

MANY-TO-ONE INTENTIONALISM

Consider the following, very prominent thesis about perceptual experience:¹

Intentionalism: The phenomenal character of perceptual experiences depends on the content of perceptual representations.

The main idea expressed in this thesis is that phenomenal character can be somehow understood in terms of representational content. This, if true, represents substantial progress toward closing the mind-body explanatory gap: if we can give a naturalistic account of representational content, we only need to plug in *Intentionalism* and we get a naturalistic account of phenomenal experience.

As many have noted,² *Intentionalism* is multiply ambiguous, and can be developed in various ways depending on how one interprets its main notions. For example, different versions of intentionalism will result from how we cash out the dependence relation; whether in terms of supervenience (this results in “weak” intentionalism),³ grounding,⁴ or identity (which results in “strong” intentionalism).⁵ Different intentionalist theses will also result from how we read

¹Fred Dretske, *Naturalizing the Mind* (Cambridge, MA: MIT Press, 1995); Gilbert Harman, “The Intrinsic Quality of Experience,” in *Reasoning, Meaning, and Mind* (Oxford: Oxford University Press, 1999), pp. 244–261; William G. Lycan, *Consciousness and Experience* (Cambridge, MA: MIT Press, 1996); Michael Tye, *Consciousness, Color, and Content* (Cambridge, MA: MIT Press, 2000); Bence Nanay, “Attention and Perceptual Content,” *Analysis* LXX, 2 (2010): 263–270.

²Tim Crane, “Intentionalism.” in Ansgar Beckerman, Brian P. McLaughlin and Sven Walter, eds., *Oxford Handbook of Philosophy of Mind* (Oxford: Oxford University Press, 2009), pp. 474–493; Andy Egan, “Appearance Properties?,” *Noûs*, XL, 3 (2006), 495–521; Amy Kind, “Restrictions on Representationalism,” *Philosophical Studies*, CXXXIV, 3 (2007), 405–427; Tye, *Consciousness, Color, and Content*, *op. cit.*

³Kind “Restrictions on Representationalism,” *op. cit.*; Tye, *Consciousness, Color, and Content*, *op. cit.*

⁴Uriah Kriegel, “Reductive Representationalism and Emotional Phenomenology,” *Midwest Studies In Philosophy*, XLI, 1 (2017): 41–59, at p. 42.

⁵Michael Tye, *Ten Problems of Consciousness* (Cambridge, MA: MIT Press, 1995,) among many others.

“perceptual”, for example, where the perception-cognition border is taken to be;⁶ or from whether we take reliance on sensory modes of presentation to be compatible or incompatible with the dependence thesis.⁷

In this paper we explore another, mostly overlooked source of ambiguity in *Intentionalism*, concerning its supervenience⁸ base: in the formulation of this thesis, what is the 'representational content' the representational content of? *Intentionalism* quantifies over perceptual experiences, on the one hand, and contents, on the other; for all the thesis says, it is an open question the phenomenal character of how many experiences is taken to depend on how many representational contents, of how many perceptual representations.

The implicit, largely unexamined default assumption apparently made both by opponents and proponents of intentionalism is that the dependence relation in the thesis links together the phenomenal character of one perceptual experience to its content. We call this view *One-to-One* intentionalism:

One-to-One Intentionalism: The phenomenal character of a perceptual experience supervenes on its representational content.

One-to-One intentionalism concerns a single mental state: a perceptual experience; and it is about the relation between two properties of this one mental state: its phenomenal character and its

⁶Jacob Beck, “Marking the Perception–Cognition Boundary: The Criterion of Stimulus-Dependence,” *Australasian Journal of Philosophy*, xcvi, 2 (2018): 319–334; Tyler Burge, *The Origins of Objectivity*, (Oxford: Clarendon, 2010).

⁷Egan, “Appearance Properties?,” *op. cit.*

⁸In what follows, for ease of exposition, we single out supervenience as the relevant dependence relation in *Intentionalism*. Nothing hangs on this, and the points we make carry straightforwardly over to other possible dependence relations, such as grounding, reduction, or identity.

representational content. All current developments of intentionalism (both by its proponents and its opponents) implicitly adhere to this One-to-One version. For a few illustrative examples, Gilbert Harman claims that

Our experience of the world has content—that is, it represents things as being in a certain way. In particular, perceptual experience represents a perceiver as in a particular environment, for example, as facing a tree with brown bark and green leaves fluttering in a slight breeze.⁹

This suggests that perceptual experience is underlain by the content of that very experience (in this case, as of facing a tree with thus and so features.) Alex Byrne appears to rely on a similar assumption:

It should be emphasized that *the content of a perceptual experience* specifies the way the world appears or seems to the subject.¹⁰

As does Fred Dretske:

[W]hat the person experiences ... is representational content—perhaps a bright orange pumpkin.¹¹

Or Michael Tye:

Necessarily, visual experiences that are alike with respect to their representational contents are alike phenomenally.¹²

⁹Harman, “The Intrinsic Quality of Experience,” *op. cit.*, p. 246.

¹⁰Alex Byrne, “Intentionalism Defended,” *The Philosophical Review*, CX, 2 (2001): 199–240, at p. 201, our emphasis.

¹¹Fred Dretske, “Experience as representation,” *Philosophical Issues*, XIII, 1 (2003): 67–82, at p. 71.

¹²Tye, *Consciousness, Color, and Content*, *op. cit.*, at p. 69.

There are many other examples.¹³ Our claim is not that it is an official, explicit ingredient of these theorists' interpretation of the intentionalist thesis that the dependence relation holds between the phenomenal character of an experience and the representational content of that very experience. We do claim that this One-to-One conception is very much an unexamined assumption in the background to those interpretations. Hopefully, by making it explicit a debate among proponents and detractors of the One-to-One conception will be allowed to surface—indeed, we would be prepared to see some of the theorists cited above disown the One-to-One conception, once an alternative is clearly formulated.

The main aim of this piece is to formulate and defend such an alternative: intentionalism is compatible with claiming that the phenomenal character of perceptual experiences depends on the contents of several of the many representations our perceptual system generates. This is what we call *Many-to-One* intentionalism.

Many-to-One Intentionalism. The phenomenal character of a perceptual experience depends on the representational contents of a set of perceptual representations, possibly scattered throughout the brain.

Many-to-One intentionalism is not a claim about one mental state and the relation between two properties of this one state, but about a number of mental entities. It is about the relation between the phenomenal character of a perceptual experience, and the content of a variety of perceptual representations.

¹³David Bain, "Intentionalism and Pain," *Philosophical Quarterly*, LIII, 213 (2003): 502–523; Lycan, *Consciousness and Experience*, *op. cit.*; Nanay, "Attention and Perceptual Content," *op. cit.*; Michael Thau, *Consciousness and Cognition* (Oxford: Oxford University Press, 2001.)

Plausibly, One-to-One intentionalism is the mainstream way to develop intentionalism because many theorists rely on an intuitive model according to which a perceptual experience is a single, personal-level representation (what we might call a *summary representation*) that perfectly matches perceptual phenomenology in all its nuances, and on which the latter phenomenology depends. As we will show, summary representations are not something one finds in neuroscience and cognitive science; what we do find are many simpler personal and subpersonal representations, scattered throughout the brain.

This means that either i) we introduce a second step in the proposed naturalization of phenomenal experience above (that is to say, from many neural representations, to one summary representation, to phenomenal character); or ii) we cut out the middleman, and construe intentionalism as the claim that phenomenal character depends directly on the many perceptual representations identified in the empirical sciences of cognition. This is what we call Many-to-One intentionalism.

In what follows we present Many-to-One intentionalism, clarify its scope and distinguish it from other, superficially related positions. We will then argue that it is preferable to One-to-One intentionalism. Specifically, it makes better sense of the current neuroscience of perception, including phenomena related to multimodal integration and object recognition that are problematic for intentionalism as traditionally conceived. It also does better at living up to the original naturalistic promise of intentionalism. Finally, it is consistent with most (but not all) positions in the metaphysics of perception.

In section I we introduce some prominent ideas on the metaphysics of representation, and briefly review some of the main evidence for the existence of representations in the perceptual system. In section II we make a second pass at the characterization of Many-to-One intentionalism, relating it

to, and distinguishing it from, “multiple contents” theses (of the sort discussed, though not endorsed, by Michael Tye),¹⁴ and dual-component theories.¹⁵ In section III we argue that current ideas on the neuroscience of object recognition support Many-to-One intentionalism—more concretely, we show how these ideas are in tension with the notion of a summary representation. In section IV we do the same with multimodal integration. In particular, we show how some results on crossmodal effects in perception are most straightforwardly interpreted in terms of a single crossmodal percept that supervenes on different representations in different modalities. Section v concludes by drawing some general lessons for contemporary debates on naturalism, and the metaphysics of perception.

I. PERCEPTUAL REPRESENTATIONS AND PERCEPTUAL CONTENTS

”Content”, “representation”, and their cognates are terms of art in philosophy and cognitive science. Our interpretation of these notions should aim at maximizing the explanatory work they make in our theories. Many prominent contemporary philosophical accounts of what it takes for something to qualify as a representation (that is, responses to what Ramsey¹⁶ calls the “job description challenge”) explicitly aim at accommodating how this notion is used in the empirical sciences of the mind. For example, an idea often expressed in theoretical neuroscience is that “neural activity patterns [serve] the function of conveying information about the world,”¹⁷ where “conveying” implies not just carrying information about the world, but also this information being “used by downstream neurons in a way

¹⁴Michael Tye, *Consciousness Revisited: Materialism Without Phenomenal Concepts*, (Cambridge, MA: The MIT Press, 2009).

¹⁵Berit Brogaard, “Seeing as a Non-Experiential Mental State: The Case From Synesthesia and Visual Imagery,” in Richard Brown, ed., *Consciousness Inside and Out: Phenomenology, Neuroscience, and the Nature of Experience* (New York: Springer, 2014), pp. 377–394; Jack Lyons, “Perceptual Belief and Nonexperiential Looks,” *Philosophical Perspectives*, XIX, 1 (2005), pp. 237–256.

¹⁶William M. Ramsey, *Representation Reconsidered* (Cambridge: Cambridge University Press, 2007).

¹⁷Nikolaus Kriegeskorte and Jörn Diedrichsen, “Peeling the Onion of Brain Representations,” *Annual Review of Neuroscience*, XLII (2019), pp. 407–432, at p. 408.

that contributes to behavior” (*ibid.*). Two important insights here are, first, that *representations are in the business of conveying information about the world*,¹⁸ and that *they need to have a downstream consumer* for this to happen.¹⁹ Appeals to biological function (for example, our use of the “in the business of” idiom above) are sometimes taken to be related to another important feature of representations: their possibly being *misrepresentations*.²⁰

These ideas, central to most philosophical treatments of representation, are sometimes supplemented with the suggestion that for neural activity to count as properly representational it has to display the right sort of robustness to input variation. This is sometimes expressed in terms of *constancies*:²¹ color constancy, for example, results from neural activity that displays sensitivity to color while filtering out variation in the illuminant, among other things; and size constancy results from neural activity that displays sensitivity to object size while filtering out variation in object distance, among other things. Other theorists have proposed the additional requirement that representations participate in “broad-banded” behavioral responses:²² they should be available to inform an open-ended set of possible behaviors. It has recently been suggested that constancy- and broad-band-related restrictions on representational status can in fact be subsumed under more general informational-efficiency considerations.²³

¹⁸See also Fred Dretske, *Explaining Behavior. Reasons in a World of Causes* (Cambridge, MA: The MIT Press, 1988); Nicholas Shea, *Representation in Cognitive Science* (Oxford: Oxford University Press, 2018).

¹⁹See also Ruth Garrett Millikan, *Language, Thought and Other Biological Categories* (Cambridge, MA: The MIT Press, 1984); David Papineau, *Reality and Representation* (Oxford: Basil Blackwell, 1987).

²⁰In Section III we address the worry that the concept of representation used here may not capture the philosophical concept of genuine representation.

²¹Burge, *The Origins of Objectivity*, *op. cit.*; Peter Schulte, “Perceiving the world outside: How to solve the distality problem for informational teleosemantics.” *The Philosophical Quarterly*, LXVIII, 271 (2018): 349-369.

²²Kim Sterelny, *Thought In A Hostile World: The Evolution of Human Cognition* (Malden, MA: John Wiley & Sons, 2003).

²³Manolo Martínez, “Representations Are Rate-Distortion Sweet Spots,” *Philosophy of Science*, LXXXVI, 5 (2019): 1214–1226.

If we take representations to be signals that sit between a producer and a consumer, carry information about the world, are capable of misrepresenting, and perhaps display constancies and broad-banded response patterns, it is easy to show that perceptual representations are routinely posited in neuroscience and cognitive science. The first thing to note is that the neuroscience of perception explicitly and extensively recognizes the presence of representations in the primary visual cortex about, among other things, chromaticity,²⁴ brightness,²⁵ lightness,²⁶ or size.²⁷

The other criteria for representational status discussed above are also met as early as the primary visual cortex. For example, there are demonstrated lightness and size constancies in the primary visual cortex.²⁸ In short, if, as Burge²⁹ suggests, constancies are the mark of representations, then the primary visual cortex already represents.

As we have seen above, another important ingredient to most philosophical theories of representation is the thought that a state can only be a representation if it can misrepresent. While the retina mostly slavishly registers whatever is in front of it, the primary visual cortex does not: for example, when we look at an illusory contour in a Kanizsa triangle display, the primary visual cortex

²⁴Thomas Wachtler, Terrence J Sejnowski, and Thomas D Albright, "Representation of Color Stimuli in Awake Macaque Primary Visual Cortex," *Neuron*, xxxvii, 4 (2003): 681–691.

²⁵Andrew F. Rossi, Cynthia D. Rittenhouse, and Michael A. Paradiso, "The Representation of Brightness in Primary Visual Cortex," *Science*, cclxxiii, 5278 (1996): 1104–1107.

²⁶Sean P. MacEvoy and Michael A. Paradiso, "Lightness constancy in primary visual cortex," *Proceedings of the National Academy of Sciences*, xcvi, 15 (2001): 8827–8831.

²⁷Scott O. Murray, Huseyin Boyaci, and Daniel Kersten, "The representation of perceived angular size in human primary visual cortex," *Nature Neuroscience*, ix, 3 (2006): 429–434. A word of caution: in most of the research cited in this paragraph, 'representation' is operationalized as informational sensitivity; that is, for example, in Watchler et al., "Representation of Color Stimuli in Awake Macaque Primary Visual Cortex," *op. cit.*, a neuron is said to be representing chromaticity if it presents chromatic tuning (that is to say, a profile of different responses to different chromaticities). This operationalized measure makes representation (against our metasemantic sketch above) compatible with the absence of a consumer. In fact, though, researchers are typically aware that evidence about downstream consumption of the information is necessary to making the full case about representational status. For example, "[t]o confirm our results, experiments would be necessary where monkeys are indicating their color percepts during recording of the neural responses" (*ibid.*, at p. 689).

²⁸MacEvoy and Paradiso, "Lightness constancy in primary visual cortex," *op. cit.*; Murray, "The representation of perceived angular size in human primary visual cortex," *op. cit.*

²⁹"Origins of Objectivity," *op. cit.*

reliably “detects” an edge,³⁰ even if the edge is not there: it misrepresents the presence of this edge. Similarly, in cases of illusory motion (caused by “visual stimuli successively presented at different locations”)³¹ there is activity in V1 (the primary visual cortex) along the path “followed” by the illusory motion.³² Early cortical representations are genuine representations, susceptible to misrepresentation. And what is true of the primary visual cortex (arguably the earliest stage of visual processing that involves representations), is also true of higher stages of visual processing. For example, Brouwer and Heeger³³ show that it is possible to reconstruct the color of presented stimuli both from neural activity in V1 and from neural activity in V4 (higher up in the visual processing hierarchy.) In fact, one can reconstruct color *better* from V1 than V4.³⁴ On the other hand, color representation in V4, but not in V1, shows *progression*: “perceptually similar colors [evoke] the most similar responses”:³⁵ representations in higher visual areas are complementary to, and different from, representations in V1.

II. MANY-TO-ONE INTENTIONALISM

When we think of representations in the visual system, we should think of the ensemble of the diverse set of representations sketched in the previous section. Note that many of these representations are subpersonal and unconscious—*a fortiori*, they are not experiences. Furthermore, vision is only one sense modality: the auditory system has its own representations as does the olfactory or tactile perceptual systems. Each time we perceive something we utilize not one but several perceptual

³⁰Tai Sing Lee and My Nguyen, “Dynamics of subjective contour formation in the early visual cortex,” *Proceedings of the National Academy of Sciences*, xcviii, 4 (2001): 1907–1911.

³¹Lars Muckli, Axel Kohler, Nikolaus Kriegeskorte, and Wolf Singer, “Primary visual cortex activity along the apparent-motion trace reflects illusory perception,” *PLOS Biology*, iii, 8 (2005): e265, at p. 1501.

³²*Ibid.*

³³Gijs Joost Brouwer and David J. Heeger, “Decoding and Reconstructing Color from Responses in Human Visual Cortex,” *Journal of Neuroscience*, xxix, 44 (2009): 13992–14003.

³⁴*Ibid.*

³⁵*Ibid.*, at p. 13998.

representations in various stages of processing in various sense modalities, and many of these representations interact in various ways (see section IV below.)

We submit that once we recognize the rich “representational capital” present in our perceptual system, the One-to-One-intentionalist thesis that there is *a* single representation on which somehow the phenomenal character of experience depends loses part of its appeal: the intentionalist should not feel forced to look for an, in all likelihood chimeric, single mental state, with a content complicated enough to mirror every nuance in the phenomenal character of a certain perceptual experience—a *summary representation*. She should just avail herself of the contents of those multiple, simpler representations the perceptual system is trading in at any given time. Of course, precisely *which* kinds of perceptual representations, in which stages of the perceptual-processing hierarchy, will figure in the supervenience base of perceptual experiences is an as-yet-unsolved empirical question—one whose answer will depend heavily on future developments in the neurobiology of consciousness. Our point is just that intentionalists should not rule out any perceptual representations as possible components of that supervenience base simply on the grounds that they are not summary representations.³⁶

Our view needs to be contrasted with various superficially related, but importantly different accounts of the relation between content and phenomenology. Our claim is that the phenomenology of perceptual experience supervenes on the content of a variety of perceptual representations. This is a different claim from saying that the phenomenology of our perceptual experience supervenes on a

³⁶Another question we will not touch upon here has to do with the nature of experiences: if they are not representations, then what are they? As far as the defense of Many-to-One intentionalism is concerned, the metaphysics of experiences is wide open: perhaps experiences are stable patterns in the landscape of perceptual representations (along the lines of Daniel C. Dennett, “Real patterns,” *The Journal of Philosophy*, LXXXVIII, 1 (1991): 27–51), or perhaps (paraphrasing Stephen Yablo, “Mental Causation,” *The Philosophical Review*, CI, 2 (1992): 245–280) they are determinables of representational determinates; among many other options. Many-to-One intentionalists can remain non-committal about this. In any event, the view is, of course, committed to the existence of experiences—the very idea of intentionalism is predicated on it.

variety of contents of a single perceptual representation.³⁷ One example of this latter view is what Michael Tye³⁸ calls, without endorsing it, the “Multiple-Contents Thesis.” As Tye puts it, the Multiple-Contents Thesis “challenges the assumption ... that each visual experience has (at most) a single content.”³⁹ For example, in Tye's elaboration of the idea, a visual experience may have both what he calls a *singular-when-filled* content (that is, a content which is either singular or gappy) and an existential content.

The Multiple-Contents Thesis concerns the various contents of *a single* representation, underlying a single perceptual experience. It is, therefore, a variety of One-to-One intentionalism as characterized above. By all means, if it turned out that a perceptual representation (from among the set of representations that perceptual experience depends on) had two or more contents, nothing would prevent a Many-to-One intentionalist from availing herself of these multiple contents in her description of the representational signature of a certain perceptual experience. The theoretical possibility of one representational state with multiple contents (which we see no reason to deny) shows that we need to be careful in characterizing Many-to-One intentionalism: the idea is not (merely) that experiences depend on various contents; it is also that they are the contents of various different representations.

A second family of accounts we need to distinguish from Many-to-One intentionalism are the various “dual-component” theories of perception (also DCTs henceforth,) according to which, roughly, perceptual experiences are composites of a conceptual state (a belief, in the classical account formulated by Reid),⁴⁰ or something along the lines of a “visual seeming” in contemporary versions

³⁷Christopher Peacocke, *A Study of Concepts* (Cambridge, MA: The MIT Press, 1992); Tye, *Consciousness Revisited*, *op. cit.*

³⁸*Ibid.*, section 4.4.

³⁹*Ibid.*

⁴⁰Thomas Reid, *An inquiry Into the Human Mind on the Principles of Common Sense* (University Park: Pennsylvania State University Press, 2000).

of the view)⁴¹ and a sensory, nonconceptual state. With a bit of effort, DCTs can be coaxed into becoming versions of Many-to-One intentionalism: if the nonconceptual component of the experience is taken to be an representational state; and both nonconceptual and conceptual components of the composite are taken to contribute to the way things look in the experiential sense, *then* the phenomenal character of a perceptual experience depends on the content of *two* (and, so, more than one) representations.

As with the multiple content thesis, DCTs are not necessarily incompatible with Many-to-One intentionalism as we are developing it here. The way we intend our view to be understood, it goes beyond DCTs in allowing for the representational supervenience base to include potentially many more states: for example, it denies that the nonconceptual component is a single representation; rather, this component resolves into a variety of simpler representations throughout the perceptual system. Many-to-One intentionalism can be seen as providing a way to peer into the nonconceptual black box.

The way we have been dealing with these two accounts invites the following worry: we have been assuming that, at least typically, we are in a position to distinguish between, for example, i) a situation in which there are two perceptual representations A and B, each with its own content, from ii) a situation in which those two contents are had by one and the same representation, AB (as in the multiple-contents thesis) or are had by states which are components of some bigger state or representation (as in dual-component theories.) But, the worry would go, this assumption is problematic: vehicle individuation in the perceptual system is to a large extent a pragmatic affair, and it is not clear that there is always a fact of the matter between i) and ii). For example, whenever we postulate a case such as i), with its two representations A and B, the One-to-One intentionalist can counter that a single representation AB is available: the composition of A and B.

⁴¹Berit Brogaard, "Seeing as a Non-Experiential Mental State," *op. cit.*

In response, we first note that a pragmatist attitude towards vehicle individuation might, after all, sit uncomfortably with intentionalism: as Shea⁴² has remarked, vehicle realism (that is to say, “there being a substantial non-semantic sense in which an individual token counts as being the same representation again”)⁴³ might be needed for representations to discharge their explanatory duties, and therefore for the intentionalist project to be viable. And it is to be expected that a substantive, realist theory of vehicles will provide guidance as to whether A and B are more basic than AB, or whether AB is actually a vehicle at all.

But, even granting pragmatism about vehicles, in order to make the “AB is just as good a vehicle as A and B” move, the One-to-One intentionalist should at least provide some guidance as to how the contents of A and B should be combined in generating the content for AB. The obvious idea, that the content of AB is “[the content of A] and [the content of B]”, will not do in general: nothing ensures that the contents of A and B will be compatible (say, if A corresponds to an episode of mind wandering, while B is tethered to the perception of our immediate surroundings), and we would not want to overgenerate incoherent representations. More importantly, there is no guarantee that personal-level “representational contents of the experience” can be obtained by composing low level perceptual representations in the manner envisaged by the objection. At any rate, this is not something that contemporary neuroscience of perception knows how to do. Another way to flesh out the idea of representation composition, suggested to us by an anonymous reviewer, is to reflect on the way long, complex stories are made up of simpler episodes, character sketches and plot elements that are, just like perceptual representations, diachronic. Perhaps the relation between AB and A, and B is, rather, like this? Perhaps it is, but it should be noted that many of the problems with the simple-minded “conjunction of contents” suggestion explored above recur here: for example, there is no

⁴²Shea, *Representation in Cognitive Science*, *op. cit.*, section 2.5.

⁴³*Ibid.*, at p. 38.

guarantee that the different simple representations (“plot elements”) in the perceptual system will immediately cohere into a full experience-like summary representation (“long-form story”). In storytelling this kind of coherence is often imposed from above, as the result of the explicit control exerted by a narrator. But, for example, the primate ventral stream of perceptual processing does not enjoy the benefit of a narrator.

So far, we have talked a lot about the supervenience base—the perceptual content that perceptual phenomenology supervenes on—and whether its members are one or many. But a similar question could be raised about the supervenient phenomenology: some take perceptual experience at any given time to be necessarily unified in a deep and essential way.⁴⁴ Others emphasize the “equally obvious *disunity* in consciousness”.⁴⁵ In principle, one’s views about whether the subvenient base is formed by one or many representations is consistent with either taking the supervening phenomenology to be unified or disunified. For simplicity of exposition, we have been and will be talking about *the* (one) perceptual phenomenology, but those who take perceptual phenomenology itself to be made of many different experiences could apply Many-to-One intentionalism to each of the disjointed pieces of phenomenal character.

We will now start putting Many-to-One intentionalism to use, first (in the following section), in making sense of contemporary theories of object recognition; then (in section IV) in accommodating what are perceived as problem cases for intentionalism, based on multimodal perception.

III. ALTERNATIVES TO MANY-TO-ONE INTENTIONALISM

⁴⁴Tim Bayne, *The unity of consciousness* (Oxford: Oxford University Press, 2010), at p. 10.

⁴⁵Ray Jackendoff, *Consciousness and the computational mind* (Cambridge, MA: The MIT Press, 1987), at p. 51.

What would be the alternative to the view we defend? If perceptual phenomenology does not supervene on the content of a variety of perceptual representations, but only on the content of one single perceptual representation, then we get one of the following two ways of thinking about perception.

First, one can deny what we have tried to show in Section I above, namely, that there are many representations along various stages and streams of perceptual processing. One could deny this by denying that representations in the visual stream (and in the perceptual system in general) qualify as genuine representations in the philosophical sense of the term. The argument would be that maybe cognitive scientists call these “representations”, but they are not what philosophers would call representations. We have tried to show that according to our best philosophical accounts of representation these states would indeed qualify, but one could of course insist that they are missing some features of the genuine article.

One could insist, for example, that representations are necessarily conscious, in which case the representations in V1, for example, would not count as ‘genuine representations’ (as they are not conscious). We do not intend to police how people use the concept of representation, but if one chooses this particular way of using it, then the ship has already sailed on coming up with a version of intentionalism, where phenomenology is supposed to supervene on and, in principle, be explainable in terms of, perceptual content. It is, of course, open to the main defenders of this option (those working on the *phenomenal-intentionality research program*)⁴⁶ to pursue alternative approaches to the naturalization of phenomenology, but not an intentionalist one.⁴⁷

⁴⁶Uriah Kriegel, *Phenomenal intentionality* (Oxford University Press, 2013); Agustín Vicente and Marta Jorba, “The Linguistic Determination of Conscious Thought Contents,” *Noûs*, LIII, 3 (2019): 737–759.

⁴⁷We would like to thank an anonymous reviewer for pressing us on this point.

But this is not the only option for the opponents of Many-to-One intentionalism. They could instead acknowledge that there are genuine representations in the perceptual system, but still insist that all these representations need to be unified into what we have called a summary representation, that brings together all the information carried by the various representations in perceptual processing. This would still be a variety of One-to-One intentionalism, as perceptual phenomenology, the idea would go, supervenes on the content of this summary representation.

The problem with this proposal is that our perceptual system does not seem to work this way. As we have seen above, different areas in the ventral visual stream (that is, the processing pathway that goes from the retina to the lateral geniculate nucleus, to V1, to V2, to V4, and finally to the inferotemporal cortex)⁴⁸ have been suggested as encoding information about different features of the visual scene. For example, many V1 and V2 cells might work as Gabor filters, detecting different textures,⁴⁹ while V4 cells have been shown to play an important role in subjective color perception.⁵⁰ V1, V2 and V4 are anatomically separate cortical areas, yet our subjective experience of the perception of scenes is, among other things, as of colored textures. The simplest way to accommodate this apparent mismatch is by embracing Many-to-One intentionalism: perceptual experience would depend, among many other representations, on the ones tokened in V1, V2 and V4, without the need for a summary representation, elsewhere in the brain, that as far as we know does not exist.⁵¹

⁴⁸James J. DiCarlo and David D. Cox, “Untangling invariant object recognition,” *Trends in Cognitive Sciences*, XI, 8 (2007): 333–341.

⁴⁹S.E. Grigorescu, N. Petkov, and P. Kruizinga, “Comparison of texture features based on Gabor filters,” *IEEE Transactions on Image Processing*, XI,10 (2002): 1160–1167.

⁵⁰C. A. Heywood, A. Gadotti, and A. Cowey, “Cortical area V4 and its role in the perception of color,” *Journal of Neuroscience*, XII, 10 (1992): 4056–4065; Brouwer and Heeger, “Decoding and Reconstructing Color from Responses in Human Visual Cortex,” *op. cit.*

⁵¹As we said above, we should not be construed as outrightly claiming here that V1 and V2 representations are in the supervenience base of perceptual experiences. It is indeed possible that only representations in higher cortical areas make a direct contribution to experience. But we certainly should not rule out early visual representations as part of the supervenience base on One-to-One grounds. Be that as it may, our main point (that experience depends on disjoint representations, possibly scattered throughout the perceptual processing hierarchy) stands, whether the scattering in question includes early visual processing or not.

One way to see that the idea of a summary representation is problematic is to examine recent work on object classification by James DiCarlo's group.⁵² The way in which object classification is conceptualized in this body of work is as follows: consider, for example, the task of deciding, upon presentation of an image, whether it is of a car or not. All the information necessary to solve the task, by hypothesis, is in the image itself; what the brain needs to do is construct, step by step, a representation which makes the car/not car decision easy to take (say, linearly decodable). This is hypothesized to happen along the ventral path, through many re-representations that step by step separate neural activity into a car region and a not-a-car region of neural activation space. The catch is that, by the time the decision is reached, and as a result of the process of separating object regions, the final representation “collapses' all other information about the images.”⁵³ That is, the very process of reaching perceptual decisions about object category destroys information about other sensory properties.

The point is not that there are no representations of sensory properties elsewhere in the brain, of course. There certainly are. The point is that they are not the same representations that encode whether the object is a car: the process of reaching this decision uses up and destroys all other information about the object. That is to say, it would seem that there are no summary representations (representations that would keep all of the relevant sensory material as the brain progresses in the process of making object classification decisions) in our perceptual system. To the extent that an intentionalist is committed to representations of basic sensory features (colors, shapes and the like) being still around by the time a decision as to object category (car or no car, say) has been reached,

⁵²James J. DiCarlo, Davide Zoccolan, and Nicole C. Rust, “How Does the Brain Solve Visual Object Recognition?,” *Neuron*, LXXIII, 3 (2012): 415–434; James J. DiCarlo and David D. Cox, “Untangling invariant object recognition,” *Trends in Cognitive Sciences*, XI, 8 (2007): 333–341; Daniel L. K. Yamins and James J. DiCarlo, “Using goal-driven deep learning models to understand sensory cortex,” *Nature Neuroscience*, XIX, 3 (2016): 356–365.

⁵³DiCarlo and Cox, “Untangling invariant object recognition,” *op. cit.*, Fig. 3.

she needs to grapple with the fact that object-category information and basic-sensory information do not coexist anywhere in the visual system. Our experience, which seem to be ostensibly as of colored cars, is more aptly thought of as depending on a set of various representations in the ventral stream, in a Many-to-One fashion.

IV. INTENTIONALISM AND MULTIMODALITY

Many-to-One intentionalism has direct implications for one of the most important objections to intentionalism, about its incompatibility with recent findings on the multimodality of our perceptual system.

While multimodality has been influentially exploited in arguments against intentionalism,⁵⁴ the strength of these objections in fact depends on the multimodal phenomenon in question; and, as it happens, the most widely discussed crossmodal phenomena do not in fact jeopardize any version of intentionalism—not even the One-to-One variety we are criticizing ourselves. We will start discussing some popular multimodal phenomena that are actually compatible with intentionalism, and then move on to the more problematic ones.

We know that our perceptual experience in one sense modality very often depends on other sense modalities.⁵⁵ Visual phenomenology, for example, depends on what is happening in the auditory perceptual system. One often cited example is ventriloquism, which is commonly described as an

⁵⁴Dominic M. McIver Lopes, “What Is It Like to See with Your Ears? The Representational Theory of Mind,” *Philosophy and Phenomenological Research*, LX, 2 (2000): 439–453; John W. O’Dea, “Representationalism, Supervenience, and the Cross-Modal Problem,” *Philosophical Studies*, CXXX, 2 (2006): 285–295.

⁵⁵Paul Bertelson and Beatrice De Gelder, “The Psychology of Multimodal Perception’, in *Crossmodal Space and Crossmodal Attention*, Charles Spence and Jon Driver, eds. (Oxford: Oxford University Press, 2004), pp. 141–177; Casey O’Callaghan, “Seeing What You Hear: Cross-Modal Illusions and Perceptions,” *Philosophical Issues*, XVIII, 1 (2008): 316–338; Bence Nanay, “Multimodal Mental Imagery,” *Cortex*, CV (2018): 125–134.

illusory auditory experience influenced by something visible.⁵⁶ It is one of the paradigmatic cases of crossmodal illusion: we experience the voices as coming from the dummy, while they in fact come from the ventriloquist. The auditory sense modality identifies the ventriloquist as the source of the voices, while the visual sense modality identifies the dummy. And, as it often (not always)⁵⁷ happens in crossmodal illusions, the visual sense modality wins out: our (auditory) experience is of the voices as coming from the dummy.

Our second example is the double-flash illusion. This is one of the most striking crossmodal illusions: you are presented with one flash and two beeps simultaneously.⁵⁸ So, the sensory stimulation in the visual sense modality is one flash, yet you experience two flashes; in fact, already in the primary visual cortex, two flashes are processed.⁵⁹ These are not isolated examples. The norm, not the exception, is for processing (and phenomenology) in one sense modality to be influenced by processing in the other sense modalities.⁶⁰

These and other multimodality findings show that phenomenology in one sense modality does not supervene only on processing confined to that sense modality. Is this a problem for One-to-One intentionalism? In fact, it is not: the findings support claims about the relation between phenomenology and multimodal *processing*, not about the relation between phenomenology and multimodal *contents*. But, in order for these findings to count as genuine objections to One-to-One

⁵⁶Paul Bertelson, "Ventriloquism: A case of crossmodal perceptual grouping," in Gisa Aschersleben Talis Bachmann and Jochen Müsseler, eds., *Cognitive Contributions to the Perception of Spatial and Temporal Events*, (Amsterdam: North-Holland, 1999): 347–362; O'Callaghan, *ibid*.

⁵⁷See O'Callaghan, *ibid*.

⁵⁸Ladan Shams, Yukiyasu Kamitani, and Shinsuke Shimojo, "What you see is what you hear," *Nature*, CDVIII, 6814 (2000): 788–788.

⁵⁹S. Watkins, L. Shams, S. Tanaka, J.-D. Haynes, and G. Rees, "Sound alters activity in human V1 in association with illusory visual perception," *NeuroImage*, xxxi, 3 (2006): 1247–1256.

⁶⁰*Crossmodal Space and Crossmodal Attention*, Charles Spence and Jon Driver, eds. (Oxford: Oxford University Press, 2004).

intentionalism, we would need to establish dependence of experience on more than one representation.

To take the ventriloquism example, auditory phenomenology there depends partly on visual processing: we see the dummy talking and the ventriloquist with her mouth closed, and this influences our auditory processing and, as a result, our auditory experience. But does our auditory experience also depend on the *content* of our visual perception? We are not forced to conclude this: one could argue that visual processing influences the content of auditory representations, and auditory phenomenology then supervenes on the content of these auditory representations alone. If so, then these examples of multimodal perception do not count as objections to any version of intentionalism. Indeed, there is evidence that the visual processing that gives rise to the ventriloquist illusion influences representations of sound location in the auditory cortex;⁶¹ and, as we saw above, there is evidence that the auditory processing that gives rise to the double flash illusion influences representations of two flashes in the primary visual cortex.

Now we can switch gears and talk about cases of multimodal perception that do pose a genuine threat to intentionalism, interpreted along One-to-One lines. These are cases where one sense modality does not merely causally influence processing (and phenomenology) in another sense modality, but where information from two different sense modalities is integrated. Neuroscientists operationalize crossmodal sensory interaction as depending on the fact that the level of activity for the combined visuo-auditory stimulus is higher than the sum of activations for the two single-modality

⁶¹Bjoern Bonath, Toemme Noesselt, Antígona Martínez, Jyoti Mishra, Kati Schwiecker, Hans-Jochen Heinze, and Steven A. Hillyard, “Neural Basis of the Ventriloquist Illusion,” *Current Biology*, XVII, 19 (2007): 1697–1703.

stimuli.⁶² The main point, for our current purposes, is that the phenomenology in crossmodal integration cases depends on the content of representations in more than one sense modality.

Here is an example. It is well known that judgments of whether a certain object is looming or receding are reached much more quickly and reliably when both auditory and visual cues are present than when only one of them is.⁶³ Crucially, this cannot be explained in terms of one sense modality enriching the content of the other sense modality, which then in itself gives rise to phenomenology in that sense modality (this would be, as we have seen, consistent with One-to-One intentionalism). Researchers in this literature often talk of a "unified percept", where this percept is not bound to any particular modality, as is the case with the ventriloquist and double-flash illusions. For example, Talsma and colleagues claim that

Multisensory integration generally refers to the set of processes by which information arriving from the individual sensory modalities (e.g. vision, audition, touch) interacts and influences processing in other sensory modalities, including how these sensory inputs are combined together to yield a unified perceptual experience of multisensory events.⁶⁴

This is a genuine objection to One-to-One intentionalism: in the case of visuo-auditory multisensory integration, visual phenomenology does not supervene on visual content. Visual phenomenology supervenes on visual and auditory content as visual and auditory representations are integrated to yield

⁶²W. A Teder-Sälejärvi, J. J McDonald, F Di Russo, and S. A Hillyard, "An analysis of audio-visual crossmodal integration by means of event-related potential (ERP) recordings," *Cognitive Brain Research*, XIV, 1 (2002): 106–114.

⁶³Céline Cappe, Antonia Thelen, Vincenzo Romei, Gregor Thut, and Micah M. Murray, "Looming Signals Reveal Synergistic Principles of Multisensory Integration," *Journal of Neuroscience*, XXXII, 4 (2012): 1171–1182; Joost X Maier, John G Neuhoff, Nikos K Logothetis, and Asif A Ghazanfar, "Multisensory Integration of Looming Signals by Rhesus Monkeys," *Neuron*, XLIII, 2 (2004): 177–181; Durk Talsma, Daniel Senkowski, Salvador Soto-Faraco, and Marty G. Woldorff, "The multifaceted interplay between attention and multisensory integration," *Trends in cognitive sciences*, XIV, 9 (2010): 400–410.

⁶⁴Talsma et al., "The multifaceted interplay between attention and multisensory integration," *op. cit.*, at p. 401.

a unified multisensory percept. These unified percepts, by definition, depend on at least two different representations, across two different sensory modalities.

Here, Many-to-One intentionalism has a major explanatory edge over One-to-One intentionalism. If we think of intentionalism as a claim about the relation between perceptual phenomenology and the content of all our perceptual representations, then the above objection does not even get off the ground. According to Many-to-One intentionalism, visual phenomenology is not supposed to supervene on visual content only. It is supposed to supervene on the content of a number of representations, some visual some not. Multimodality does not trouble Many-to-One intentionalists.

V. CONCLUSION: NATURALISM AND THE METAPHYSICS OF PERCEPTION

The original motivation behind intentionalism is naturalistic: we aim at clearing the explanatory gap between phenomenology and neural activity by dividing it into two smaller gaps: first one between neural activity and representational phenomena, and a second one between representational phenomena and phenomenal character. Intentionalism is supposed to close the latter gap.

However, if intentionalism is formulated the One-to-One way, as concerning just one perceptual representation, there is a third naturalistic “gap” to clear: how do we get from the representations identified in the neuroscience of perception to the One-to-One-intentionalist's all-encompassing, phenomenology-fixing, summary representation? Our best scientific theories do not seem to postulate anything of the sort, and the philosopher of perception is, again, left to her own devices. *We can*, in contrast, use our best scientific theories to find out more about the content of various representations in the perceptual system. In fact, we already know a lot about these

representations and the way they represent what they represent (as we have seen in Section I above). One may object that these representations are not conscious, and indeed most of them are not. Or that they are subpersonal representations and not personal ones. We take this to be a feature, not a bug, especially from a naturalistic point of view: our current scientific theories have much more information about subpersonal representations in the visual cortex than about perceptual experiences in and of themselves, whatever they might be.⁶⁵

In this paper we have focused on an intentionalist in-house discussion: we have defended one particular way of developing the intentionalist thesis, against another very prominent way. But not everyone is on board with some of the background assumptions of the intentionalist project. Those, for example, who believe that perceptual experiences do not have content will find the debate about what does and what does not supervene on the content of perceptual experience (the existence of which they deny) pointless. That is, the following would seem little more than a truism: intentionalism only makes sense if we also endorse the view that perceptual experiences have content.

But note that if we interpret intentionalism the Many-to-One way, as the view that perceptual phenomenology supervenes on the content of a variety of representations in the perceptual system, then intentionalism *is* compatible with the claim that perceptual experience itself has no content. Content comes into the picture through (non-experiential) perceptual representations. It is open to the Many-to-One intentionalist to defend that the phenomenology of (contentless) perceptual experience depends on the content of (non-experiential) perceptual representations.

⁶⁵An anonymous reviewer has also suggested to us that having the same entity (an experience) be both the bearer of intentional content and the bearer of phenomenal character (as in One-to-One intentionalism) makes for a tight explanatory relation between the two properties, and that this is an attractive feature of the view we are arguing against. On the other hand, explanatory relations (in cognitive science, in other sciences, and in every walk of life) much more often than not hold between different entities: activity in V4 depends on previous activity in V1; a bump in the road explains the flat tire.

At least for this reason, we do not believe that whatever benefits accrue to One-to-One intentionalism from having one entity as the bearer of the two properties implicated in the intentionalist explanatory relation outweighs the explanatory advantages that Many-to-One intentionalism has over it.

In this construal, Many-to-One intentionalism is consistent with at least the negative claim of such anti-representationalist accounts (if we take anti-representationalism to be a view about the representational status of perceptual experiences.) Of course, many anti-representationalists have their own positive account of what determines the phenomenology of perceptual experiences—say, the perceived object itself, or our active engagement with the world—which will make their views incompatible with the non-negotiable intentionalist tenet that it is representational content that determines phenomenal character. But those who are drawn to these positions mainly because of their mistrust of the idea that perceptual experience has content are welcome to embrace Many-to-One intentionalism as a plausible Middle Way.⁶⁶

MANOLO MARTÍNEZ & BENCE NANAY

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