle-shaped, *and* it has the relational viewpoint-dependent property of being non-circle-shaped-in-egocentric-space-S. We can thus say that the content of visual experience is (partially) constituted by relational properties of this sort. So, the content of my visual experience of the bracelet represents the bracelet as being circle-shaped and as being non-circle-shaped-in-egocentric-space-S.

Peacocke has rejected something like this proposal on the grounds that it is unlikely that people will have concepts corresponding to such complex relational perceptual contents. However, there is a way of cashing out the proposal that imposes very little demand on the perceiver. The view I have in mind is a natural extension of the centered-content view developed by Chalmers.²¹ On the standard approach to properties, properties are (or represent) functions from worlds to extensions. So, objects instantiate properties relative only to possible worlds. Whether or not I have the property of having looked at a particular book depends on my having looked at a particular book, but if I have the property, I have it relative to the world as a whole. I do not instantiate it only relative to a centered possible world in which some observer is marked. Let us call properties which things can have only relative to possible worlds “uncentered properties.” The properties of being a bachelor and being human are good candidates to be uncentered properties: they are (or represent) functions from worlds to extensions.

Centered properties are (or represent) functions from centered worlds to extensions. So, whether an object has a centered property will depend not only on what the perceiver’s world is like but also on what the perceiver’s centered world is like. That is, whether an object has a centered property will also depend on where the perceiver is spatio-temporally located, what her body position is, what her eye position is, what she is looking at, how the viewing conditions are as she is looking, and so on. Centered properties yield extensions only relative to a centered world. So, it does not make sense to ask whether, at world *w*, the coin is oval-shaped. However, it does make sense to ask whether, at a centered world in which I am occupying the center, the coin is oval-shaped. For, at a centered world at which I am occupying the center, if I am looking at anything, then I am looking at it from a particular perspective.

²¹ Chalmers, “The Representational Character of Experience,” in Brian Leiter, ed., *The Future for Philosophy* (New York: Oxford, 2004), pp. 153–81.

On the centered view, perceptual contents are conglomerations of centered and uncentered properties. Just like centered properties, centered-property contents have extensions (that is, truth-values) only relative to centered worlds. There is a centered property of being circle-shaped as well as an uncentered property of being circle-shaped. The centered property of being circle-shaped will have an extension only relative to a perceiver and a time of perception, whereas the uncentered property of being circle-shaped will have the same extension regardless of who the perceiver is and what the time of perception is. My experience as of my bracelet being circle-shaped and oval-shaped thus has something like this content: “the bracelet is circle-shaped_u and oval-shaped_c,” where the subscripts indicate that one property is centered and the other uncentered. When I see the bracelet obliquely, the content of my experience is true, and so my experience is veridical. For, relative to the uncentered world I occupy, the bracelet is then circle-shaped and oval-shaped-in-egocentric-space. When the bracelet is viewed from above, on the other hand, the content is false, for even though the bracelet is intrinsically circle-shaped, it is not oval-shaped-in-egocentric-space at the uncentered world I occupy. So, my experience is falsidical. Uncentered and centered ovalness thus differ metaphysically, but we can hypothesize (on phenomenal grounds) that uncentered and centered ovalness look (or at least can look) exactly the same way to the perceiver.

On this view, then, the bracelet really veridically looks to me to be circle-shaped, and it veridically looks to me to be oval-shaped. Given what we said above about ventral-stream processing, we should expect the representational content of my experience to be correlated with how the tilted bracelet looks. The centered-property view makes exactly this prediction. It predicts that the content of my experience represents the bracelet as being circle-shaped_u and as being oval-shaped_c, and that the experience is veridical just in case the bracelet is intrinsically circle-shaped and oval-shaped-in-egocentric-space.

Whether we adopt the relational or nonrelational approach to properties in egocentric space is of minor consequence. What matters here is that information about properties in egocentric space seems to contribute to the character of conscious visual experience. But information about properties in egocentric space is computed in the dorsal stream. So, it follows that information computed in the dorsal stream can contribute to the character of conscious visual experience. Hence, there is good reason to think that the dissociation hypothesis must be reinterpreted. On one interpretation, it is

at least in part a hypothesis about which parts of the brain compute information that contributes to the character of conscious visual experience. However, if the dorsal-stream mechanisms process information about the properties of objects in egocentric space and this information contributes to the character of conscious visual experience, then a standard interpretation of the dissociation hypothesis is mistaken. There is indeed dissociation: Information about the egocentric properties of objects is processed by the dorsal stream, and information about allocentric properties of objects is processed by the ventral stream. But the dissociation hypothesis, so understood, has no bearing on what information is passed on to parts of the brain that process information which correlates with visual awareness. The brain can pass information about egocentric properties from the dorsal stream to the ventral stream via feedback connections, and information about egocentric properties can in that way contribute to the conscious character of mental states. This is good news for psychofunctionalism: Psychofunctionalism can correctly treat perceptual and cognitive states that carry information processed in the ventral visual stream as capable of representing egocentric properties.

V. CONCLUSION

Psychofunctionalism treats brain states and processes as intentional mental states only if they play a mental-state role specified by cognitive psychology. Psychofunctionalism must always listen to what cognitive psychology says. If cognitive psychology says that visual memory states or perceptually grounded belief states play mental-state role *R*, and only states with content that derives from the ventral-stream processing play mental-state role *R*, then psychofunctionalism is forced to say that dorsal-stream states do not play mental-state role *R*. Psychofunctionalism is in direct conflict with Milner and Goodale's dissociation hypothesis, when the latter is combined with the strong intuition that visual memory states and other perceptually grounded mental states sometimes represent egocentric properties. This is a *prima facie* problem for psychofunctionalism, because at first glance, Milner and Goodale's dissociation hypothesis and the widely shared intuition about mental states and egocentric properties appear to have more solid backing than psychofunctionalism.

However, I have argued that, rather than rejecting psychofunctionalism, we should reject a particular formulation of Milner and Goodale's theory of the two visual streams. The formulation we should reject is the one that states that dorsal-stream information

cannot contribute to the potentially conscious representations computed by the ventral stream. As we have seen, dorsal-stream information can and does contribute to conscious ventral-stream representations. This is good news, for, as argued above, a weak form of psychofunctionalism is arguably among our most plausible theories of intentional mental states.

BERIT (BRIT) BROGAARD

University of Missouri, St. Louis