

## Consciousness and Indeterminacy

### §1. Axiological Significance and the Affective Component of Conscious States

A straightforward argument against reductive materialism based upon vagueness<sup>1</sup> is the following:

1. All complex physical states are vague (they have borderline cases)<sup>2</sup>.
2. No conscious state is vague (there are no borderline cases of consciousness).
3. Therefore, no conscious state is identical to a complex physical state.

Suppose that we identify consciousness with some complex physical state,  $\phi$  (either directly physical or functionally defined with physical realizers). The argument is then based on the simple idea that in some cases it will be indeterminate whether we have a case of  $\phi$  or not. A simple example would arise if a necessary condition for consciousness is that a large number of neural firings be involved in the brain processes to be identified with any conscious state. Obviously, ‘large’ is a vague term and there will be regions where it is indeterminate whether or not we have a large enough set of neural firings to subserve consciousness. Given the materialist identification we will then have a case where it is indeterminate whether this is a state of consciousness. But by (2) there are no borderline cases of consciousness. Whether a creature at some time enjoys some spark of consciousness, no matter how meager, faint, transitory or confused marks a bright metaphysical line dividing nature, rather like the bright metaphysical line between particles with and without electric charge. William Clifford characterized this as an ‘enormous jump from one creature to another’ involving ‘the introduction of a fact entirely different . . . from the physical fact’ (1886, p. 266). Of course, we frequently won’t *know* if we are facing a creature with consciousness or not, as perhaps when we wonder whether a lobster is a conscious being or not, say in the sense of being able to feel pain. But we think there is, and must be, a fact of the matter here, unlike in the case of knowing the exact height of someone and still being uncertain whether or not they are tall. So the materialist identification fails.

But perhaps you disagree with (2). Maybe you think there *are* borderline cases of consciousness: as we ascend from considering definitely non-conscious simple organisms we reach a stage of organismic complexity where it is indeterminate whether we are facing a conscious being, or perhaps as we observe someone emerging from deep anesthesia, we think there is a similar point of indeterminacy where there is no fact of the matter about whether the person has reached consciousness or not<sup>3</sup>. Brian Cutter (2017) argues that the basic line of argument

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<sup>1</sup>I find that this argument turns up quite frequently in conversation. For discussion in print see Antony 2006, Jonathan Simon 2017, Phillip Goff 2014 and the two replies to Goff by William Robinson and Simon, and ch. 1 of Joshua O’Rourke 2018.

<sup>2</sup>When I say a state is vague I only mean that the term(s) involved in specifying or referring to the state are vague terms. Below the possibility of ontological (or metaphysical) vagueness (or indeterminacy) will be considered.

<sup>3</sup>We mean here any kind of consciousness. If we asked about reaching ‘full’ human consciousness, that might well have borderline cases. The issue here is just about bare consciousness: a state which feels like something. It might be that some of the confusion about whether or not consciousness is susceptible to borderline cases depends on confusing modes of consciousness with bare consciousness. It seems clear that conscious states will inherit vagueness in many cases, as in for example, being conscious of a vermilion colour.

given above can nonetheless succeed, based upon a lack of vagueness in another realm which he holds to be intimately linked to consciousness: morality. The basic idea is to develop an argument based on three claims:

4. Moral properties are ‘robustly real’ and hence determinate (there are no borderline cases for ‘the most fundamental moral expressions’ (Cutter 2017, p. 103).
5. Reductive materialism implies that consciousness properties are not determinate.
6. Consciousness makes a moral difference (at least sometimes).

It may seem, and it does seem to me, that the determinacy of consciousness is much more plausible than the determinacy of moral facts. It is quite natural to assess actions on a scale of morality: neutral, somewhat good, good, very good, extremely good, etc. The existence of this scale suggests that there will be borderline cases between, for example, the good and the very good. However, Cutter holds robust realism only for the evaluatively fundamental. Perhaps goodness is fundamental while slightly good and very good are derivative aspects of goodness. Is the evaluative status of the shift from morally neutral to good also one that has borderline cases? There is an intuition that here we do have a discontinuous jump from the morally irrelevant to the morally relevant and hence no borderline cases of goodness.

Although I think there is a stronger intuition that there is no such scale in consciousness, there is an important similarity in the two cases. While we do not talk of mental states as being slightly conscious, moderately conscious or very conscious there are many qualitative scales within the range of conscious states: slightly to very painful, say, where indeterminacy is highly plausible. Notice how this may mirror the evaluative situation. The qualitative scales within modes of consciousness are non-fundamental, bare consciousness is the fundamental attribution. The jump from non-conscious to conscious is where we find the discontinuous alteration which means no borderline cases.

It nonetheless seems to me more plausible to argue for the determinacy of moral properties from the determinacy of consciousness rather than the reverse. In every case of variation in evaluative status, there will be some other, non-evaluative, difference in the cases which accounts for the evaluative difference. If that difference is described in a vague way there will be evaluative indeterminacy, if described in a determinate way the evaluative will also be determinate. In cases where an evaluative fact depends on whether consciousness is present or not, that evaluative fact will be determinate given the determinacy of consciousness. In the contrast between a putting a lobster in a pot of boiling water versus dunking an anesthetized lobster (cases BL and AL discussed below), if the slightest negatively valenced consciousness makes BL worse than AL we derive the determinacy of that evaluative fact from the determinacy of the fact about consciousness<sup>4</sup>. But suppose we are within the region of conscious states which are varying from barely to slightly to moderately to very to extremely painful. It is plausible that someone is morally blameworthy for refusing to endure a tiny degree of pain (which has no other inconvenient consequences) in order to prevent another

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<sup>4</sup>Although irrelevant to the purposes of this discussion, which is hypothetical, it is unsurprisingly controversial whether or not lobsters feel pain. This reflects our ignorance about what physical substrate is required for pain experience. For a negative judgement about lobsters’ capacity to feel pain see Sømme (2005), for a positive one see Magee and Elwood (2013).

suffering an extreme pain. But as we bring the pains closer together on the agony scale any moral disapprobation is somewhere going to evaporate. It will be indeterminate whether our subject is blameworthy or not and this will be because of an indeterminacy in the level of pain across the subjects of our scenario. Perhaps an appeal to the fundamentality of evaluative properties can evade this objection, but it is not at all clear how. In any case, I will follow Cutter in what follows to trace the consequences of moral determinacy and consciousness indeterminacy.

The highly intuitive (6) is an instance of what Cutter calls the axiological significance of consciousness. Cutter argues that (4), (5) and (6) imply that reductive materialism is false.

Let's begin with the assumptions and abbreviations that Cutter uses, following as much as possible Cutter's own schema.

Definitions:

$\Delta P$  = 'it is determinate that P'.  $\Delta$  is a semantic operator.  $\Delta P$  is true when every precisification of the terms in  $P$  makes  $P$  come out true. If  $P$  involves vague terms then some precisifications of them will make  $P$  come out true and others will make it come out false. In that case  $\Delta P$  will be false.

BL = The boiling lobster scenario: a normal lobster is placed in a pot of boiling water.

AL = The anesthetized lobster scenario: just like BL except the lobster is definitely not conscious.

$W$  = 'BL is worse than AL' (i.e. the boiling lobster scenario is normatively worse than the anesthetized lobster scenario).

$C$  = 'BL features consciousness'.

Assumptions:

$M$  = reductive materialism about consciousness is true (conscious states can be identified with complex physical or physical-functional states<sup>5</sup>).

A1 =  $\Delta(W \leftrightarrow C)$  (It is determinate that BL is worse than AL if and only if BL features consciousness.)

A4 =  $\Delta W \vee \Delta \neg W$  (Either it is determinate that BL is worse than AL or it is determinate that BL is not worse than AL.)

Reductive materialism ( $M$ ) is assumed for the purposes of the reductio. A4 is a consequence of robust realism about moral properties, taking 'worse than' to be an evaluatively fundamental expression, so it too is assumed for the sake of the argument.

A1 is then the only substantive assumption. At first glance it seems to be an extremely plausible claim: what else could make the difference? There are some issues however. We are tacitly making the natural but additional assumption that the kind of consciousness that may feature in BL is *negatively* valenced. If lobsters take to boiling water like a nice hot bath

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<sup>5</sup>The situation would be different in interesting ways if consciousness was identified with simple or fundamental physical states. This would lead to some kind of panpsychism and the axiological status of consciousness and of reductive materialism would take on quite a different complexion.

the example won't work as stated. We could then replace 'worse than' with 'evaluatively different than', or 'either better or worse than'.

It is also plausible that there are some conscious states whose phenomenal nature is affectively neutral. Perhaps an example would be a brief non-affective experience of blueness. Suppose that when we put a normal lobster in a pot of boiling water the only consciousness that occurs is a brief experience of blueness which carries no affective quality whatsoever for the lobster. Although this would mean that BL features consciousness, this would not seem to make  $W$  true. So we need to assume that the conscious state which features in BL is not affectively neutral. If it was neutral, how could it constitute a moral difference between BL and AL?

Clarifying these points reveals the pivot on which Cutter's argument turns: *affectively* valenced conscious states have evaluative or normative properties. This is the ground of the axiological significance of consciousness<sup>6</sup>. Consider then whether the affective aspect of consciousness is subject to borderline cases. It seems clear that it is. Sometimes as pain decreases, for example, it turns into a mere sensation without an affective dimension before it disappears from consciousness. It is frequently reported that opioid analgesics eliminate the affective dimension of pain without eliminating the attendant sensations. Although I'm fortunate never to have tested this personally, presumably the affective component is gradually attenuated so it would not be strange if there was a borderline region between pain and non-pain. If the affective valence of a conscious state is subject to borderline cases, it follows that some morally significant states have borderline cases, contrary to robust realism about moral properties. Such an argument does not depend on consciousness itself having borderline cases; all that matters is that the axiological significance of consciousness have borderline cases.

This line of thought undercuts Cutter's argumentative strategy. It is, I think, independently plausible that affective consciousness comes in degrees ranging from truly awful to truly wonderful with a place in the middle where the affective dimension of the conscious states at issue disappears. It is easy to think that there will then be borderline cases where there is no fact of the matter whether, for example, some state counts as a pain or not. We do not need to invoke reductive materialism to deduce this; it is intuitively plausible by itself from the nature of graduated affective consciousness.

We can then generate a simple case of Cutter's argument as follows. For any conscious state,  $\psi$ , it is determinate that  $\psi$  is intrinsically morally bad or it is determinate that  $\psi$  is not intrinsically bad<sup>7</sup>,

$$(7) \Delta B\psi \vee \Delta \neg B\psi.$$

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<sup>6</sup>The axiological significance of consciousness is subtle. Sufferers of chronic pain might prefer to remain conscious because of the positivity of their overall state of consciousness even if it does not contain any overtly pleasurable states to counterbalance their ongoing pain. Here something like being conscious that one is a conscious, or being conscious that one can appreciate what is happening has an intrinsic value. It is probably easier to withstand chronic pain than the sense of personal disappearance involved in progressive dementia. In the lobster case, could one argue that the non-affective moment of blue consciousness we posited is a morally positive thing? Maybe a little consciousness is normatively better than none. But this suggests there must be some small degree of affectively negative consciousness which counterbalances the positivity of bare consciousness, and so the same result accrues: there are morally neutral moments of consciousness.

<sup>7</sup>We need to add the 'intrinsically' to avoid side issues about instrumentally morally valuable states and to reflect the requirement that we are presuming we are dealing with a fundamental evaluative property.

This follows from robust realism about moral properties ( $\psi$  could be anything). But suppose it is indeterminate whether  $\psi$  has a negative affective dimension (e.g. is really a case of pain or not), or

$$(8) \neg\Delta N\psi.$$

By the claim that the axiological significance of states of consciousness depends on their affective dimension, we have

$$(9) \Delta(B\psi \longleftrightarrow N\psi).$$

By the distribution of determinacy over conjunction and implication, and the conjunctive definition of the biconditional<sup>8</sup>, this implies

$$(10) \Delta B\psi \rightarrow \Delta N\psi.$$

Now, (8) and (10) imply

$$(11) \neg\Delta B\psi.$$

(11) and (7) then give us

$$(12) \Delta\neg B\psi.$$

However, (9) also implies

$$(13) \Delta(\neg B\psi \longleftrightarrow \neg N\psi).$$

Again by distribution of  $\Delta$  and the definition of the biconditional we can deduce that

$$(14) \Delta\neg N\psi$$

which yields the desired contradiction.

So robust realism about morality implies that there are no borderline cases of pain, which seems highly implausible. Furthermore, pain is merely an example of a non-moral property with axiological significance. Pleasure would be another example, with ‘good’ replacing ‘bad’ as the moral significance of the property. A non-consciousness involving example might be beauty. One might hold that beauty has positive intrinsic moral significance. Cutter’s argument could then be marshalled to show that there are no borderline cases of beauty which also seems implausible. The reader can doubtless think of a host of other potential examples of such properties.

## §2. Cutter’s Anti-Materialist Argument and Ontological Indeterminacy

Now to return to Cutter’s anti-materialism argument. To refute reductive materialism we can argue from each disjunct of A4. But first we need a lemma showing that  $M$  implies that it is indeterminate whether BL features consciousness, or:

$$M \rightarrow (\neg\Delta C \& \neg\Delta\neg C)$$

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<sup>8</sup>The first is  $\Delta(X\&Y) \longrightarrow \Delta X\&\Delta Y$ , the second is  $\Delta(X \rightarrow Y) \longrightarrow (\Delta X \rightarrow \Delta Y)$  and the third is  $(X \longleftrightarrow Y) =_{df} (X \rightarrow Y)\&(Y \rightarrow X)$ .

Why does reductive materialism entail that  $C$  is not determinate? Because, as above, the physical states which reduce consciousness will be highly complex states involving many neural processes and a large number of synaptic transmissions. The example given above was very crude but imagining more realistic examples won't weaken the plausibility of the indeterminacy of complex physical states. Suppose we model consciousness as a phase transition in the brain: some neural property suddenly comes into being in a way analogous to, say, the sudden magnetization of iron as it cools below the Curie temperature. Various forms of neural phase transitions have been discussed, not necessarily in relation to consciousness, such as large scale neural phase synchronization (see Varela *et al.* 2001) or so-called neural avalanches (see Yu *et al.* 2017). In these examples of relatively sudden transformations to a new state, there is still going to be a question of how extensive the new phase has to be in the brain to subserve consciousness (e.g. the extensiveness of neural synchronization, or the number of neurons recruited in the avalanche) and the transition will not be literally instantaneous so there will be both spatial and temporal borderline cases. As we dial up or down the relevant physical parameter there will be no physical 'bright line' which marks out the exact place where consciousness appears or disappears<sup>9</sup>. In short, 'amount of synchronization' is like 'number of hairs' in a baldness case.

Further we can (without loss of generality) assume we are in this borderline case region with BL. Given  $M$ , we thus deduce

$$A2 = (\neg\Delta C \& \neg\Delta\neg C).$$

Now, suppose the first disjunct in  $A4$ , that is suppose  $\Delta W$  (that it is determinately true that BL is worse than AL). That is an evaluative claim and hence is determinate (by realism).  $A2$  implies  $\neg\Delta C$ . Following the line of argument described above,  $A1$  entails  $\Delta(W \rightarrow C) \& \Delta(C \rightarrow W)$  by the distribution of determinacy over conjunction and the definition of the biconditional. Simplification yields  $\Delta(W \rightarrow C)$ , which in turn entails  $\Delta W \rightarrow \Delta C$ . So given  $\Delta W$  we conclude  $\Delta C$  contrary to the above. The reason for the presumed indeterminacy of  $C$  however is the supposition of reductive materialism. Therefore, if moral properties are determinate, and consciousness is what matters for whether BL is or is not worse than AL, reductive materialism is false. A similar argument (*mutatis mutandis*) can be made based on  $\Delta\neg W$  and we refute reductive materialism by an argument from cases.

It's worth noting that the argument does not in any essential way depend on the nature of consciousness. Any property that makes a moral difference and which supervenes on a complex base will generate the same case against reducing that property to elements of its supervenience base. But are there any such properties apart from consciousness? I think that most candidates will, upon reflection, either actually involve consciousness in some way or represent a merely epistemic problem of attribution rather than vagueness (examples would be the property of being brain dead or the property of being in an irreversible coma). But consider the property of *being alive*. Whether someone is alive or not has morally significant consequences in, for example, what sorts of treatment of their body is permissible. The

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<sup>9</sup>We should carefully distinguish this case, where we identify consciousness with a certain brain state and the case where a non-physical consciousness property exemplification is caused to occur when the brain get into a certain state. It's not impossible for an infinitesimal change in physical state to cause a state of consciousness to appear even if the physical state has borderline cases (but see Goff 2014 for worries about this).

nature of life is complicated but all instances seem to supervene upon biochemical processes which are entirely physical. Suppose we try to give a reductive materialist account of life: a subject is alive when in biochemical state  $\beta$ . Since  $\beta$  is a complicated and widespread biochemical state involving a host of metabolic processes its attribution will be subject to borderline cases. Given the reduction, there will be cases where it is indeterminate whether someone is alive and the moral consequences then will also be indeterminate, contrary to the assumption of robust realism. So either life is not reducible to biochemistry or it's not actually the property of 'being alive' that grounds moral significance. I tend to think the latter option is correct: being alive stands proxy for the properties that really matter, such as, notably, having consciousness or for an explicitly socially determined declaration of the moral status of a human body.

It's important to emphasize that the problem lies in the proposed reduction, not in the supervenience of the property in question upon the physical. The supervenience relation can be absolutely sharp edged; it can be sensitive to physical differences that are semantically invisible. It is the physical state attribution which will in most or all complex cases be indeterminate.

Cutter's argument works under the presupposition that vagueness is semantical. That is, Cutter is supposing that 'is worse than' is not vague in this sense (it never exhibits semantic indeterminacy). But there could, perhaps, be other forms of indeterminacy.

So Cutter considers what happens to the argument if there is *ontological or metaphysical indeterminacy* with respect to fundamental moral properties. Ontological indeterminacy arises when it is simply indeterminate whether some fact obtains, given all other relevant facts and independent of semantics. By contrast, the indeterminacy of the fact that 'S is bald' depends (in part) on the semantics of 'bald'. We could eliminate this indeterminacy by strictly defining baldness in terms of number of hairs on someone's head (there's a problem with 'head' too I guess but we could tighten up its definition as well). We can't do that with ontological indeterminacy. Say we know that an electron is in a box. It might nonetheless be ontologically indeterminate whether the electron is in the right half or the left half of the box (quantum mechanics suggests scenarios just like this). This has nothing to do with vagueness; the position of the electron is not vague. The electron is determinately in the box but not determinately in the right side or the left. We can't tighten up the definition of 'position' to eliminate this indeterminacy.

Supposing that ontological indeterminacy is possible, what if 'is worse than' is a case of an ontologically indeterminate property even though the predicate 'is worse than' is not semantically vague?

The argument begins exactly as before. We are assuming both reductive materialism ( $M$ ) and robust moral realism. Cutter has argued that  $M$  implies that it is semantically indeterminate whether there is consciousness in BL, or  $M \rightarrow A2$ . So given we are assuming  $M$ , we again deduce  $A2$ .

Cutter claims that even in the face of ontological indeterminacy this leads to a contradiction with the assumption of  $A1$ . Let's see how.  $W$  is a moral claim which we now suppose is ontologically indeterminate. Crucially, Cutter holds that if  $X$  is ontologically indeterminate then on every precisification of the terms in  $X$ ,  $X$  will come out as neither true nor false. That seems obviously correct if  $X$  is *purely* ontologically indeterminate, where there no vague terms in  $X$ . We might wonder about mixed cases, as in 'it is morally good if you are happy'.

We might suppose the moral goodness of your happiness is ontologically indeterminate while ‘happy’ is semantically vague. It seems possible to argue that as your state of mind moves through borderline case territory heading towards ‘definitely happy’ the goodness of your state might be less ontologically indeterminate<sup>10</sup>. That is, it might be that ontological indeterminacy and semantical vagueness interact with one another in some cases.  $W$  seems to be a mixed case: ‘boiled’ is probably a vague term as is ‘anesthetized’. Be that as it may, for the sake of the argument let us assume that no precisification of ‘anesthetized’, ‘lobster’ or ‘boiled’ will create a situation where  $W$  is ontologically determinate.

Since Cutter uses the Kleene three-valued logic, if one term in a biconditional is neither true nor false then the biconditional is neither true nor false (see Cutter’s note 13 and the truth tables provided in the appendix below), so given that  $W$  is indeterminate, the biconditional  $W \longleftrightarrow C$  is indeterminate and hence not true. If  $W \longleftrightarrow C$  is not true then obviously it is not true on every precisification of the terms in  $C$  (which is, we are supposing, semantically vague). That means that  $\neg A1$  contrary to our assumption.

But notice something here. Although Cutter claims to use  $A2$  in the derivation, it actually plays no role. Suppose that  $C$  was determinately true, or that  $C$  comes out true on every precisification: BL absolutely does feature consciousness. Or suppose that  $C$  was determinately false, or that  $C$  comes out false on every precisification: BL absolutely does not feature consciousness. It will still be the case the  $W \longleftrightarrow C$  is not true. The indeterminacy of  $W$  is doing all the work here and the indeterminacy of  $C$  generated by  $M$  is irrelevant. So  $M$  is not an assumption of the argument and can’t be refuted by getting a contradiction merely between the determinate relation of  $W$  and  $C$  and the assumption that morality is ontologically indeterminate.

Now consider  $W \rightarrow C$  which is *entailed* by  $A1$ . If  $C$  is true then even though  $W$  is indeterminate, the conditional comes out as true. If  $C$  is indeterminate then  $W \rightarrow C$  is also indeterminate. This means that we need the indeterminacy of  $C$  to get the conclusion that  $\Delta(W \rightarrow C)$  is false (even though we do not need it to refute the determinacy of the biconditional). And we need the assumption of reductive materialism to show that  $C$  is indeterminate. So I think Cutter would be right that we have a reductio of reductive materialism if we restricted ourselves to considering  $W \rightarrow C$ . The dialectical situation here seems a bit peculiar. It depends on the fact that  $\Delta(X \longleftrightarrow Y) \rightarrow [\Delta(X \rightarrow Y) \& \Delta(Y \rightarrow X)]$ . Only one conjunct needs to fail to show that the biconditional is indeterminate and  $C \rightarrow W$  fails just because  $W$  is indeterminate.

The above considerations are based upon the Kleene three-valued truth tables, but they are not the only possible interpretation of the logic of indeterminacy. Candidate logics differ in how they treat the propositional connectives, most especially the conditional.

The Bochvar three-valued, or Weak Kleene, logic goes further than Kleene: *any* compound statement with an indeterminate component will be indeterminate, even in the case of conjunction. So according to the Bochvar logic, the indeterminacy of  $W$  will force any statement containing it or its negation to be indeterminate. The assumption of reductive

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<sup>10</sup>This is just a manner of speaking of course. But it does raise the question whether ontological indeterminacy could come in degrees. Suppose, in the electron case, the probability of being in the left side of the box is increasing. Is that a way that ontological indeterminacy in position is decreasing? Or should we hold that so long as the quantum probability is not 1, there is ontological indeterminacy. That would entail, given that quantum mechanics describes the entire world, that virtually everything is ontologically indeterminate.



materialism is irrelevant and can't be refuted by Cutter's line of argument.

The Lukasiewicz truth table for the conditional differs from Kleene's in that it assigns T to a conditional where both antecedent and consequent are indeterminate.  $M$  implies that  $C$  is semantically indeterminate. We are assuming that  $W$  is (ontologically) indeterminate. So it appears that both  $W \rightarrow C$  and  $C \rightarrow W$  come out at true in the Lukasiewicz logic, and the biconditional is thus also true. However, as Cutter points out, the truth of  $\Delta(W \leftrightarrow C)$  requires that  $W \leftrightarrow C$  come out true on every precisification of the terms in  $C$  but we are assuming that our case is one where some precisification make  $C$  true and others make it false. That is, we are assuming (quite properly) that BL is a borderline case of consciousness. In a case where  $C$  is false,  $W \rightarrow C$  will be indeterminate and so  $W \leftrightarrow C$  will also be indeterminate. This in turn entails  $\neg A1$  and we get the contradiction and we need to appeal to reductive materialism to do so.

Yet another three-valued logic is that of Gödel in which a conditional with indeterminate antecedent and false consequent comes out F. So where a precisification makes  $C$  false,  $W \rightarrow C$  will be false, which also leads to  $\neg A1$ .

Now, it seems strange that the refutation of reductive materialism depends on one's choice of three-valued logic. While only the Bochvar truth tables prevent Cutter's argument from succeeding in the face of ontological indeterminacy this doesn't seem to be a case where 'majority rules'. However, intuitively, Bochvar's strictures seem overly stringent in this context: if I know that P is true then, even if Q is indeterminate, don't I know that (P or Q) is true, no matter the truth status of Q? The usual interpretations of Bochvar's logic are that the indeterminate value has nothing to do with truth but rather, for example, the distinction between meaningful and nonsensical (Bochvar 1981), or the distinction between being 'on topic' versus 'off topic' (Beall 2016)<sup>11</sup>. I think it is reasonable to ignore the Bochvar logic of indeterminacy.

In conclusion, I think Cutter has a strong case that if moral realism entails that moral properties are determinate then moral realism plus the axiological significance of consciousness refutes reductive materialism. But I've argued above that Cutter's line of argument is too strong insofar as moral determinacy implies that there are no borderline cases of pain, nor such for *any* other non-moral property with axiological significance, which seems highly implausible. The more direct argument from the determinacy of consciousness seems a better route to attack reductive materialism.

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<sup>11</sup>For a brief review of interpretations of Bochvar's logic see §6 of Ciuni and Carrara 2019.

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## Appendix – Truth Tables for Three Valued Logic

T = True; F = False; I = Indeterminate.

Note that all the interpretations agree on the truth table for conjunction, save for Bochvar's.

Kleene

The Conditional:

→		T	I	F
T		T	I	F
I		T	I	I
F		T	T	T

Conjunction:

&		T	I	F
T		T	I	F
I		I	I	F
F		F	F	F

Bochvar

The Conditional:

→		T	I	F
T		T	I	F
I		I	I	I
F		T	I	T

Conjunction:

&		T	I	F
T		T	I	F
I		I	I	I
F		F	I	F

Lukasiewicz

The Conditional:

→		T	I	F
T		T	I	F
I		T	T	I
F		T	T	T

Conjunction:

&		T	I	F
T		T	I	F
I		I	I	F
F		F	F	F

Gödel

The Conditional:

→		T	I	F
T		T	I	F
I		T	T	F
F		T	T	T

Conjunction:

&		T	I	F
T		T	I	F
I		I	I	F
F		F	F	F