Disunity Defended: A Reply to Bayne

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We have recently argued [8] that phenomenal consciousness is not a unity, in the sense of being a single thing at each instant. It is a multiplicity, an aggregate of phenomenal elements, each of which is the product of a distinct consciousness-making mechanism in the brain. We call this the multi-track conception of consciousness. It is, we believe, quite consistent with the available evidence, both phenomenological and neurophysiological, and ought to be considered a serious rival to more orthodox approaches. Tim Bayne, in a lively and stimulating paper [2], claims that our arguments in support of the multi-track conception are unpersuasive, and that the evidence we present is at best equivocal. We respond by defending our arguments on a number of fronts, and by taking a second look at the available evidence.

I. The Orthodox Conception Revisited

Our attempt to reject the philosophically orthodox doctrine of the unity of consciousness begins badly, according to Bayne, because we offer an eccentric characterisation of our target. To claim that consciousness is a unity is to claim that a subject's conscious experience is, from moment to moment, a single thing. But this, Bayne rightly observes, could mean a number of things. And what we take it to mean – namely, that a subject's phenomenal consciousness is generated by a single consciousness-making mechanism or process in the brain – is not how this claim is normally understood. Hence we are "in danger of engendering unnecessary confusion" [2, p.249].

Far from being confused, however, we think our characterisation of the unity of consciousness is the only one available that is both perspicuous and consistent with materialism. To see this, reflect for a moment on Bayne's alternative offering, one he thinks is more in keeping with normal usage: "[A]ll of a subject's experiences are part of a single phenomenal field: all of a subject's experiences are co-present in her consciousness, they are part of a single global experience" [2, p.248]. Now we don't dispute Bayne's claim that this kind of characterisation of the unity of consciousness is out there in the philosophical literature. What we do dispute, though, is that it's intelligible. The unity of consciousness, on this construal, consists in the fact that all of a subject's experiences are part of or co-present in a single experience. When philosophers use the term 'experience' in these discussions, they typically mean *phenomenal consciousness* – the what-it-is-like of experience. But the two uses of the term 'experience' in Bayne's offering cannot both refer to phenomenal consciousness, since the first denotes a plurality while the second refers to something singular. We are required to ask, therefore, which of these two uses of 'experience' (if either) refers to phenomenal consciousness? And, perhaps

more importantly, what is denoted by the other use of this term? The point, of course, is that without further explication, this rendering of the orthodox conception of the unity of consciousness is incomprehensible.

It was precisely this further explication that we sought to provide (see [8, pp. 378-9]). It is difficult to deny that instantaneous phenomenal consciousness comprises a number of identifiable parts (cf. the reference to the co-presence of "experiences" in Bayne's characterisation). Most theorists understand these parts in representational terms: conscious experience is composed of numerous distinct contentful elements. But then we have a problem: how are we to reconcile the representational multiplicity of phenomenal consciousness with its alleged unity? The only answer that presents itself is that the distinct contents must be fused in a single experience (cf. the reference to a "single global experience" in Bayne's characterisation). It is this requirement that, once we conjoin it with a commitment to materialism, inexorably leads to a single consciousness-making mechanism or process in the brain. On the one hand, the task of combining multiple representational contents in a single experience must be performed by some physical mechanism or process. On the other, if we suppose that the brain implements more than one such mechanism or process, then it will be capable of simultaneously generating more than one experience.

II. Distinguishability and Subtractability

What is at issue here is the relationship between the structure of consciousness and the structure of the brain activity that supports it. The doctrine of the unity of consciousness holds that conscious experience depends on a single consciousness-making mechanism or process in the brain. We call this the *single-track* conception of consciousness. In 'The disunity of consciousness' [8] we sought to marshal the evidence, both phenomenological and neuroscientific, in favour of the multi-track alternative.

To begin with we argued that phenomenal consciousness is "polyphonic" – that is, conscious experience contains, at each instant, a number of distinct "voices", each tending to harmonise with the others, but maintaining its own identity within the totality. In other words, moment by moment experience is both rich, and highly structured (particularly intra-modally). We went on to suggest that the various modalities and kinds of consciousness exhibit a certain degree of independence of each other, which can be established via simple phenomenological experiments, such as shutting one's eyes, or changing focus when confronted by ambiguous input (e.g., the Necker cube). Also noteworthy is the large variety of phenomenal deficits to which humans are (unfortunately) subject (e.g., blindness, achromatopsia, prosopagnosia, and so on). Although the boundaries of many of these deficits remain to be fully established, it seems fairly clear that specific deficits in experience are very often accompanied by complete sparing in other modalities or sub-modalities.

Next we briefly explored some evidence drawn from the neurosciences. Many phenomenal deficits are now known to be accompanied by, and apparently result from lesions in specific parts of the brain. Lesion studies have been instrumental in establishing the degree and kinds of functional specialisation and localisation in the brain. The picture that is emerging is of a brain which divides and conquers, with broad divisions among modalities and task domains reflected in large-scale anatomical divisions (e.g., primary visual processing in occipital cortex, auditory processing in temporal cortex, planning and working memory in frontal cortex), while more fine-grained functional distinctions are reflected in correspondingly restricted anatomical divisions and loci (e.g, visual motion detection in area V5, colour processing in V4). Other kinds of studies, such as fMRI, PET, micro-electrode and EPR, which are effective over a wide range of spatial and temporal scales, have lately confirmed and enriched this picture with regard to both normal and abnormal function. The significance of this experimental work for the study of consciousness is that, where specific *losses* of phenomenology are concerned we find

corresponding lesions and deficits in brain activity, and, in the case of normal function and phenomenology, we are beginning to map the relevant brain loci with considerable accuracy (for an interesting example see [5]).

Bayne attributes two arguments to us, corresponding to the two kinds of evidence rehearsed above. The first he derives from our claim that the parts of experience "are independent because they are distinguishable in experience, and because any one of them can be removed or lost without affecting the others" [8, p.387]. According to Bayne, there are actually two (phenomenological) arguments here: 1) "consciousness must be multi-track because one can distinguish different elements in one's phenomenal field" [2, p.250] (he calls this the "distinguishability argument"), and 2) "a conscious content is produced by a distinct consciousness-making mechanism if one can subtract the conscious content in question without affecting the rest of one's phenomenal field" [2, p.250] (he calls this the "subtractability argument"). Bayne rejects the distinguishability argument because there doesn't seem to be any obvious route from the mere distinguishability of contents in consciousness to their neurophysiological independence. We accept this point. It is indeed important to distinguish "the unity of consciousness at phenomenal or introspective level and the unity of consciousness at a vehicular level" [2, p.250]. However, we never intended distinguishability to be read as a separate *argument* for the multi-track conception. It is, rather, a *condition* on the possibility of a multi-track theory. Phenomenal consciousness can hardly be multi-track if it is undifferentiated. In so far as the phenomenological evidence can be regarded as a distinct argument for multi-track polyphony, it amounts to the *conjunction* of distinguishability and subtractability.

Presumably Bayne will remain unconvinced, because he regards subtractability itself as an unreliable guide to the neural substrate of consciousness [2, p.251]. No matter – we take the conjunction of distinguishability and subtractability to be merely suggestive on this score. A powerful argument for the multi-track account really only emerges when one combines the apparent independence of the parts of experience with the evidence from lesion and other neuropsychological studies. It goes like this. Moment by moment conscious experience has numerous proper parts that can be identified via introspection. The existence of "phenomenally localised" (Bayne's term [2, p.251]) deficits, both common and pathological, indicates that many of these parts are "subtractable", in the sense that the loss of one or more is consistent with the continued existence of the others. Turning to the neurosciences, we find powerful indications that information coding in the brain is highly *physically* localised, and that deficits (not to mention augmentations) in phenomenology co-vary with altered activity in the relevant coding sites. From here it is a short step to the following conclusion: the brain sites that code for particular contents are the very sites where those contents are made conscious. Since the contents and associated brain loci are multiple, phenomenal consciousness is multi-track.

Bayne is not impressed. He has two kinds of responses. First, he (in effect) suggests that this line of argument is incoherent, because it "would seem to entail that a normal human being has an indefinite number of consciousnesses, and certainly more than one per sense modality" [2, p.251]. This criticism echoes an earlier worry [p.249] about our monophonic/polyphonic distinction, which seems to depend on an account of content individuation that isn't yet in place. We certainly accept that the problem of individuating contents (conscious or otherwise) in a principled and systematic way is an enormous challenge for cognitive science – a challenge made all the more difficult by the many senses of "mental content" currently in use. Even if one restricts attention to perceptual contents (and ignores the kinds of contents associated with linguistically mediated thought), perceptual experience is extremely rich, and seems capable of being divided up in many different ways. Moreover, it is not yet clear what the appropriate perceptual simples (minimal content units) will be, or even if the idea of such simples is completely coherent.

However, none of this undermines our position. What Bayne identifies are questions with which any complete theory of mental representation must grapple. As such they are questions

for the philosophy of mind in general, not just for particular theories of phenomenal consciousness. Neither are they exclusively conceptual questions. To a significant degree the issues here are empirical, because they concern the way information is represented in neural tissue. We don't yet know a whole lot about that, but we can safely venture that the brain engages numerous distinct content-bearing media at each instant. Bayne's examples are tendentious: "Is seeing that a brown cat is lying in the sun an experience with one content or two?" [2, p.249]. Being mono-modal, such an experience is not apt for deciding between the monophonic and polyphonic models of consciousness. How about: observing a sun-bathing brown cat while listening to Mozart? Surely everyone would accept that the brain is generating *more than one* distinct content in this case. Of course the indications are that at each moment the brain independently fixes many more contents than those generated in visual and auditory cortex, which is grist to the multi-track mill.

Bayne points out that this kind of reasoning must also lead to the conclusion that there are distinct consciousnesses *within* modalities, given the evidence for intra-modal localisation of function (e.g., the distinct neural resources involved in coding colour, motion and form in the visual system – see [9]). We accept this conclusion. This is exactly where the neuropsychological studies lead. However, accepting this is far from having to accept that a normal human being has "an *indefinite* number of consciousnesses" [p.251, our emphasis]. The mereological issues connected with the multi-track perspective are certainly "very forbidding", but, as Bayne himself admits, this doesn't mean they are "in principle unanswerable" [2, p.249]. What is crucial is that we regard them as a matter for science. To borrow Bayne's example [2, p.249]: proprioceptive experiences may, for all we know, turn out to individuate at the level of the entire body, or the level of body parts, or in some yet unimagined way. But this will only be settled by a research program that aims to reconcile all the relevant data: neurological, computational and phenomenological. It is not the kind of issue that can be settled *a priori*.

III. Dealing with the Evidence

One reason we offered for preferring a multi-track account of phenomenal consciousness is that it is, *prima facie*, the most parsimonious way of dealing with the existing evidence [2, p.251]. What we had in mind is that a single-track theory must posit, in addition to all the *local* activity apparently associated with phenomenal consciousness, a single, *global* consciousness-making mechanism, process or system. This seems to us an unnecessary imposition on the data. But intuitions about parsimony are notoriously interest-relative. Bayne thinks that a multi-track account is *less* parsimonious than a single-track account because it posits *multiple* consciousness-making mechanisms, rather than a *single*, global mechanism. Clearly, trading these sorts of intuitions won't get us very far, because they ultimately fail to address the crucial evidential issues.

This brings us to Bayne's second, and we think more significant response to our argument for the multi-track account, namely, that single-track and multi-track theorists can handle the neuropsychological evidence about equally well. In support he quotes our claim that "a single-track theorist could argue that the deficits in consciousness experienced as a result of localised cortical ablations are due to the relevant contents never being passed on to the executive system" [8, p.391]. We admit that this makes the situation look like something of a stand-off, but let's have a closer look. As far as we can tell there are only two roads open to the advocate of a single-track account: 1) treat conscious experience as the product of a single, central neural system where informational contents must be re-presented to be made conscious – this is the familiar Cartesian theatre model that Dennett warns against [6], 2) opt for a somehow unitary consciousness-making *process* that acts simultaneously on the brain's many distinct information

processing sites[1] – this is somewhat less familiar, but is probably the nearest thing to a consensus view at present. There isn't much to be said for the first option, because neuroscientists are fairly convinced that there are no brain sites suited to the role of central theatre. Quite a lot of research suggests that one can lose a good deal of association cortex without losing awareness of the contents thought to be fixed in the more peripheral systems (see [3, Ch. 5] for discussion).

At any rate, Bayne is no defender of the Cartesian theatre. As he points out, a number of neuroscientists have recently suggested that phenomenal consciousness might involve "distributed time-locked neural oscillations", which may in fact be an instance of the unitary process strategy (the second of our two single-track options above). Consider, for example, Damasio's proposal:

> The integration of multiple aspects of reality, external as well as internal, in perceptual or recalled experiences, both within each modality and across modalities, depends on the time-locked co-activation of geographically separate sites of neural activity within sensory and motor cortices, rather than on a neural transfer and integration of different representations towards rostral integration sites. The conscious experience of these co-activations depends on their simultaneous, but temporary, enhancement…against the background activity on which other activations are being played out. [4, p.39]

Damasio here explicitly repudiates the Cartesian theatre model, and builds his account around the acknowledged parcellation of information processing in the brain. Yet it is still possible to gloss this as a single-track account. What brings content-bearing activity to consciousness is its temporary enhancement as a result of time-locked co-activation with contents coded elsewhere in the brain. Time-locking "integrates" contents coded at "geographically separate sites", which are then capable of simultaneously entering consciousness. *Time-locked enhancement* is thus a candidate for a unitary consciousness-making process. This putative process occurs simultaneously at many separate sites, and is unitary in virtue of being phase-locked, or falling within a single well defined temporal window of some kind.

But one wonders just how coherent this reading of Damasio actually is. There is a deep tension here between the role of local and global processes. Although time-locking is a global process, in that it concerns temporal relations among numerous distinct information processing sites, the process that actually seems to count, so far as consciousness-making is concerned, is the *local* enhancement of activity connected (in some unspecified way) with that time-locking. And there are as many sites of such enhancement as there are co-active regions of information processing activity. What we portrayed as a single-track account begins to sound distinctly multi-track. Admittedly, it's not obvious that this result generalises beyond Damasio's model, but, whatever form it takes, a unitary process model must face the following difficult question: why is the local activity that such a process generates *not* to be regarded as the material basis of consciousness?

There is, of course, a way a single-track theorist can respond to this difficulty. It involves denying that activity in localised brain regions is both necessary and sufficient for the contents fixed there to be made conscious. Such a theorist must instead regard appropriate causal relations among contents (be they inter-modal or intra-modal relations), as a further *necessary* condition on consciousness-making. When it comes to Damasio's account this means treating time-locking not merely as an integration process, but as a process that is partly constitutive of consciousness. In order for contents to *be* conscious they must be bound or integrated with other contents by some means. More generally, in the absence of the causal relations characteristic of whatever unitary process acts as consciousness-maker (be it time-locking, or something else

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[1] Such a process may rely on special, perhaps even centralised, neural machinery. However, this machinery would not amount to a Cartesian theatre, because there is no suggestion here that informational contents need to be re-presented centrally in order to become conscious.

entirely), content-fixations and other forms of local activity are quite incapable of producing conscious experience.

A consequence of this view is that the discernible parts of consciousness are located in a region no smaller than the entire set of brain sites currently subject to consciousness-making. Visual consciousness is not, strictly speaking, in the visual cortex, nor is auditory consciousness in the auditory cortex. Rather, each and every conscious content is distributed right across the complete set of regions that are, at that moment, caught up in the relevant process. If we deny this it is difficult to see how the unitary process strategy fails to collapse into a multi-track account. Notice how the manoeuvre works: content-fixation is assumed to take place at numerous distinct sites scattered about the brain – that's the common ground between multi-track and unitary process accounts – but consciousness of those contents is taken to be pretty much a whole brain thing. In this way the unitary process strategy can be made consistent with all the evidence for functional localisation in the brain, while offering a genuinely single-track account of phenomenal consciousness.

Where does this leave us? The situation is at worst a stand-off, as far as a multi-track theorist is concerned. There is certainly no presumption in *favour* of a single-track account, based on current evidence. For our money there are some features of the single-track model that are none too appealing – the single-track approach to the location of consciousness for one – but let's put that aside and assume that the multi-track and single-track accounts are equally consistent with the evidence presented so far. In order to choose between them we must therefore look for further constraints.

One possibility Bayne alerts us to is that the phenomenon of inter-sensory integration may create special difficulties for the multi-track conception of phenomenal consciousness. Sensory integration has two aspects: 1) our senses are generally *coherent* – we *see* our body parts in positions we *feel* them, that we *hear* sounds emanating from objects in the direction we *see* them, and so on, 2) the information processed in one sensory modality sometimes *influences* the content of experience in another – the McGurk effect [7], where what subjects report *hearing* is partly determined by what they *see*, is an example. A very natural way for a single-track theorist to deal with this feature of consciousness is to hold that the process of bringing a particular content to consciousness and the process of integrating it with other contents, both intra-modally and inter-modally, are one and the same. After all, both involve global causal relations among representational contents. A single-track interpretation of Damasio's model would presumably go that way.[2] The multi-track theorist, on the other hand, has a *prima facie* difficulty with integration.[3] How, for example, can the McGurk effect be understood, if, as the multi-track theorist supposes, the experience of seeing is produced by one set of consciousness-making mechanisms, while the experience of hearing is produced by another? Similar worries attend the process of bringing phenomenal elements into spatio-temporal register (i.e., making them coherent) if we assume that each is produced by a distinct mechanism.

Clearly, it is incumbent on any proponent of a multi-track model to explain both these kinds of integration. But in this respect multi-track theorists are really no worse off than their single-track counterparts. Inter-sensory, and indeed intra-sensory, integration is a phenomenon concerning relations between the different contents represented in experience. Consequently,

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[2] Which is not to say that the only way to *be* a single-track theorist is to hold that integration (or binding) and consciousness-making are the same process. Bayne, for example, doesn't seem to like this approach [2, p.250].

[3] For this reason it is particularly odd that Bayne, in the final section of his paper, attributes to us an argument "from the mere coincidence of representational contents to the fact that they have been produced by distinct consciousness-making mechanisms" [2, p.252]. We offer no such argument. In the passage to which he refers, rather than developing an argument for the multi-track conception of consciousness, we are actually exploring a different sense in which instantaneous consciousness might be said to be "unified" – one that turns on the *coherence* of the different contents represented in experience.

single-track theorists, just as much as multi-track theorists, have the burden of explaining precisely how these contents are made consistent with one another.[4] As we indicated, one option for a single-track theorist is to specify a unitary global process that performs the twin roles of consciousness-making and integration. Multi-track theorists, on the other hand, regard as distinct the processes in the brain responsible for representational integration and those responsible for generating consciousness, even if, as seems likely, the brain is so wired that integration and consciousness-making occur roughly simultaneously. In particular, multi-track theorists are committed to the view that consciousness-making is a local, not a global, phenomenon. But this seems perfectly consistent with the claim that integration depends on, say, communicative links among the disparate regions where consciousness-making takes place. At any given moment there are all sorts of influences, both intra-sensory and inter-sensory, criss-crossing the brain, such that conscious contents not only co-occur, but mutually influence and shape one another. Which of these two approaches is to be preferred is a matter for careful empirical work. The mere existence of inter-sensory integration provides no grounds for favouring the single-track account over its rival.

So it all seems to come down to this: are consciousness-making and binding one and the same process (to put it a bit tendentiously), as single-track theorists generally assert, or are they distinct, albeit closely related processes, as a multi-track theorist would have it? In so far as there is any evidence here it seems to favour the multi-track account. Zeki and Bartels, in a number of fascinating papers (see, for example, [1, 10 & 11]), have recently argued (in terms strikingly similar to our own) that "consciousness is not a unitary faculty, but…consists of many micro-consciousnesses" [1, p.2327]. Moreover, they argue that "[b]inding cellular activity at different nodes is…not a process preceding or even facilitating conscious experience, but rather bringing different conscious experiences together" [1, p.2330], and again "consciousness is not the consequence of binding the activities of cells at different sites; rather, it is the micro-consciousnesses that are generated at different sites which require binding" [11, p.1584]. In support of these claims Zeki and Bartels cite many of the kinds of evidence we've already discussed, but in addition they draw on work suggesting that when the different attributes of a visual scene are presented simultaneously these attributes are not perceived at the same time. It appears that colour is perceived before orientation, which in turn is perceived before motion, the difference between colour and motion being about 60-80 ms [1, p.2329]. Experiments in which subjects are asked to pair two rapidly alternating states of two attributes (e.g., a bar with two possible orientations and two possible colours), reveal systematic misbinding of attributes relative to their actual time of occurrence [11, p.1583]. From this it seems to follow that there are "multiple visual micro-consciousnesses which are asynchronous with respect to each other" [p.1584].

The upshot of all this, we think, is that the multi-track conception of phenomenal consciousness has to be taken very seriously. It is consistent with all of the empirical evidence we've adduced, and certainly doesn't succumb to any obvious *a priori* objections. Rather, this conception appears as a viable alternative to current orthodoxy. If it challenges some of our preconceptions about the unity of consciousness then maybe we need to rethink our commitments in this regard.

References

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[4] It is important to recognise that time-locking alone won't do the job. Time-locking, while it may assist in communication among brain regions, isn't a particularly obvious candidate for the control of content-altering interactions (such as take place in the McGurk effect).

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