The Indeterminacy of Consciousness

This paper considers the relationship between three theses in the philosophy of consciousness: the *Determinacy* thesis, on which for each x, it is determinate whether x is conscious; the *Degree* thesis, on which consciousness comes in degree; and the *Dimensionality* thesis, on which consciousness is multidimensional. The paper distinguishes two parallel arguments against Determinacy, one from Degree and one from Dimensionality, and shows that while the first is subject to serious objections, the second is not. The underlying reason is that multidimensionality brings with it a distinctive and up-to-now unrecognized form of indeterminacy: indeterminacy in how dimensions are aggregated. This novel Dimensionality argument is significant since it shows, in virtue of avoiding the objections to which the Degree argument is subject, that what appear to be drastic consequences of Determinacy—including the falsehood of many of our best theories of consciousness and the falsehood of gradualism about its evolution—may be avoided.

Keywords: consciousness, vagueness, indeterminacy, degrees, gradability, multidimensionality

1. Three Theses in the Philosophy of Consciousness

Much recent work in the philosophy of consciousness has coalesced around three theses. The first is the Determinacy thesis:

Determinacy Consciousness is determinate.

The idea underlying this thesis is that it is always determinate whether something is conscious or not. In other words, consciousness does not admit of borderline cases. Just as it is always determinate whether a country is or is not a member of the United Nations, hence there are no borderline cases of UN membership

[Bayne et al., 2016], so it is determinate whether or not one is conscious, hence there are no borderline cases of consciousness.

The second thesis is the Degree thesis:

Degree Consciousness comes in degree.

The idea underlying this thesis is that it is possible for a thing to be conscious to varying degrees, and so for one thing to be conscious to a greater degree than another. In other words, consciousness is a quantity.[1] Just as one can have more or less mass [Lee, 2022], and can have mass to varying degrees, one can have more or less consciousness and can be conscious to varying degrees.

The third thesis is the Dimensionality thesis:

Dimensionality Consciousness is multidimensional.

The idea underlying this thesis is that whether and to what degree something is conscious depend on how that thing stands with respect to some set of underlying dimensions of consciousness.[2] In other words, consciousness is an aggregate notion.[3] Just as whether something is athletic and how athletic it is depend on aggregating, for instance, its strength, speed, and agility, whether something

[1]Here, and throughout, we will use 'quantity' in a very general way to mean 'something that comes in degree'. Importantly, we do not require quantities to have an additive structure, and wish to include among the quantities things that can be measured on an ordinal scale, rather than requiring that they be measurable with interval or ratio scales. In this we follow Bigelow and Pargetter [1988], but see Wolff [2020] for a more recent discussion. However, nothing of substance will turn on terminological choice in what follows.

[2]For discussion of the multidimensionality of consciousness see Bayne et al. [2016], Fazekas and Overgaard [2016], Walter [2021], Veit [2022].

[3]Here, and throughout, we will say that F is an aggregate if and only if whether something is F and how F something is are determined by how it stands along F's underlying dimensions. But this warrants two clarifications. First, we do not require that F or its dimensions come in degree, though in many cases, including most of the ones we will discuss, they do. Second, while we speak in terms of determination by underlying dimensions, strictly speaking, we mean to leave open the question of whether F or its dimensions are explanatorily prior.

is conscious and how conscious it is depend on aggregating the underlying dimensions of consciousness.

These theses—the three Ds as we will sometimes call them—are of interest both independently and together. Determinacy is particularly important because, as we will see in more detail below, it appears to have three striking consequences for theorizing about consciousness, both in philosophy and in science. The first apparent consequence is that gradualism about the evolution of consciousness cannot be true; the second is that most existing scientific theories of consciousness are mistaken; the third is that standard metaphysical models of how consciousness fits into the physical world are false. These apparent consequences make the truth of Determinacy a matter of considerable urgency, and provide us with *prima facie* reason to resist it.

How, then, to resist it? This is where the second and third theses likewise become urgent. The main suggestion in the literature has been that that Degree can serve as the basis for an argument against Determinacy, and so allow us to avoid its consequences.[4] The idea behind this argument is that if consciousness comes in degree, it must admit of borderline cases, for, if it comes in degree, we can always move, in small increments, from something that isn't conscious to something that is, and in the process will encounter borderline cases. But as we will see below, while initially appealing, this argument is in the end unpersuasive. There are many adjectives that denote properties which come in degree and yet have no borderline cases. Thus, on its own, Degree does not provide a good reason to reject Determinacy.

The main aim of this paper is to introduce and defend a different but parallel argument against Determinacy, one which takes as its premise not Degree, but

[4]See Lee [2020], Tye [2021], among others.

instead Dimensionality. This argument from Dimensionality is important for three reasons. First, it identifies and invokes an up-to-now unrecognized source of indeterminacy in consciousness, indeterminacy in how the dimensions of consciousness are aggregated. This contrasts with the more familiar source invoked by the argument from Degree, which concerns the threshold an object must meet in order to be conscious. Second, the argument from Dimensionality is more plausible than the argument from Degree, since as we will see, it avoids the objections to which the latter argument is subject. Finally, the possibility of indeterminacy due to multidimensionality is something that all philosophers of consciousness must reckon with regardless of whether they ultimately accept our conclusions. Part of the goal of our discussion, therefore, is to bring this possibility to the fore.

The rest of the paper has four sections. In section 2, we examine Determinacy in more detail. In section 3, we set out the argument from Degree to the falsehood of Determinacy and explain why it is unpersuasive. In section 4, we set out and defend the argument we are most interested in, the argument from Dimensionality to the falsehood of Determinacy. In section 5, we conclude by noting some limitations on the present discussion and suggesting further avenues for research.

2. The Determinacy Thesis

We can state the determinacy thesis in slightly more formal terms as follows:

Determinacy Necessarily, for all x, it is determinate whether x is conscious.

Given a standard semantics for 'whether'-questions, the thesis is equivalent to the claim that necessarily, for all x, either x is determinately conscious or x is

determinately unconscious.[5] But even so formulated, the thesis raises several issues.

First, over what kinds of things does the universal quantifier range? Here we will understand the quantifier as ranging over subjects (typically people or other organisms), rather than psychological states that those subjects can be in. So, as we will understand the thesis, it states that necessarily, for all subjects x, it is determinate whether x is conscious. There is a close correspondence, however, between being a conscious subject and being in a conscious state, and most of our claims and arguments in what follows can be reformulated in terms of conscious states if need be.

Second, what notion of consciousness does the determinacy thesis concern? Here we will operate with the *phenomenal conception* of consciousness:

PC A psychological subject S is conscious if and only if there is something it is like to be S.[6]

Given this notion of consciousness, Determinacy is the thesis that necessarily, for any psychological subject S, it is determinate whether there is something it is like to be S. Once again, it is important to note there is a parallel conception of consciousness that is defined not for subjects but for states. On this conception, a psychological state x of a subject S is conscious if and only there is something it is like for S to be in x. As before, however, much of the argumentation to follow could be formulated in terms of this state conception, but we will leave that implicit in the presentation.

Third, what notion of determinacy and indeterminacy is at play in the thesis?

[5] See Karttunen [1977].

[6] The classic discussion of the phenomenal conception is due to Nagel [1974]. For discussion of an alternative conception, the access conception, see Block [1995].

It is controversial whether indeterminacy is semantic, epistemic, or metaphysical.[7] However, deciding between these competing views is beyond the scope of this paper. In what follows, therefore, we will assume only the following principle:

BC-Det Necessarily, for all x, it is determinate whether x is F if and only if x is not a borderline case of $\ulcorner$ is $F\urcorner$.

This principle connects determinacy and indeterminacy with borderline cases (hence its label), but remains neutral on how determinacy is to be understood. Our arguments likewise will invoke only BC-Det, and so will not depend on any particular view of indeterminacy. Having noted this, however, we will sometimes talk about *consciousness* being determinate or indeterminate. But this is merely for convenience, and should not be seen as a departure from our neutral stance.[8]

Fourth, how does the determinacy thesis relate to context? It is standard in the literature on vagueness to think of vague expressions as having borderline cases not simpliciter, but relative to a context.[9] Given this, we will assume in what follows that Determinacy requires determinacy in *all* contexts, and so can be stated in fully explicit form as follows:

Determinacy Necessarily, for all objects x and contexts c, it is determinate whether x is conscious in c.

[7] For the semantic conception, see Lewis [1970, 1986], Fine [1975], and Kamp [1975]; for the epistemic conception, see Williamson [2000], Sorensen [1988], and Horwich [1990]; and for the metaphysical conception, see Tye [1990], van Inwagen [1988] and Morreau [2002].

[8] In addition to remaining neutral on the nature of determinacy, we also wish to leave open the possibility that determinacy may come in degree. We often, for example, speak of things as more or less determinate. But here we will take Determinacy to assert that consciousness is *fully* or *perfectly* determinate, just as we sometimes say that an adjective or concept is perfectly sharp. To anticipate some terminology that will be explained below, we think 'determinate' is an *absolute total* gradable adjective. See Hájek and Rabinowicz [2021] for discussion.

[9] See Kamp [1975], Fara [2001], Kennedy [2007], Varzi [2007], and Kölbel [2010], among many others.

In the light of this amendment, we then need to understand BC-Det as likewise involving a contextual parameter c, so that it is determinate whether x is F in c iff x is not a borderline case of c. However, in much of what follows we will leave this contextual parameter implicit, and take for granted that whether consciousness has borderline cases is a matter of whether it has borderline cases in some context or other.

Fifth, what reason do we have to think that Determinacy is even *prima facie* true? Given the principle just introduced that connects Determinacy with borderline cases, namely BC-Det, the easiest forms of argument for Determinacy operate by providing evidence that borderline cases of consciousness are impossible, and so reasoning, via BC-Det, to the conclusion that Determinacy is true.

In turn, it is convenient to distinguish two ways of arguing that borderline cases of consciousness are impossible. The first way, which we will call a *weak inconceivability argument*, proceeds by asserting that it does *not* appear possible for there to be borderline cases of consciousness. Given that we have no reason to think that the appearances are deceptive, the premise, together with BC-Det, entails Determinacy.

The second way, which we will call a *strong inconceivability argument*, proceeds by asserting that it appears *im*possible that there are borderline cases of consciousness. Given that again, we have no reason to think that the appearances are deceptive, together with BC-Det, this premise entails Determinacy.[10]

Weak inconceivability arguments have little force. By itself, the fact that something fails to appear possible to you provides minimal support for the claim that it is impossible. We will therefore set arguments of this kind aside. Strong

[10]For discussion of these two kinds of arguments, see Van Cleve [1983] and Stoljar [2006].

inconceivability arguments, by contrast, provide considerably more support for claims of impossibility. Many of the arguments we will consider below, which begin from premises about the semantics of the word 'conscious' and conclude that borderline cases are impossible, may be understood as taking this form.

Finally, if Determinacy is true, what follows? As we noted above, the principle seems to allow us to argue, *a priori*, for three profound consequences concerning the philosophy and science of consciousness.[11] We can state these consequences as follows:

Consequence 1 (for the evolution of consciousness) If consciousness is fully determinate, then the evolutionary process that produced consciousness, whatever it may be, would appear to be a non-gradual one. But if we assume as an empirical matter that the evolution of consciousness is gradualist in nature, and that any gradualist process will give rise to borderline cases, it follows that Determinacy is false. Hence, if Determinacy is true, gradualism is false.

Consequence 2 (for the science of consciousness) If consciousness is fully determinate, and consciousness is nomologically correlated with some physical property or collection of properties (as most existing theories of consciousness assume), then it must always be a fully determinate matter whether an object has these properties. But for no existing theory of consciousness is this the case; all proposed correlates give rise to borderline cases. Hence, if Determinacy is true, all empirical theories of consciousness are false.[12]

[11] See [Antony, 2006, 2008], [Simon, 2012, 2017], [Tye, 2021], and Schwitzgebel [2023]. See also Godfrey-Smith [2020] for discussion of gradualism and consciousness.

[12] Perhaps excepting Integrated Information Theory, depending on what degree of integrated information is taken to be necessary for consciousness. For discussion of IIT, see Tononi [2008].

Consequence 3 (for the metaphysics of consciousness) If consciousness is fully determinate, and consciousness is either grounded in or identical to some collection of physical properties (as physicalism demands), then it must always be fully determinate whether an object has these properties. But there is no candidate collection of physical properties for which this is the case; again, all such proposals concerning the nature of consciousness give rise to borderline cases. Hence, if Determinacy is true, physicalism is false.

How can these consequences be resisted? One option is to maintain that the arguments just given are flawed and that in fact, these consequences for consciousness are illusory. Another option is to accept that Determinacy has these consequences, at least provisionally, and avoid them in another way: by rejecting Determinacy itself. It is this latter option that we will pursue in this paper, and this is where the second two D's— Degree and Dimensionality—become relevant. In the next section, we consider an argument against Determinacy that proceeds from Degree, and in the following section we consider a parallel argument that proceeds from Dimensionality.

3. The Argument from Degree

The argument from Degree to the falsehood of Determinacy can be formulated as follows:

P1 Consciousness comes in degree.

P2 If consciousness comes in degree, then there are borderline cases of 'is conscious'.

C There are borderline cases of 'is conscious'.

The first premise of the argument is the degree thesis from above, while the conclusion of the argument, together with BC-Det, entails the falsehood of Determinacy. What reason, then, do we have to believe the premises?

3.1. In Favour of P1

One piece of evidence in favour of P1 is that 'conscious' is naturally used in comparative constructions, as in (1):

(1) a. A human is more conscious than a fish.
b. A dog is more conscious than a rock.
c. A fully awake person is more conscious than a drowsy person.

A related piece of evidence is that when 'conscious' is used in its positive form, 'is conscious', it allows for scalar modification, as in (2):

(2) a. John is fully conscious.
b. Before having coffee, Mary is only partly conscious.
c. An ant is barely conscious, if it is conscious at all.
d. A rock isn't at all conscious.

Figuring into comparative constructions and allowing for scalar modification are the characteristic features of gradability. Thus, the fact that 'conscious' exhibits them gives us reason to think that it is gradable. In turn, the fact that 'conscious' is gradable suggests that consciousness comes in degree—i.e. it is a quantity.

Further support for the view that consciousness comes in degree is found in the literature on the semantics of gradable adjectives. The leading approach here is the degree approach.[13] On the degree approach, each gradable adjective

[13]See, for instance, Kennedy [2001, 2007], Kennedy and McNally [2005].

is associated with an ordered set of degrees—a scale—used to measure some underlying quantity or degreed property. The degree approach then specifies the truth-conditions of constructions involving gradable adjectives in their positive and comparative forms in terms of the degree to which various objects have the property measured by the scale.

To take a simple example, on the degree approach the gradable adjective 'tall' is associated with a quantity—namely, height—and denotes a function that maps each object in the domain to its maximal degree of height—i.e. the greatest degree of height that it in fact has.

Given this, the degree approach specifies the truth conditions for claims involving the comparative form of 'tall' in terms of comparisons between these degrees:

(3) $\ulcorner x$ is at least as tall as $y\urcorner$ is true if and only if $\mathbf{tall}(x) \succcurlyeq_{height} \mathbf{tall}(y)$.[14]

What this tells us is that x is at least as tall as y if and only if x's maximal degree of height is at least as great as y's (where, within degree semantics, '$\succcurlyeq_{height}$' denotes the ordering on the degrees of height).

The degree approach then specifies the truth conditions for sentences involving the positive form of the adjective in terms of its comparative form:

(4) $\ulcorner x$ is tall$\urcorner$ is true if and only if $\mathbf{tall}(x) \succcurlyeq_{height} d_{tall}$.

What this tells us is that x is tall just in case x's maximal degree of height is greater than or equal to the contextually determined standard of comparison d_{tall}, whatever it is. So, for an object to be tall, and hence for the predicate 'is tall' to apply to it, is for that object to have a degree of height that meets this standard.

[14] Here, and in what follows, we suppress variable assignments for readability.

If, as we saw above, 'conscious' is a gradable adjective, we can adopt the same approach to its semantics. As with 'tall', the degree approach associates 'conscious' with a degreed property and treats 'conscious' as denoting a function that maps each object in its domain to its maximal degree of consciousness.

Given this, we can specify the truth conditions for the sentences involving the comparative form of the adjective, 'at least as conscious as', as follows.

(5) $\ulcorner x$ is at least as conscious as $y\urcorner$ is true if and only if $\mathbf{conscious}(x) \succcurlyeq_{con} \mathbf{conscious}(y)$.

According to (5), x is at least as conscious as y if and only if x's maximal degree of consciousness is at least as great as y's.

In turn, we can specify the truth conditions for constructions involving the positive form of the adjective, 'is conscious', in terms of its comparative form:

(6) $\ulcorner x$ is conscious$\urcorner$ is true if and only if $\mathbf{conscious}(x) \succcurlyeq_{con} d_{con}$.

What this tells us is that x is conscious just in case x's maximal degree of consciousness is greater than or equal to the standard d_{con}, whatever it is. So, for an object to be conscious, and so for the predicate 'is conscious' to apply to it, is for that object to have a degree of consciousness that meets this standard.

Thus, if 'conscious' is an ordinary gradable adjective, our best semantics gives us strong reason to believe P1, because it specifies the truth conditions of constructions involving 'conscious' in terms of a property that comes in degree—i.e. a quantity.

3.2. In Favour of P2

What, then, are the reasons for believing P2? The main consideration comes from the idea that typically, there is indeterminacy in the standard that an object must meet in order for it to fall into the extension of the positive form of a gradable adjective—i.e. d is indeterminate. In turn, this indeterminacy generates the familiar features of vagueness: sorites susceptibility, lack of sharp boundaries, and most importantly for our purposes: borderline cases.[15]

Consider again our example of 'tall'. How tall must something be to be tall? Given that tall is associated with a scale, we can consider a sequence of objects, each of which is incrementally taller than the previous object. But plausibly, in this sequence, there will be objects that we are inclined to neither classify as tall nor classify as not tall—there will be borderline cases of 'is tall'.

This indeterminacy in which objects are tall is traceable to indeterminacy in the standard for the positive form, d_{tall}. It is not plausible that there is a determinate degree d_{tall} such that one object in the sequence of incrementally taller objects is not tall while the next object is. Rather, there will be no sharp cutoffs, and a range of objects that we will be hesitant to categorize as either 'tall' or 'not tall'. In other words, 'is tall' will admit of borderline cases. Insofar as 'is conscious' behaves like 'is tall', the same applies to it, and thus we arrive at P2.

3.3. Objection 1: Rejecting Gradability

On the face of it, the argument from Degree to the falsehood of Determinacy is persuasive. But in fact, it faces two serious objections.

One objection, due to Bayne et al. [2016], is that P1 is false. They maintain

[15]For discussion of the characteristic features of vagueness, see, e.g. Williamson [1994], Keefe [2000], and Smith [2002].

that, contrary to appearances, 'is conscious' does not come in degree. Rather, 'is conscious' is like 'is a member of the UN': it is not the case that some countries are more members of the UN than others, nor is it the case that countries can be partly or mostly members of the UN. In other words, being a member of the UN does not come in degree. The same applies, they argue, to consciousness.

In making this objection, Bayne et al. confront the difficulty of explaining away the linguistic data in (1) and (2). But here, they might insist that appearances are deceptive and that 'conscious' is not genuinely gradable, even though it can figure into comparatives and allows for scalar modification. One strategy that can be employed here is to adopt a suggestion made by Mankowitz [2023] concerning 'true', and hold that (1) and (2) are instances of *coercion*. In cases of coercion, a non-gradable adjective is forced to behave like a gradable one, but is not, as a matter of its lexical semantics, associated with a quantity or degreed property.

Mankowitz herself focuses on examples such as (7) and (8):

(7) What Tom said is very true.

(8) What Tom said is more true than what Jerry said. Mankowitz [2023]

In these cases, she argues, while 'true' itself is not gradable, there are related expressions—such as 'closeness to truth'—that are gradable, and the comparative and degree-modified forms of 'true' are interpreted with respect to them. Assuming that there are plausible alternatives to 'conscious' that behave in this way, it is open to Bayne et al. to say that examples (1) and (2) can be similarly reinterpreted. Hence, contrary to P1, while 'conscious' appears gradable, in fact it is not.

3.4. Objection 2: Absolute and Relative Gradable Adjectives

The second objection to the argument from Degree targets P2 as opposed to P1. This objection begins from a well-known distinction in semantics between absolute and relative gradable adjectives. 'Tall', for instance, is a relative gradable adjective, and as we pointed out, has a standard that is plausibly indeterminate. This is what gives rise to the features of vagueness mentioned above. However, as Chris Kennedy argues,

> [i]n addition to the large class of gradable adjectives that are vague in the positive form—henceforth RELATIVE gradable adjectives—there is a well-defined set of adjectives that are demonstrably gradable but do not have context dependent interpretations, do not give rise to borderline cases, and do not trigger the Sorites Paradox in the positive form [...] I will refer to this class as ABSOLUTE (gradable) adjectives." [Kennedy, 2007]

Absolute gradable adjectives include 'flat', 'dirty', 'wet', 'bent', 'full', 'visible', and 'open', among many others. Each of these adjectives has in common that the standard for falling into the extension of its positive form is either minimal or maximal along its associated scale.

Adjectives whose standard is maximal include 'full', 'flat', and 'closed'—these adjectives are *absolute total* gradable adjectives. Adjectives whose associated standard is minimal include 'dirty', 'wet', 'bent', 'visible', and 'open', among others. The idea underlying a scale-minimal standard type is that an object falls into the extension of the positive form if it has any positive degree along the associated scale. So an object is bent if it is bent to any positive degree, visible if it is visible to any positive degree, open if it is open to any positive degree, *etc*.

These are the *absolute partial* gradable adjectives.

This distinction makes available the possibility that unlike 'tall', 'conscious' is an *absolute* gradable adjective whose standard type is minimal—it is an absolute *partial* gradable adjective. A position of exactly this sort has recently been defended by Lee [2022]. On this view, an object is conscious if it is conscious to any positive degree. If so, P2 is false—consciousness admits of degree, but does not give rise to borderline cases, which is exactly the feature characteristic of absolute gradable adjectives.

3.5. Assessing the Objections

The argument from Degree was supposed to provide us with a way of avoiding the drastic consequences of Determinacy. But as we have seen, there are two objections to the argument, which make it reasonable to conclude that the argument is unpersuasive. Thus, if we are to avoid these consequences, we need an alternative argument. Before turning to this alternative, however, it is necessary to make two further points concerning the failure of the argument from Degree.

The first point is that the two objections we have been considering cannot both be true. If the second objection is right, and 'conscious' is an absolute partial gradable adjective, it follows that 'conscious' is gradable, which is precisely what the first objection denies. So we cannot endorse both objections at once. For the remainder of the paper, therefore, we will follow Lee [2022] in adopting the hypothesis that 'conscious' is an absolute partial gradable adjective. We make this choice for several reasons. First, it allows us to take sentences such as those in (1) and (2) at face value, and does not require resorting to the view that they involve coercion, which is a *prima facie* more complicated approach. Second, it invokes a standard semantic distinction between absolute and relative gradable adjectives,

while the coercion proposal is more novel, and at least in the case of 'conscious,' less fully developed.

The second point concerns a consequence of accepting that 'conscious' is an absolute partial gradable adjective. We have seen so far that if this view is correct, then the argument from Degree to the falsehood of Determinacy fails, because P2 is false. But in addition to showing that P2 is false, the proposal can be used as the basis of an argument that Determinacy is true. The reason is that, if 'conscious' is an absolute partial gradable adjective, and so has a scale-minimal standard, this standard is perfectly determinate: to be conscious is to have any positive degree of consciousness at all. Given that the distinction between having a positive degree of consciousness and no positive degree of consciousness is perfectly sharp, so too, it would appear, is the positive form 'is conscious'. Thus, for all x, it is determinate whether x is conscious, and so Determinacy is true. This is a strong inconceivability argument of the kind mentioned earlier, one that follows from a fact about the lexical semantics of the adjective 'conscious'.

While this may appear to be a strong argument for Determinacy, it only establishes its conclusion on the assumption that indeterminacy in the standard of the positive form is the only source of indeterminacy. But as we will show in the next section, there is another source: indeterminacy that results from multidimensionality.[16] This idea is at the heart of the second argument to the

[16]Some in the literature (e.g. Williamson [1994], Keefe [2000], and Lee [2022]) have suggested that it is in general false that absolute gradable adjectives are perfectly determinate, and so that the argument above fails for reasons unrelated to multidimensionality. For suppose (for the sake of argument) that to be bald is simply to have no hairs at all. It follows that if you have at least one hair, you aren't bald. But according to these authors, it can be indeterminate whether *S* is bald because it can be indeterminate whether *S* has a single hair. However, there is a distinction between absolute adjectives such as 'is bald,' whose degrees are specified with a count noun (1 hair, 2 hairs, *etc.*), and adjectives such as 'has mass' or 'has height', whose degrees are specified with a mass noun (has some mass, has some height). Adjectives in the latter category do not seem to admit of the same kind of indeterminacy; it seems impossible for it to be indeterminate whether an object has some mass or height. We think that 'is conscious'

falsehood of Determinacy, the argument from Dimensionality, to which we now turn.

4. The Argument from Dimensionality

The argument from Dimensionality to the falsehood of Determinacy can be formulated as follows:

P1 Consciousness is multidimensional.

P2 If consciousness is multidimensional, then there are borderline cases of 'is conscious'.

C There are borderline cases of 'is conscious'.

The first premise of the argument is the dimensionality thesis from above, while the conclusion of the argument, together with BC-Det, entails the falsehood of Determinacy.

Clearly this argument is the same in structure as the argument from Degree we just considered. What we will now argue, however, is that it is considerably more plausible.

4.1. What are Multidimensional Adjectives?

We may begin by looking more closely at how to interpret the first premise of the argument, and so at what it means to say that consciousness is multidimensional.

In line with the standard view of multidimensionality in the semantics literature [Sassoon, 2013a,b, D'Ambrosio and Hedden, 2024], when we say that F is multidimensional, we mean that the application conditions of $\ulcorner$ is $F\urcorner$ and $\ulcorner$ is at

patterns with the latter category rather than the former, although as we will see, 'is conscious' is indeterminate for another reason.

least as *F* as ⌝ depend on how objects stand with respect to multiple underlying dimensions of *F*-ness.

For example, to say that athleticism is multidimensional is to say that the application conditions of 'is athletic' and 'is at least as athletic as' depend on how individuals in the domain stand with respect to the underlying dimensions of athleticism. If we suppose that the dimensions of athleticism are speed, strength, and agility, then whether or not someone is athletic or at least as athletic as someone else overall will depend on how strong, fast, and agile they are together with some method of aggregation.

Given this, to assert P1, and so to assert that consciousness is multidimensional, is to say that the application conditions of 'is conscious' and 'is at least as conscious as' depend on how individuals stand with respect to the underlying dimensions of consciousness together with a method of aggregation. As we will see later, what the dimensions of consciousness might be is extremely controversial, but let us suppose for the sake of exposition that they are awareness (how aware of a relevant thing the subject is), attention (how much attention they pay to it), and valence (the degree to which the experience feels good or bad for them).[17]

In that case, whether a person is conscious overall, or is at least as conscious as another overall, is a matter of where they stand with respect to valence, attention, and awareness, and how these dimensions are aggregated.

4.2. In Favour of P1

But why should we accept this premise, so understood? One piece of evidence supporting it is that 'conscious' bears the typical linguistic marks of a multidi-

[17] On awareness, see Dretske [1993] and Rosenthal [2005]; on attention, see, e.g., Chris Mole [2011], Watzl [2017], Jennings [2020]; on valence, see, e.g., Jacobson [2021, forthcoming] and Birch [2024].

mensional adjective. Consider the following examples:

(9) a. John is conscious in some respects but not in others.
b. John is more conscious than Suzie in some respects, but Suzie is more conscious in others.
c. Suzie is conscious in every respect except that things don't feel good or bad to her.

The acceptability of such constructions—and in particular the felicity of modifiers such as 'with respect to', 'in some respects', and 'except that'—provide us with evidence that 'conscious' is multidimensional. In the literature on the semantics of multidimensional adjectives, the acceptability of such constructions is treated as sufficient for an adjective to qualify as multidimensional, much as the availability of a comparative construction and the felicity of degree modification is seen as sufficient for an adjective to qualify as gradable [Sassoon, 2013a,b, D'Ambrosio and Hedden, 2024].

A different consideration in support of P1 emerges if we consider again the point that 'conscious' is naturally used in comparative constructions:

(10) a. A human is more conscious than an octopus. Birch et al. [2020]
b. A cat is more conscious than a bat.

We mentioned similar examples in the previous section to motivate the idea that 'conscious' is a gradable adjective and that consciousness itself comes in degree. But a further point about comparisons in terms of consciousness is that they are sometimes indeterminate. Plausibly, for example, it is indeterminate whether a human is more conscious than an octopus, and whether a cat is more conscious than a bat. It is also plausible that such indeterminacy is a consequence

of multidimensionality Birch et al. [2020]: it is indeterminate whether a human is more conscious than an octopus because a human is more conscious in some respects, an octopus is more conscious in others, and there is no unique way to aggregate these different dimensions to say which is more conscious overall. Thus, the best explanation of the indeterminacy of (9) and (10) is that consciousness is multidimensional.

These arguments give us good reason to accept P1: that consciousness is multidimensional. But they also reflect an observation about P1 that is important for our purposes, namely, P1 is widely accepted by philosophers and scientists of consciousness, including by those who reject the corresponding premise of the Degree argument against Determinacy (see, for instance, Bayne et al. [2016]). This by itself shows that the argument from Dimensionality may be more dialectically effective than the parallel argument from Degree, since its first premise is more persuasive.

4.3. Semantics for Multidimensional Adjectives

So much for P1; what of P2, the claim that if consciousness is multidimensional, 'is conscious' admits of borderline cases?

In discussing this premise we may begin with the observation that the semantics of multidimensional adjectives makes available a novel form indeterminacy not present in the semantics of unidimensional gradable adjectives.

We saw above that, given that 'athletic' is multidimensional, whether you're athletic and how athletic you are overall (or all things considered) depends on two things: where you stand with respect to the dimensions of athleticism—speed, strength, and agility—and also how these dimensions are aggregated. Different ways of aggregating these factors will yield different verdicts about whether you

are athletic and how athletic you are overall, and there may be more than one way of aggregating dimensions available in a context.

Following D'Ambrosio and Hedden [2024], we can think of how objects stand with respect to an adjective's underlying dimensions as determined by a function $DIM(`F', c, w)$ that takes an adjective, context, and world and returns a profile of weak orderings of the domain: $\langle \succcurlyeq_{F_1} \cdots \succcurlyeq_{F_n} \rangle$, one for each of the dimensions of F relevant in the context. We can represent these orderings, although not uniquely, as a profile of value functions $\langle V_1 \ldots V_n \rangle$, which are formally identical to degree functions. Applying this idea, $DIM(`athletic', c, w)$ tells us that speed, strength, and agility are the relevant dimensions of athleticism in c and also tells us how objects in w stand with respect to these dimensions.

We can then think of the overall ordering of objects in the domain as determined relative to an *aggregation function*. Informally, an aggregation function takes the facts about how objects stand along the underlying dimensions of some adjective F and outputs an ordering of those objects in terms of how F they are overall. Formally, an aggregation function a takes a profile of value functions—the profile that is the output of DIM—and returns an ordering $\succcurlyeq^a_F$ of objects in the domain with respect to overall or all-things-considered F-ness.[18] Thus, an aggregation function for 'athletic' takes the profile of orderings corresponding to the dimensions of athleticism as input and outputs an ordering of the domain in terms of overall athleticism.

Which methods of aggregation are admissible in a context is then determined

[18] D'Ambrosio and Hedden use value functions, i.e. degree functions, to represent the orderings in the underlying dimensions, but initially not in the overall dimension. In this sense their approach differs from more standard degree-theoretic approaches, such as Sassoon's [2013b]. Nevertheless, as they explain, on certain assumptions, their view can be understood as degree-theoretic in a more general sense. Nothing in what follows will turn on this feature of their account.

by a function $ADM(`F', c)$, which takes an adjective and a context to the set of aggregation functions admissible in $c$. Context will also fix a standard for the adjective, $d_F$. Applying this to our example, given $ADM(`athletic', c)$ and d_ath, an object x is:

(a) determinately athletic iff $\ulcorner x \succcurlyeq^a_{ath} d_{ath} \urcorner$, for all $a \in ADM$.

(b) determinately not athletic iff $\ulcorner \neg\, x \succcurlyeq^a_{ath} d_{ath} \urcorner$, for all $a \in ADM$.

(c) a borderline case of 'is athletic' otherwise.[19]

This tells us that an object x is determinately athletic if it is at least as athletic as the contextually determined standard d_{ath} on all admissible ways of aggregating the dimensions of athleticism. By contrast, x is determinately not athletic if it less athletic than d_{ath} on all admissible ways of aggregating those dimensions. Otherwise, it is neither determinately athletic nor determinately not athletic—i.e. it is a borderline case.

The key point for our purposes is that the admissibility of multiple aggregation functions is a potential source of indeterminacy distinct from indeterminacy in an adjective's standard or threshold. When there are multiple aggregation functions admissible for an adjective F in a context, there can be borderline cases of $\ulcorner$ is $F \urcorner$ even when d is fixed. The reason is that, given a particular standard d_a, an object x may be such that $\ulcorner x \succcurlyeq_F d_a \urcorner$ with respect to one aggregation function but not with respect to another, which, given the above semantics, entails that x is neither determinately F nor determinately not F, and so is a borderline case.

Turning back now to consciousness, if consciousness is multidimensional, then a semantics of exactly this kind applies to it as well. Thus, $DIM(`conscious', c, w)$

[19] Here we suppress variable assignments, for readability.

is a function that returns a profile of weak orderings of the domain: $\langle \succcurlyeq_{F_1} \cdots \succcurlyeq_{F_n} \rangle$, one for each dimension of consciousness. We can represent these orderings, although not uniquely, as a profile of value functions $\langle V_1 \ldots V_n \rangle$. An aggregation function a takes this profile and returns an ordering $\succcurlyeq_{con}$ of individuals in the domain with respect to overall consciousness.

In each context, there will be a set $ADM(\text{`}conscious\text{'}, c)$ of aggregation functions that are admissible for 'conscious'—i.e. ways of aggregating the dimensions of consciousness along with a standard d_{con} for the positive form. We can then specify which objects are determinately conscious, determinately not conscious, or neither with respect to this set and standard as follows. An object x is:

(a) determinately conscious iff $\ulcorner x \succcurlyeq^{a}_{con} d_{con} \urcorner$, for all $a \in ADM(\text{`}conscious\text{'}, c)$.

(b) determinately not conscious iff $\ulcorner \neg\, x \succcurlyeq^{a}_{con} d_{con} \urcorner$, for all $a \in ADM(\text{`}conscious\text{'}, c)$.

(c) a borderline case of 'is conscious' otherwise.

This tells us that an object x is determinately conscious if it is at least as conscious as the standard for consciousness d_{con} on all admissible ways of aggregating the dimensions of consciousness. By contrast, x is determinately not conscious if it is less conscious than d_{con} on all admissible ways of aggregating those dimensions. Otherwise, it is neither determinately conscious nor determinately not conscious—i.e. it is a borderline case of 'is conscious'.

4.4. Support for P2

We have seen so far what it would take for 'is conscious' to admit of borderline cases as a consequence of multidimensionality. But how do we establish that multidimensionality in this case does in fact generate borderline cases? How do we establish P2?

Our argument for P2 rests on the idea that, in the case of 'conscious,' it is plausible that there are contexts in which there are multiple aggregation functions admissible that yield conflicting verdicts concerning whether a certain thing is conscious. If that is so, the semantics just set out tells us that there are contexts in which 'is conscious' has borderline cases.

To see this in more detail, recall our function $DIM(\text{`}conscious\text{'}, c, w)$, which given a world w and a context c, returns a set of orderings corresponding to the dimensions of 'conscious.' Here, c fixes which dimensions are relevant in the context, and w fixes the facts about how objects stand with respect to those dimensions. Now consider the set of contexts in which the relevant dimensions of consciousness are valence and attention, setting aside, for simplicity, the dimension of awareness. Further, consider a particular world w whose domain consists of two things: a rock and a person. The rock, we can assume, is conscious to degree zero along every dimension of consciousness and overall. The person, by contrast, ranks higher than the rock in terms of valence, but does not rank higher than the rock in terms of attention—neither, let us imagine, exhibits any positive degree of attention whatsoever.

Earlier we assumed that 'is conscious' is an absolute partial gradable adjective, and so has a minimal standard. Given that the rock has no positive degree of consciousness, we can implement the idea that 'is conscious' has a minimal standard by saying that something is conscious if and only if it is more conscious than the rock overall. Hence, the person in our example is conscious—i.e., they meet the standard d_{con}—if and only if they are more conscious than the rock.

Now consider two aggregation functions. According to one aggregation function, the person is more conscious than the rock overall if and only if the person ranks higher than the rock along *at least one* dimension of consciousness

and at least as high along the others. Call this aggregation function PE, for Pareto Extension. According to the other aggregation function, the person is more conscious than the rock overall if and only if the person ranks higher than the rock along *every* dimension of consciousness. Call the second aggregation function WP, for Weak Pareto.[20] If there is at least one context in which PE and WP are both admissible, then, since the person in our situation is conscious according to one but not the other, that person will qualify as a borderline case of consciousness.[21]

It seems clear, however, that among the contexts consistent with the very general constraints mentioned above—that is, among contexts in which attention and valence are the dimensions of consciousness—there is at least one at which PE and WP are both admissible. There are several reasons that this is plausible.

First, suppose we ask, of the person whose mental states have valence, but who altogether lacks attention, whether they are more conscious than a rock—i.e., whether they are conscious to any positive degree overall. What response should you give? The most natural response is 'it's hard to say,' for it seems like an open question whether some positive degree of attention, in addition to a positive degree of valence, is required for an overall positive degree of consciousness.[22]

[20]The labels 'Pareto Extension' and 'Weak Pareto' are derived from the literature in social choice theory. This reflects the fact that, as D'Ambrosio and Hedden [2024] point out, there is an extensive analogy between preference aggregation in social choice theory and dimensional aggregation in the semantics of multidimensional adjectives. See Sen [1970, p. 125] for discussion of these particular aggregation functions.

[21]Strictly speaking, there are two ways for this to happen. One way is for there to be some aggregation function a admissible for 'conscious' in c that is incomplete with respect to x and the standard d_{con}, so that $\ulcorner x \not\succcurlyeq^{a}_{con} d_{con} \urcorner$ and $\ulcorner d_{con} \not\succcurlyeq^{a}_{con} x \urcorner$. In any such context, x will be a borderline case of F-ness. Here we will assume that this kind of indeterminacy—what we will call 'brute order indeterminacy'—does not arise. In other words, we will assume that the principle of Comparability holds for the outputs of all admissible aggregation functions. This is what D'Ambrosio and Hedden [2024] call 'Weak Ordering', or **WO**. We think that making this assumption should be amenable to the defender of determinacy, for it only makes our case more difficult—it eliminates a potential source of indeterminacy.

[22]If you think valence is more central to the concept of consciousness, simply reverse the ordering—suppose that the person exhibits some positive degree of attention but their mental states have no valence.

This tells us that not only is PE admissible, but WP is as well. If only PE were admissible, your response should automatically be 'yes.' We take this response to be exactly analogous to what you'd say if asked whether someone who is 5'10" is tall—it's hard to say, because someone who is 5'10" is a borderline case of the predicate 'is tall.'

Second, if there were no context in which PE and WP were both admissible, then we would expect sentences such as (11) to be contradictory:

(11) There is an individual that has some positive degree of attention and is not conscious,

and sentences such as (12) to be analytic:

(12) If an individual has any positive degree along any dimension of consciousness, it is conscious.

But these judgments seem highly questionable. (11) does not seem contradictory, and (12) does not seem analytic. The main reason is that we cannot rule out, a priori, that being conscious requires an organism to have positive degrees along more than one of its dimensions. Consider an analogy. Suppose that each dimension of consciousness had just two values: on and off. For all we know, it may be that an organism needs to have more than just one switch in the "on" position in order to be conscious overall. But from this, it follows that WP cannot be ruled out a priori, and so will be admissible in some context.

Finally, it is plausible that there is some context in which both PE and WP are admissible because of how little this requires. It requires merely that there is *some* context in which nothing rules out either aggregation function. But it seems, at present, to be an open theoretical question about the semantics and metaphysics

of consciousness whether an individual must have a positive degree along all or merely some dimensions to have a positive degree overall. Moreover, barring conclusive arguments that there are no contexts in which both are admissible, there will be some such context. The nature of admissibility places the burden of proof on the person who would show that WP and PE are never jointly admissible.

Drawing these points together, we see that if consciousness is multidimensional, then there are contexts in which there are multiple aggregation functions admissible which yield different verdicts about whether an object is conscious. This claim, together with the semantics for multidimensional adjectives laid out above, entails P2.

4.5. Objection: The Strong Pareto Principle

We have argued that consciousness is multidimensional, and as a consequence, admits of borderline cases. From this it follows that the Determinacy thesis is false. How, then, might one react to this argument from multidimensionality?

As we noted, this argument is more plausible than the one we considered earlier for at least the following reason: many of those who reject the first premise of the argument from Degree accept the first premise of the argument from Dimensionality. In what follows, therefore, we will take P1 for granted, and focus instead on what we take to be the main objection to P2.

This objection grants that there are often multiple admissible ways of aggregating the dimensions of consciousness. It also grants that, if these admissible ways of aggregating dimensions yield conflicting verdicts concerning whether an individual is conscious, we would have borderline cases of 'is conscious'. What it insists on instead is that the admissible aggregation functions in question never yield such conflicting verdicts, and so multidimensionality does not generate

borderline cases.

What is the rationale for saying the aggregation functions in question never yield conflicting verdicts? To explain this, we need to look again at the semantics for multidimensional adjectives developed by D'Ambrosio and Hedden [2024] on which we relied above. As we noted (fn. 18), a guiding theme of this semantics is that dimensional aggregation is formally analogous to preference aggregation in social choice theory. Accordingly, just as there are principles that constrain how individual preferences are aggregated into group preferences, so there are constraints on how the orderings corresponding to the dimensions of a multidimensional adjective are aggregated into an overall ordering of the domain.

In social choice theory, a widely discussed constraint on preference aggregation is the Strong Pareto Principle (SPP).

Strong Pareto Principle If x ranks at least as high as y in every preference ordering, and x ranks strictly higher than y in some preference ordering, then x is strictly preferred to y overall.

In light of the analogy between preference aggregation and dimensional aggregation, the possibility arises that a structurally analogous principle constrains which aggregation functions are admissible, both for 'conscious' and for multidimensional adjectives more generally.

Strong Pareto Principle (dimensional version) If x ranks at least as high as y on all dimensions, and x ranks strictly higher than y on some dimension, then x ranks strictly higher than y overall.

The aggregation function PE clearly meets this Strong-Pareto condition on dimensional aggregation: given that the person ranks at least as highly as the rock along

every dimension of consciousness (trivially), and strictly higher on one, PE ranks the person higher than the rock overall, just as the SPP requires. But WP does not meet the condition imposed by the principle. The person ranks at least as highly as the rock along every dimension of consciousness and strictly higher on one, yet WP does not rank the person higher than the rock overall. In effect, WP tells us that positive degrees of *both* valence and attention are required for overall consciousness, while PE does not. So if the SPP constrains which aggregation functions are admissible, there will be no context in which WP is admissible, and a fortiori, no context in which both PE and WP are admissible.

According to the objection, therefore, P2 is false. Consciousness may be multidimensional, and there may be more than one way of aggregating its dimensions, but it does not admit of borderline cases, since the kinds of aggregation functions that would generate borderline cases are ruled out by the Strong Pareto Principle.

How should we respond to this objection? Our reply is that, while there is an extensive analogy between preference aggregation in social choice theory and dimensional aggregation in the semantics of multidimensional adjectives, this analogy is imperfect. The question of whether the SPP governs preference aggregation in social choice theory is a normative question—it is a question of what the *rational* or *just* method of aggregating preferences is. This is why the SPP is seen as a *constraint* on preference aggregation: preference aggregation must conform to the principle, because we have independent reason to think that the principle captures part of what it is for preferences to be aggregated rationally or justly.

By contrast, whether the SPP is a constraint on aggregation for multidimensional adjectives in general, and for 'conscious' in particular, is a descriptive question within semantics. As such, it is beholden to speakers' judgments about

the application conditions of certain adjectives and the truth-conditions of sentences containing them, such as those above. But as we saw, those judgments conflict with the view that WP is never admissible, and therefore conflict with the dimensional version of the SPP. The principle mistakenly predicts that speakers will not hesitate in saying, in the situation above, that the person is obviously more conscious overall than the rock, despite lacking attention altogether. It also erroneously predicts that sentences such as (11) are contradictory and (12) are analytic. Given that the principle generates incorrect predictions, it cannot be a constraint on how the dimensions of consciousness are aggregated.

5. Conclusion

We began with the three Ds—Determinacy, Degree and Dimensionality—and with the point that since Determinacy apparently places a priori constraints on the science and philosophy of consciousness, there is reason to try avoid it. What we have been investigating are two ways to avoid it, i.e., two routes to the indeterminacy of consciousness. The first route, from Degree, is initially promising but ultimately unpersuasive. The second route, we have argued—from the third D, Dimensionality—is considerably more plausible.

We will conclude by noting four areas in which our discussion has been limited, and which merit further attention in the future. The first concerns the question of what the dimensions of consciousness are. We assumed earlier that the dimensions are awareness, attention and valence. But this assumption was one merely of convenience. It will take much further work to properly identify the dimensions of consciousness. This does not affect the conclusions of this paper, since our interest is in the thesis *that* consciousness is multidimensional rather

than in the question of *what* exactly these dimensions are. Still the issue of the identification of the dimensions is a very large one that we have here not fully addressed.

The second area concerns the apparent consequences of the determinacy thesis for the evolution, science, and metaphysics of consciousness. We assumed above that these consequences are genuine. But actually the arguments here are complex and raise all manner of important questions; this too is an issue we will leave for another occasion.

The third area concerns the idea that 'conscious' is a minimal standard adjective. In the course of discussing the argument from Degree, we assumed that the best objection to the argument is that 'conscious' is an absolute partial gradable adjective, and that this objection renders the argument unpersuasive. But our assumption here is still open to question. If that is so, the argument from Degree deserves a second look.

The fourth and final area concerns the point we discussed at the end, about whether the Strong Pareto Principle places constraints on how the dimensions of consciousness are aggregated. We argued that while the Strong Pareto Principle may plausibly constrain preference aggregation, it is less plausible in the case of dimensional aggregation. But the analogy between dimensional aggregation and preference aggregation is itself a wholly new area of research. Further work on the analogy between dimensions and preferences, as well as arguments over the appropriate constraints on dimensional aggregation, must also be left for the future.

References

Michael Antony. Vagueness and the metaphysics of consciousness. *Philosophical Studies*, 128(3):515–538, April 2006.

Michael V. Antony. Are our concepts conscious state and conscious creature vague? *Erkenntnis*, 68:239–263, 2008.

Tim Bayne, Jakob Hohwy, and Adrian M. Owen. Are there levels of consciousness? *Trends in Cognitive Sciences*, 20(6):405–413, 2016.

John Bigelow and Robert Pargetter. Quantities. *Philosophical Studies*, 54:287–316, 1988.

Jonathan Birch. *The Edge of Sentience: Risk and Precaution in Humans, Other Animals, and AI*. Oxford University Press, Oxford, 2024.

Jonathan Birch, Alexandra K. Schnell, and Nicola S. Clayton. Dimensions of animal consciousness. *Trends in Cognitive Science*, 24(10):789–801, 2020.

Ned Block. On a confusion about a function of consciousness. *Brain and Behavioral Sciences*, 18(2):227–247, 1995.

Wayne Wu Chris Mole, Declan Smithies, editor. *Attention: philosophical and psychological essays*. Oxford University Press, New York, 2011.

Justin D'Ambrosio and Brian Hedden. Multidimensional adjectives. *Australasian Journal of Philosophy*, 102(2):253–277, 2024.

Fred Dretske. Conscious experience. *Mind*, 102:263–283, 1993.

Delia Graff Fara. Descriptions as predicates. *Philosophical Studies*, 102(1):1–42, January 2001. Originally published under the name "Delia Graff".

Peter Fazekas and Morten Overgaard. Multidimensionl models of degrees and levels of understanding. *Trends in Cognitive Sciences*, 20(10):715–716, 2016.

Kit Fine. Vagueness, truth, and logic. *Synthese*, 30(3/4):265–300, 1975.

Peter Godfrey-Smith. Gradualism and the evolution of experience. *Philosophical Topics*, 48(1):201–220, 2020.

Alan Hájek and Wlodek Rabinowicz. Degrees of commensurability and the repugnant conclusion. *Noûs*, Early View(https://doi.org/10.1111/nous.12388), 05 July 2021 2021.

Paul Horwich. *Truth*. Oxford University Press, Oxford, 1990.

Hilla Jacobson. The role of valence in perception: an artistic treatment. *Philosophical Review*, 130(4):481–531, 2021.

Hilla Jacobson. On the very idea of valenced perception. *Journal of Philosophy*, forthcoming.

Carolyn Dicey Jennings. *The Attending Mind*. Cambridge University Press, Oxford, 2020.

Hans Kamp. Two theories about adjectives. In E. L. Keenan, editor, *Formal Semantics of Natural Language*. Cambridge University Press, 1975.

Lauri Karttunen. Syntax and semantics of questions. *Linguistics and Philosophy*, 1:

1–44, 1977.
Rosanna Keefe. *Theories of Vagueness*. Cambridge University Press, Cambridge, 2000.
Christopher Kennedy. Polar opposition and the ontology of 'degrees'. *Linguistics and Philosophy*, 24:33–70, 2001.
Christopher Kennedy. Vagueness and grammar. *Linguistics and Philosophy*, 30(1): 1–45, 2007.
Christopher Kennedy and Louise McNally. Scale structure, degree modification, and the semantics of gradable predicates. *Language*, 81(2):345–381, June 2005.
Max Kölbel. Vagueness as semantic. In Richard Dietz and Sebastiano Moruzzi, editors, *Cuts and clouds: vagueness, its nature, and its logic*. Oxford University Press, New York, 2010.
Andrew Y. Lee. Does sentience come in degrees? *Animal Sentience*, 29(20), 2020.
Andrew Y. Lee. Degrees of consciousness. *Noûs*, 2022.
David Lewis. General semantics. *Synthese*, 22:18–67, 1970.
David Lewis. *On the Plurality of Worlds*. Blackwell Publishers, Oxford, 1986.
Poppy Mankowitz. Not half true. *Mind*, 525:84–112, 2023.
Michael Morreau. What vague objects are like. *Journal of Philosophy*, 99:333–361, 2002.
Thomas Nagel. What is it like to be a bat? *Philosophical Review*, 83:435–450, October 1974.
David Rosenthal. *Consciousness and Mind*. Oxford University Press, New York, 2005.
Galit W. Sassoon. A typology of multi-dimensional adjectives. *Journal of Semantics*, 30(3):335–380, August 2013a.
Galit W. Sassoon. *Vagueness, Gradability, and Typicality: The Interpretation of Adjectives and Nouns*. Current Research in the Semantics/Pragmatics Interface. Brill, Leiden and Boston, 2013b.
Eric Schwitzgebel. Borderline consciousness, when it's neither determinately true nor determinately false that experience is present. *Philosophical Studies*, 180: 3415–3439, 2023.
Amartya Sen. *Collective Choice and Social Welfare*. Economics. Penguin Books, third edition edition, 1970.
Jonathan Simon. *The Sharp Contour of Consciousness*. PhD thesis, New York University, New York, NY, May 2012.
Jonathan Simon. Vagueness and zombies: why 'phenomenally conscious' has no borderline cases. *Philosphical Studies*, 174(8):2105–2123, 2017.
A. D. Smith. *The Problem of Perception*. Harvard University Press, Cambridge, MA, 2002.
Roy Sorensen. *Blindspots*. Oxford University Press, New York, 1988.
Daniel Stoljar. *Ignorance and Imagination: The Epistemic Origin of the Problem of*

Consciousness. Oxford University Press, USA, 2006.
Giulio Tononi. Consciousness as integrated information: a provisional manifesto. *Biological Bulletin*, 215(3):216–242, 2008.
Michael Tye. Vague objects. *Mind*, 99(396), 1990.
Michael Tye. *Vagueness and the Evolution of Consciousness: Through the Looking Glass*. Oxford University Press, Oxford, 2021.
James Van Cleve. Conceivability and the cartesian argument for dualism. *Pacific Philosophical Quarterly*, 64(1):35–45, 1983.
Peter van Inwagen. How to reason about vague objects. *Philosophical Topics*, 16: 255–284, 1988.
Achille Varzi. Supervaluationism and its logics. *Mind*, 116:633–676, 2007.
Walter Veit. The origins of consciousness or the war of the five dimensions. *Biological Theory*, 17:276–291, 2022.
Jasmine Walter. Consciousness as a multidimensional phenomenon: implications for the assessment of disorders of consciousness. *Neuroscience of Consciousness*, (2), 2021.
Sebastian Watzl. *Structuring mind: the nature of attention and how it shapes consciousness*. Oxford University Press, Oxford, 2017.
Timothy Williamson. *Vagueness*. Routledge, London and New York, 1994.
Timothy Williamson. *Knowledge and its Limits*. Oxford University Press, Oxford and New York, 2000.
J. E. Wolff. *The Metaphysics of Quantities*. Oxford University Press, Oxford, 2020.