

# The Disunity of Consciousness

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## Abstract

It is commonplace for both philosophers and cognitive scientists to express their allegiance to the “unity of consciousness”. This is the claim that a subject’s phenomenal consciousness, at any one moment in time, is a *single* thing. This view has had a major influence on computational theories of consciousness. In particular, what we call **single-track** theories dominate the literature, theories which contend that our conscious experience is the result of a single consciousness-making process or mechanism in the brain. We argue that the orthodox view is quite wrong: phenomenal experience 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. Consequently, cognitive science is in need of a **multi-track** theory of consciousness; a computational model that acknowledges both the manifold nature of experience, and its distributed neural basis.

## 1. Introduction

It is commonplace for both philosophers and cognitive scientists to express their allegiance to the “unity of consciousness”. This is the claim that a subject’s phenomenal consciousness<sup>1</sup>, at any one moment in time, is a *single* thing. And the oneness of consciousness at each instant brings with it a commitment to the *seriality* of phenomenal consciousness over time. In his influential book *A Cognitive Theory of Consciousness*, Bernard Baars puts it this way:

Conscious experience is *one thing after another*, a “stream of consciousness,” as William James called it. Psychological theories that are largely confined to conscious processes...postulate largely serial mechanisms. And, as Wundt observed in the 1880s, even two simultaneous conscious events are experienced either fused into a single experience or serially, one after the other. There is no such thing as true psychological simultaneity of two distinct events...(1988, p.83, emphasis added)

Apart from being a nice expression of a very common view of consciousness, this quote illustrates the way unity and seriality go very much hand in hand. To be serial, conscious experience must be “one thing after another”, the opposition here being between the one and the

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<sup>1</sup> While the concept of consciousness is, as Ned Block has recently put it, a “mongrel”, in that denotes a number of different phenomena (1995, p.227), we believe that its primary referent is what Block dubs *phenomenal consciousness*. Consequently, when we speak variously of ‘phenomenal experience’, ‘phenomenal consciousness’, ‘conscious experience’, or sometimes just plain ‘consciousness’, in each case we refer to the same thing: the “what it is like” of experience.

many. If many things in a system co-occur – if there is “true psychological simultaneity” – then that system is operating in a parallel, not a serial fashion. So the unity of consciousness at each instant gives rise to its seriality over time.

The view expressed here by Baars is very widely shared. Nonetheless, there is a tension lurking in the Baars quote, which is evident in most discussions of the unity of consciousness. On the one hand, Baars tells us that “even two simultaneous conscious events are experienced either fused into a single experience or serially, one after the other”; but, on the other, he says that “there is no such thing as true psychological simultaneity of two distinct events”. There is an obvious inconsistency here, as the first statement appears to be committed to what the second denies, i.e., the simultaneity of distinct conscious events. There is, however, an obvious way of resolving this inconsistency. Where Baars writes of “two simultaneous conscious events” being “fused into a single experience”, we can read this as a claim about simultaneous *contents*; namely, that different contentful elements can be fused into one *experience*, and hence while the experience remains “single”, its contents are multiple.

But this reading of Baars makes it clear that there are actually two distinct ways of conceiving of the unity of consciousness: as a serial stream containing only one contentful element at a time, and as a single experience embracing multiple contents. These two angles on the unity of consciousness can be likened to varieties of unaccompanied (a cappella) choral music. The first is like a solo performance, in which the chorus remains silent, and a single voice is all that we hear. The limitations of the human vocal folds ensure that such a solo is *monophonic*, i.e., it contains only one note at a time. An advocate of the single content conception of the unity of consciousness supposes that the brain imposes a similar limitation on phenomenal experience – it can contain only one distinct content at each moment. A nice feature of this analogy concerns the duet. Operatic music sometimes involves the musical equivalent of a dialogue, in which two singers alternately take the melodic line. Such music changes in tonal quality as each singer (say a soprano and an alto) takes her turn, yet it is monophonic throughout. This approach implies that we are only ever privy to a single mode of experience at a time (since we are only privy to a single content at a time), but, like the duet, consciousness can involve switching between modes, thus changing its “tonal” quality.

On the other hand, if we suppose that consciousness incorporates a number of distinct contentful elements (e.g., from a number of modalities) fused into a single experience, then it is best likened to *polyphonic* choral music. Polyphony involves two or more *simultaneously active* voices, such that at any moment there are a number of different notes being sounded. In a similar fashion, an advocate of the fusion conception of the unity of consciousness supposes that the brain binds together a collection of informational elements into a single conscious experience. In this case, however, we are left with no clear impression of the kind of unity on offer. It can't be a unity without parts, because the single experience is actually a *composite* structure: it is assembled from contentful elements that have been fused together in some way. What this seems to entail, therefore, is that there is a single consciousness-making mechanism or process, in the brain, whose task it is to bind these different contents together into a unitary experience.

Both the monophonic and polyphonic models of the unity of consciousness are at large in the literature. And between them they have had a major influence on the computational theories of consciousness that have lately been appearing in cognitive science. In particular, they have led to the dominance of *executive* theories of consciousness: theories which contend that our conscious experience is the result of an executive process or system in the brain that privileges certain mental representations over others.

It is our view that the orthodox conception of the target phenomenon, in either its monophonic or polyphonic guise, is quite wrong. Phenomenal consciousness, we think, is not a

unity; rather, it is manifold and distributed. This in turn suggests that we need a radically different computational conception of consciousness, one that can do justice to its palpable disunity. In order to defend this claim, we must consider the monophonic and polyphonic models of the unity of consciousness separately. We begin with the monophonic approach.

## 2. The Monophonic Model of the Unity of Consciousness

Roger Penrose appears to be an adherent of the monophonic model. Consider the following:

Utterances like ‘How can you expect me to think of more than one thing at a time?’ are commonplace. Is it possible *at all* to keep separate things going on in one’s consciousness simultaneously? Perhaps one *can* keep a few things going on at once, but this seems to be more like continual flitting backwards and forwards between the various topics than actually thinking about them simultaneously, consciously, and independently. If one were to think consciously about two things quite independently it would be more like having two *separate consciousnesses*...while what seems to be experienced...is a *single* consciousness which may be vaguely aware of a number of things, but which is concentrated at any one time on only one particular thing. (1989, p.399)

Thus, according to Penrose, consciousness is “single”, because we can’t hold two independent thoughts at once. Doing so would be like having two consciousnesses in the one head. At any moment in time consciousness involves only one “thing”, or one “topic”.

There is some truth in these claims. However, read as a description of *consciousness* this material is mistaken on at least two counts. On the one hand there is evidence of a straightforward conflation of consciousness and what we might call “higher-thought”. And on the other, there is an apparent confusion of consciousness and attention.

Consider first the nature of human thought. Humans are unique in the animal world for our capacity to engage in complex symbolic thought, which we can conduct using both formal and informal languages. This kind of thinking involves a good deal of conscious phenomenology, and not just the visual or auditory phenomenology associated with perceiving symbols, but also the phenomenology required for their proper manipulation. On the latter, consider the difference between Jacques (a monoglot Frenchman) and Jack (a monoglot Englishman) as they listen to the news in French. While there is a sense in which Jacques and Jack have the same aural experience, their experiences are utterly different in another respect. Jacques *understands* what he hears, and Jack does not. This difference is not just a difference in Jacques’ capacity to respond to what he hears, it is a difference *within* phenomenal experience. Jacques consciously experiences something that Jack doesn’t. Galen Strawson calls this additional phenomenal element “understanding-experience” (1994, pp.5-13); it’s the experience that’s missing when no sense is conveyed by what one sees or hears. And our point here is that higher (i.e., symbolic) thought implicates, in addition to visual and auditory phenomenology, a good deal of this more abstract phenomenology.

So Penrose is right to identify an important relationship between consciousness and higher-thought. Moreover, there is something to be said for the claim that higher-thought is serial; we do seem, in some sense, to be restricted to a single “topic” at any given moment. However, it is surely not consciousness *in toto* that is so restricted. Even the most casual inspection of our instantaneous phenomenal field reveals that contents drawn from different modalities can simultaneously co-exist in experience. This is a point that really should be banal, but is often overlooked in discussions of consciousness. When you go for a walk in the country, for example, you not only have a great deal of pleasant visual experience, but at the same time you hear the sound of wind in the trees and birds singing, you feel your feet hitting the ground, and you have a sense of your bodily state (whether you’re tired, energetic etc.). It is *not* the case that you, for example, first hear a bird, and then see it (or vice versa). Sound and vision don’t compete for a

place in awareness; both are simultaneously present to us. You may not be able to simultaneously react to, or focus on, disparate sources of experience, but the phenomenology they generate can certainly co-occur.<sup>2</sup>

Once one distinguishes phenomenal consciousness *per se*, and higher-thought, with its various phenomenal concomitants, it becomes clear that conscious thought is merely one component of a richer total experience. Moreover, not only does such thinking clearly fail to exhaust the possible contents of consciousness, it doesn't even *exclude* other kinds of conscious experience when in progress. Thus, while it may be that we can only entertain one topic of higher-thought at a time, it's wrong to suggest that conscious experience as a whole is thereby rendered "single" and hence "serial". It is possible to admit the seriality of higher-thought, without accepting that phenomenal experience in general is monophonic. Penrose fails to spell out his views in such a way as to clearly distinguish the latter claim from the former.<sup>3</sup>

One way to make Penrose's position sound more plausible is to recast his discussion in terms of attention, that is, read him as suggesting that *attention* is serial. For there does appear to be a mechanism whereby we can focus on some particular object or aspect of experience. And attention is clearly more restricted than consciousness in general. You are currently subject to a large range of phenomenal states, but your focus is on the task of understanding these sentences. If you shift focus to the sensation of the chair against your body, a process which heightens (but does not create *ab initio*) those very sensations, then your language understanding activities are temporarily, if briefly, suspended. Thus, attention does appear to be a process whereby first one "thing" and then another becomes focal.

But one must be careful here. It is all too easy to slide from the claim that attention is serial to the claim that consciousness is monophonic. And this slide is by no means inevitable. A quite natural view of attention is that it concerns variations *inside* consciousness, implying that the content of focal attention is but one element of total consciousness. Of course, if one denies this, that is, if one rejects this distinction between attention and total consciousness, then one does recover some kind of monophonic consciousness. A supporter of genuine seriality might make just this move, indeed, it is a forced move in the monophonic game. One can hardly have a varying focus *inside* a single-voiced consciousness, since the distinction between focus and periphery is, in part, a distinction between different, but contemporaneous, contents of consciousness. Attentional shifts within a serial stream are *without remainder*, i.e., they correspond to *total* shifts of consciousness from one object to another.

This view of attention is quite prominent in the literature. There have, however, been some important dissenters. In an influential early discussion Ulric Neisser claims that before the processes of focal attention can be brought to bear on particular figures in a visual scene, there are *preattentive* processes whose role is to segregate the figural units which later mechanisms will "flesh out and interpret" (1967, p.89). He then goes on to develop the distinction between *primary* thought processes, which are "rich, chaotic, and inefficient", and *secondary* thought processes - those that are "deliberate, efficient, and obviously goal-directed" (p.297).<sup>4</sup> Neisser

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<sup>2</sup> A possible reply, at this point, is that, while it might seem that we have more than one modality in consciousness at the same time, this is only an illusion generated by very rapid swapping between them. It is hard to take this reply seriously. Apart from being rather *ad hoc* (why would one assert this, unless committed to genuine seriality, come what may), it seems to conflate consciousness and attention (see the remarks to follow).

<sup>3</sup> There is textual evidence to suggest that Penrose may be aware of this distinction. He tells us that "oneness" is a characteristic feature of conscious *thought*, and he has a tendency to refer to "thinking" rather than consciousness (1989, p399).

<sup>4</sup> What Neisser appears to have in mind here is the distinction between the kind of thinking that goes on in dreams and fantasy, and deliberate, purposeful thinking (1967, p.298).

suggests that “the processes of visual cognition, and perception in general, may serve as useful models for...thought”. In particular, he claims that the primary process “constructs crudely formed “thoughts” or “ideas”,” and so functions like preattentive processes, while the secondary process of directed thought is like focal attention; it has the function of elaborating those objects generated by the primary process (pp. 301-304). Now if focal attention and consciousness are one and the same then the primary (or preattentive) processes ought to be unconscious. But Neisser demurs; when it comes to the preattentive processes he remarks that they:

produce...fleeting and evanescent objects of consciousness, crudely defined and hard to remember. If their products are not seized on and elaborated by an executive process of some kind, they have little effect on further thinking and behaviour. (p. 301)

Elsewhere he claims that the products of primary thought “are only fleetingly conscious, unless they undergo elaboration by secondary processes” (p.304).

Thus, Neisser recognizes the existence of a characteristic phenomenology of primary (i.e., preattentive) thought processes. He carefully distinguishes this from the kind of experience associated with focal attention. Later interpreters have not been so careful. George Mandler, for example, initially seems to go along with Neisser’s characterisation:

The products of the primary process alone...are only “fleetingly” conscious unless elaborated by secondary processes. By implication the elaboration by secondary processes is what produces fully conscious events. (1975, p.232)

However, within the space of a few paragraphs he is claiming that the “processes that make up *consciousness* are secondary processes, secondary in elaboration and time to primary, preattentive processes that are *unconscious*...” (p.233, emphasis added). Indeed, he is so bold as to remark that we will “note why Neisser’s contribution is important”, if we “permit the free translation of “attention” into consciousness” (p.232). He thus reconstructs Neisser’s comment that certain activities (such as walking and driving) can be conducted “without the use of focal attention” (Neisser, 1967, p.92), as the claim that “[there] are processes that run off outside consciousness (unconsciously)” (Mandler, 1975, p.232).

Looked at purely as a matter of exegesis, Mandler is clearly getting something wrong here. What Neisser tells us is that the products of preattentive perception and primary thought processes are “fleeting and evanescent objects of consciousness”, which are “crudely defined and hard to remember”. He *does not* say that they are unconscious, indeed he gives us a rough characterisation of the *kind* of conscious phenomenology these processes generate. But, of course, the question remains: is there a genuine distinction between the phenomenology of attention and total consciousness? The answer, we suggest, is yes. Consider a game of tennis. One’s focus, during play, is primarily on the movement of the ball. Even so, one doesn’t entirely cease to perceive other features of the environment (even if they become peripheral), and one is, for example, still host to a complex mix of proprioceptive sensations, without which it would be impossible to maintain posture and balance. Attention serves to heighten some aspects of experience over others; it moves like a searchlight through the phenomenal field, but it doesn’t define that field – there is plenty of phenomenology that falls outside its beam. Penrose actually concedes this when he suggests that “a single consciousness” may be “vaguely aware of a number of things”, and yet be “concentrated at any one time on only one particular thing” (1989, p.399). That is, it is possible to simultaneously focus on one thing and also be aware of other things.<sup>5</sup>

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<sup>5</sup> Neisser proposes that we view attention as “an allotment of analyzing mechanisms to a limited region of the field” (1967, p.88). The idea is to treat attention as a matter of resource allocation; to suppose that there are simply not enough computational resources to permit a detailed inspection of, say, the whole visual field at once. Instead, preattentive processes provide a sketchy analysis, which attentive mechanisms then “flesh out and interpret” (p.89). That is, mechanisms of attention subject information already extracted from the world, and already displayed in the

Despite this, some will argue that there are compelling reasons to identify attention with total consciousness. In particular, it is often asserted that there are a range of “background” phenomena, which enter consciousness only when we focus on them, but are otherwise unconscious. Baars, for example, tells us that

In contrast to your conscious experiences, you are probably *not* conscious of the feel of your chair at this instant; nor of a certain background taste in your mouth, of that monotonous background noise, or the sound of music or talking in the background...(1988, p.3)

These kinds of examples are probably the strongest intuitive ground for treating the contents of consciousness as co-extensive with the contents of attention, since they tend to reinforce the idea that what is outside attention is outside consciousness (you have to *attend* to the feel of your chair to become conscious of it).

But is this the right thing to say about sensations of pressure, or, for that matter, about unattended background sounds? Are they really unconscious? In the case of background sounds, for example, isn't it rather the case that when one first attends to, say, the sound of the cooling fan housed in one's desktop computer, one realizes that this sound has been present in experience for some time? Because unattended, such a sound has not been labelled, or integrated into one's higher thought processes in any way (in conventional language: it has gone “unrecognized”), but it has nevertheless been an ongoing part of total consciousness. Or consider proprioception: the sensory feedback that emanates from one's limbs, creating a sense of their relative positions. Proprioception is even more prone to be relegated to the unconscious background, from which (it is supposed) it can only be retrieved by deliberately focussing on one's body. Yet, we suggest, this sense of body position, like our externally oriented senses, is an ever present feature of experience.

Our consciousness is not monophonic or single-voiced. It is a complex amalgam of many contents, which, for the most part, are so constant that it's easy to take them for granted. We know of the persistence of visual experience, for instance, because we are all familiar with the decrement in phenomenology that accompanies closing our eyes. But most of us require a more striking demonstration than this in order to acknowledge the persistence of proprioception. Sadly, nature occasionally obliges in this regard. Oliver Sacks describes the tragic case of a woman who, due to acute polyneuritis of the spinal and cranial nerves throughout the neuraxis, suddenly loses her capacity to have proprioceptive experiences: “Something awful's happened,” she tells Sacks, “I can't feel my body. I feel weird – disembodied.” (1985, p.44). This woman has *none* of the usual (proprioceptive) feedback from her body. Without it she recognizes (perhaps for the first time) what she had, but has now lost: the feeling of embodiment. Most of us don't realize that we *don't* feel disembodied, but she is in the horrible position of having this realisation forced upon her. The experience of embodiment, like a number of other “background” phenomena, is a constant feature of consciousness.

An advocate of the monophonic conception ignores, or misses, these constants of experience, and in so doing expedites the conflation of consciousness with attention. Once this conflation is rejected, as we've argued it must be, then the seriality of attention can no longer infect total consciousness. We believe these considerations, together with our earlier remarks about the similarly mistaken conflation of consciousness with higher-thought, significantly diminish the appeal of the monophonic conception of consciousness. We are thus in need of an alternative. This brings us to the polyphonic model of consciousness.

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phenomenal field, to more intense processing. Such additional processing perhaps then generates the enhanced phenomenology that accompanies attention shifts. (Ray Jackendoff has suggested a similar account – see his 1987, pp.280-283.)

### 3. The Polyphonic Model of the Unity of Consciousness

It seems that the monophonic conception of consciousness is untenable. Many theorists recognize this, and so prefer to adopt a polyphonic model of the unity of consciousness, in which many “voices” can sound their notes simultaneously. Paul Churchland, for example, advocates just such a model. He includes in his enumeration of the “salient dimensions of human consciousness” the following:

Consciousness harbors the contents of the several basic sensory modalities within a *single unified experience*. A conscious individual appears to have not several distinct consciousnesses, one for each of the external senses, but rather a single consciousness to which each of the external senses contributes a thoroughly integrated part. (1995, p.214)

This corresponds to what we have described as the polyphonic conception of the unity of consciousness, because, while Churchland claims that instantaneous consciousness is a “single unified experience”, he grants that *each* of the external senses contributes a part, so rendering it “polymodal” in character (p.222).

In order to account for this, and a number of other features of consciousness (pp.213-24), Churchland develops the conjecture that phenomenal experience is the preserve of a particular neuroanatomical structure in the brain: the intralaminar nucleus in the thalamus. This structure has axonal projections to all areas of the cerebral hemispheres, and receives projections from those same areas. The brain thus contains a “grand informational loop” that “embraces all of the cerebral cortex”, and which “has a bottleneck in the intralaminar nucleus” (p.215). Churchland claims (albeit tentatively – see p.223) that “a cognitive representation is an element of your current consciousness if, but only if, it is a representation...within the broad recurrent system [of the intralaminar nucleus]” (p.223). This conjecture allows him to account for the fact that “there are several distinct senses but only one unified consciousness”. He does so as follows:

There is one widespread recurrent system with an information bottleneck at the intralaminar nucleus. Information from all of the sensory cortical areas is fed into the recurrent system, and it gets jointly and *collectively* represented in the coding vectors at the intralaminar nucleus, and in the axonal activity radiating outward from there. The representations in that recurrent system must therefore be *polymodal* in character. (p.222)

So information is conscious when it is represented by “coding vectors”<sup>6</sup> that lie within the information loop centring on the intralaminar nucleus. And consciousness is a unity because these “polymodal” vectors are part of a single system.

This account is strikingly similar to the “Global Workspace” model of consciousness developed by Bernard Baars (1988). Baars’ approach begins with the premise that the brain contains a multitude of distributed, unconscious processors all operating in parallel, each highly specialized, and all competing for access to a global workspace – a kind of central information exchange for the interaction, coordination, and control of the specialists. Such coordination and control is partly a result of restrictions on access to the global workspace. At any one time only a limited number of specialists can broadcast global messages (via the workspace), since different messages may often be contradictory. Those contents are conscious which gain access to the global workspace (perhaps as a result of a number of specialists forming a coalition and ousting their rivals) and are subsequently broadcast throughout the brain. (pp.73-118.)

In support of this global workspace model, Baars claims there is a brain structure suited to the role of workspace, namely: the Extended Reticular-Thalamic Activating System (ERTAS), which includes the reticular formation, the thalamus, and the “diffuse thalamic projection

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<sup>6</sup> Churchland seems to have in mind here both firing patterns within neural networks, and patterns of signals passing down axons.

system" (p.124). The latter corresponds to the recurrent loop that Churchland takes to be so significant. The ERTAS is particularly suited to the role of "global broadcaster", given the bidirectional projection system that it incorporates. Moreover, there is "evidence of a feedback flow from cortical modules to the ERTAS" and of global information feeding "back into its own input sources". Baars suggests that "[both] kinds of feedback may serve to strengthen and stabilize a coalition of systems that work to keep a certain content on the global workspace". That is, given the competitive nature of access to consciousness, "a circulating flow of information may be necessary to keep some contents in consciousness" (p.134).

So both Churchland and Baars give informational feedback a pivotal role in their accounts of consciousness. Both identify brain structures that may act as a conduit - a functional bottleneck - through which information passes in order to become conscious (the thalamic projection system and associated structures), and both conjecture that these brain structures realize an executive computational mechanism that guarantees the unity of consciousness. This executive acts as a *composer* and *broadcaster*. Its role is to combine a number of distinct contents hailing from different sense modalities into a single work which it then broadcasts polyphonically. Thus the unity of consciousness, on this story, is not imposed by the *seriality* of the stream of contents broadcast (as would be the case with a monophonic executive), but by the *singularity* of the broadcasting mechanism.

We argued in the previous section that our instantaneous phenomenal experience is typically polymodal in character, so we certainly think that Churchland's and Baars' polyphonic accounts are an improvement over the monophonic model. But these theorists (and others like them)<sup>7</sup> are nonetheless led astray, we believe, by their unquestioning allegiance to the orthodox conception of the unity of consciousness. As a result they overlook a more parsimonious account of consciousness, one that is more consistent with both our moment by moment phenomenal experience and our neuroscientific understanding of the mechanisms subserving cognition.

To see that an alternative account of consciousness is available, we need to explore the phenomenon of polyphony in a little more depth. Recall that choral polyphony involves two or more *simultaneously active* voices, such that at any moment there are a number of different notes being sounded. How might we understand the relationship between the individual voices and their combined product? There are two possibilities. On the one hand we might think of it in terms of the superposition of sound waves, which results in a single complex wave reaching the listener's ear. On this reading, while distinct voices are involved in the creation of the work, the final product is a single structure. On the other hand, we might think of this relationship in terms of the *harmony* between the individual voices. On this quite different reading, the product can exhibit a *coherence* and *connectedness*, even though each of its constituent parts has a distinct and independent existence.

Obviously, it is the first reading here that is more in tune with Churchland's and Baars' polyphonic models. But that still leaves the second possibility. If we adopt this analogy then it is possible to conceive of instantaneous consciousness as a many, rather than as a one. And the sense in which it is "unified" is not that of the orthodox conception, not a matter of *oneness*, but a matter of *harmony* or *coherence*. On this conception, our instantaneous phenomenal experience is a complex amalgam of distinct and separable conscious events; not a serial stream, but a mass of tributaries running in parallel. And it is not the preserve of a single, executive computational device, but the combined output of myriad consciousness-making mechanisms distributed right across the cortex. On this conception, *pace* Churchland, a conscious individual does not have a "single consciousness", but several distinct phenomenal consciousnesses, at least one for each of

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<sup>7</sup> Other theorists who defend a polyphonic model of the unity of consciousness include: Crick (1984), Johnson-Laird (1988), Newman (1995), Shallice (1988), and Schacter (1989).

the senses, running in parallel. The sense in which it is correct to talk of a “unified” consciousness, one incorporating elements from the different modalities, is that in which the representational contents of the various components *coincide*: we *see* our bodily parts in positions we *feel* them; we *hear* sounds emanating from objects in the direction we *see* them; we *taste* the food that we can *feel* in our mouths; and so on.

We can’t resist employing another musical metaphor here to further distinguish this alternative polyphonic model of consciousness from its more orthodox counterpart. Before the advent of modern studios the only way to record music was to get all the musicians in a room together, place a microphone in their midst, and start up the band. The signal from the microphone would then go through a limited amount of processing before leaving a groove on a wax disc, or more recently, a magnetic trace on a tape. Such a recording is said to be *single-track*, since there is no way to separate out the individual contributions of the musicians – they are packaged into a single structure. By contrast, on a *multi-track* recording one or more separate tracks can be devoted to each musical instrument. As a result, while all the musical parts combine to make up the total sound during playback, *at the level of the recording* one can distinguish between them. This has a couple of benefits for the sound engineer. First, it’s not

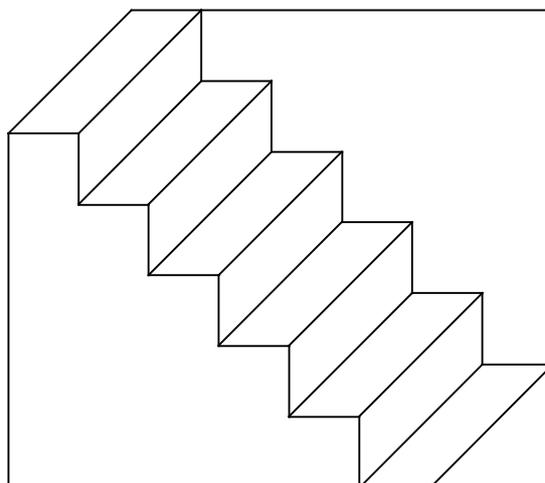


Figure 1. Inverting stairs ambiguous figure.

necessary for the musicians to record their parts at the same time. As long as they play to a common click-track the musicians will be “in synch” with each other. Second, during playback the various parts or voices can be independently brought in and out of the mix so as to assess their individual contributions to the total sound. Churchland’s model of consciousness is equivalent to single-track polyphony: all of the different contentful elements are packaged together within a “single unified experience” (1995, p.214). But there is clearly room in logical space for a *multi-track* polyphonic conception of consciousness. In what remains, we’ll suggest that the evidence tends to support the latter.

Consider, first, the phenomenological evidence. Close attention to our instantaneous experience reveals it to be a complex *aggregate* of many elements – a sum of relatively independent parts. Right now, for example, as you concentrate on these sentences, your phenomenal experience is a very complex affair: visual experiences (the shapes, textures and colours of these sentences, together with other objects in the room), auditory experiences (noises from outside the room), tactile experiences (the chair pressing against your body), proprioceptive experiences (the position of your limbs), and understanding experiences (what these words and sentences mean), to name a few, together comprise your instantaneous

*phenomenal field*. These parts are independent because they are distinguishable in experience, and because any one of them can be removed or lost without affecting the others (try closing your eyes for a moment). They are like the parallel tracks on a multi-track recording – each track adds to the mix, but, since they run side by side, the loss of any one track doesn't affect the others, it merely reduces the total sound.

This independence among the parts of experience is even evident, to some extent, *within* modalities. Consider Figure 1. It can be seen as a flight of stairs in normal orientation, with rear wall uppermost; as an inverted flight of stairs, with front wall uppermost; or even as a flat line drawing, with no perspective. And whichever of these interpretations one adopts, the details of line and space remain the same. That is, our experience here incorporates not only lines, and regions, but also some abstract phenomenology (in this case, *a sense of perspective*), phenomenology which is subject to a degree of voluntary control. Or consider Figure 2. Whether one interprets it as a vase (dark figure, light background), or as a pair of faces (light figure, dark background), there is no change in the experience of tone and line itself. Again there is some primary visual experience (i.e., the experience of lines, boundaries, light and dark regions), to which an additional variable element of abstract phenomenology is added (in this case, *object recognition*). What is striking in both these cases is the looseness of fit between the more abstract and the more concrete parts of experience. It seems that, like a sound engineer, we have some capacity to control which parts go into the mix, and how they will sound.

The real force of this phenomenological evidence for multi-track polyphony only fully

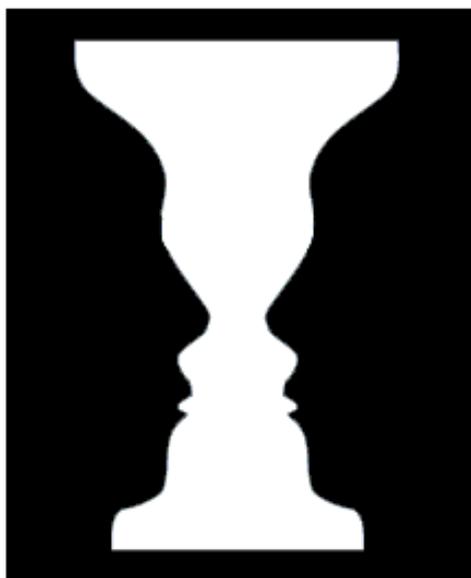


Figure 2. Vase/Faces ambiguous figure.

emerges when it is conjoined with the available neuroscientific evidence. We know, on the basis of deficit studies, that the information processing that supports conscious experience is realized in structures distributed right across the brain. And the distributed nature of this information processing is both an intra-modal and an inter-modal affair. Consider, again, our visual experience. Recent work in the neurosciences has shown that visual processing is highly modularized; the visual cortex appears to contain separate subsystems for the processing of information about colour, shape, depth and even motion. When any one of these subsystems is damaged, the particular element of visual experience it supports drops out, more or less independently of the others. Take motion perception for example. Semir Zeki relates the case of a

woman who, due to a vascular disorder in the brain which resulted in a lesion to a part of the cortex outside the primary visual area, lost the ability to detect motion visually. This was so severe that,

She had difficulty, for example, in pouring tea or coffee into a cup because the fluid appeared to be frozen, like a glacier. In addition, she could not stop pouring at the right time since she was unable to perceive the movement in the cup (or a pot) when the fluid rose. The patient also complained of difficulties in following a dialogue because she could not see the movement of...the mouth of the speaker. (Quoted in Zeki, 1993, p.82)

Zeki notes that this was not a total defect in the appreciation of movement "because the perception of movement elicited by auditory or tactile stimulation was unaffected" (p.82). Moreover, her perception of other visual attributes appeared to be normal. Similarly striking case studies are available in relation to the loss of colour sensations (see, for example, Sacks 1995, pp.1-38).

What these kinds of case suggest is that consciousness depends entirely on a multitude of distributed mechanisms. The deficits and dissociations that sometimes occur in experience are to be explained entirely in terms of damage to these localized content-fixing mechanisms, and not in terms of the failure of informational contents to be passed on and re-presented elsewhere in the brain.<sup>8</sup> There are echoes here of Daniel Dennett's multiple drafts theory of consciousness (1991, 1993). Dennett, like us, resists the idea that there is a single stream of consciousness, claiming that there are instead "multiple channels in which specialist circuits try, in parallel pandemoniums, to do their various things, creating Multiple Drafts as they go" (1991, pp.253-254). He further rejects what he calls the "Cartesian theatre" model of consciousness; the idea that there is a single structure or system in the brain where the contents of consciousness all come together for the delectation of the mind's eye. Consciousness, instead, is the result of processes (Dennett calls them "microtakings") distributed right across the brain.<sup>9</sup> Thus, Dennett, like us, advocates a multi-track model of consciousness.

To re-iterate: the plurality and neural distribution of cognitive processing modules revealed by deficit studies can be interpreted as evidence for the multiplicity of consciousness-making mechanisms in the brain. This is the hardware implementation of multi-track polyphonic conscious experience. Just as with the separate codings of the various voices on a multi-track recording, it accounts for the relative independence of the various strands of experience, and the "looseness of fit" between abstract and more concrete experiences within modalities.

Now, the evidence we have presented so far might, at a stretch, be made consistent with a single-track reading of polyphony. For example, a single-track theorist could argue that the deficits in consciousness experienced as a result of localized cortical ablations are due to the relevant contents never being passed on to the executive system. However, the multi-track reading does seem more parsimonious, given that it doesn't require an additional, executive

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<sup>8</sup> For more neuro-psychological evidence pointing to the distributed neural basis of consciousness, see, e.g., the papers in Milner & Rugg 1992.

<sup>9</sup> Given all this, it is initially surprising to find Dennett eventually concluding that a conscious human mind is a "more-or-less serial virtual [machine] implemented - inefficiently - on the parallel hardware that evolution has provided for us" (1991, p.218). This "von Neumannesque" virtual machine, he tells us, is "a product of cultural evolution that gets imparted to brains in early training"; "an organized and partly pretested set of habits of mind", whose major structural characteristic is "serial chaining, in which first one "thing" and then another "thing" takes place in (roughly) the same "place"." (pp.219-221.) However, Dennett's frequent use of the formulations "human consciousness" and "conscious human minds" when discussing the seriality issue, suggests that he wants to distinguish this serial form of consciousness (a *component* of human experience; what earlier in the paper we termed "higher thought"), from consciousness more generally (large chunks of which are phylogenetically prior to the phenomenology of symbolic thought).

consciousness-making system over and above the distributed information-processing modules that we know to exist in the brain. Moreover, there is a further source of evidence that supports the multi-track story. On the kind of model that Churchland and Baars are developing, the executive consciousness-making system is not just a polyphonic *broadcaster*, it is also a *composer*. Its role, remember, is to combine a number of distinct contents hailing from different sense modalities into a single work which it then broadcasts polyphonically. The process of bringing a particular content to consciousness and the process of making that content part of a coherent experience, therefore, *are one and the same*. The coherence of representational content would thus seem to be a necessary, not a contingent, feature of single-track consciousness.<sup>10</sup> But, and here's the rub, cases of incoherent consciousness do occur, both intra-modally and inter-modally.

An example of intra-modal incoherence occurs in the peculiar visual phenomenology experienced by subjects recovering from damage to striate cortex. Here a definite sequence is followed in which the different visual elements that normally come together in an integrated package (i.e., colour, shape, depth, and motion), individually "reappear". But what is particularly interesting are the disharmonies that occur during this recovery sequence:

At first the patient will see pure motion (usually rotary) without any form or colour. Then brightness perception returns as a pure Ganzfeld – a uniform brightness covering the whole visual field. When colours develop they do so in the form of 'space' or 'film' colours not attached to objects. The latter develop as fragments which join together and eventually the colours enter their objects to complete the construction of the phenomenal object. (Smythies 1994, p.313)

Note that the normal binding of colour and form to produce coherent objects is initially absent here, but *not* as a result of central damage; the damage involved is relatively peripheral. The existence of these kinds of experiences clearly militates against an approach that seeks to make coherence a necessary feature of consciousness.

A nice example of inter-modal incoherence is found in subjects who experience *synesthesia*: the involuntary stimulation of sensation in one modality by input to another. Most commonly this takes the form of "hearing colours", in which colour sensations are evoked by sounds. Each subject reports a consistent and reproducible pattern of colour/sound associations, although there are few similarities across subjects. Michael, whose case is documented in *The Man Who Tasted Shapes* (Cytowic, 1993), has a more unusual form of synesthesia in which tactile sensations are generated in response to tastes. These sensations are experienced as notional objects, close to the body, which Michael can literally reach out and touch. The following is reported by Cytowic immediately after giving Michael a shot of Angostura bitters (conducted as a blind test).

He shivered past the bitter part and spoke quickly. "Yes, the round part comes first, with a spongy texture," he said, tracing a curve with both hands this time. "Then the shape develops – I feel the holes now," he said, closing his fingers. "Here are the strands. A little thread. It gets bigger, like a rope. If I pull my hand along one its feels like oily leaves on a short vine." (p.65)

What is important about this, for our purposes, is that there is *no* seen object corresponding to the felt object that Michael describes, and hence no accord between the visual and tactile modalities. Thus, synesthetes exhibit a certain amount of inter-modal incoherence – a breakdown in the normal pattern of connections between the parts of experience.

While these cases of incoherent consciousness create a problem for the single-track polyphonic model of consciousness, they are just what one would expect to find on the multi-

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<sup>10</sup> This is something that Baars, at least, is quite explicit about. He argues that only *compatible* contents can enter the global workspace, and hence be simultaneously broadcast. If incompatible sensory contents, say "a speech sound in the left ear, and...a falling glass in the right visual field", compete for access to the limited capacity global workspace, then "only one of the two can be broadcast at any moment, because they conflict in spatial location and content, so that the two simultaneous cortical events cannot be fused into a single, consistent conscious event" (1988, p.126).

track reading. On this alternative account, the coherence of representational content will depend, among other things, on the connectivity relations between the distributed consciousness-making mechanisms. Consequently, it is not surprising to discover pathologies that disturb these connectivity relations, and hence lead to the incoherencies that we have described.

#### 4. Conclusion

The phenomenological and neuroscientific evidence suggests that human consciousness is not a unity, but *manifold* and *distributed*. It is manifold because our instantaneous experience is a very complex aggregate state composed of a large number of distinct and separable phenomenal elements. And it is distributed because there are multiple sites of consciousness-making scattered throughout the brain. In the face of this evidence it's surprising that the multi-track polyphonic model of consciousness is not more popular. Why do so many theorists insist that we need a single, resource-expensive, executive system in order to account for phenomenal experience, when there is a more parsimonious model to be had?

The answer, of course, is that most theorists are committed to the orthodox conception of the unity of consciousness. And if one insists that instantaneous consciousness is just *one thing*, then one must suppose there is a single consciousness-making mechanism that gives rise to it. Allegiance to this conception of unity can be explained, in part, by the confluences against which we earlier counselled (see section two). If instantaneous consciousness corresponds with higher thought, or with attention, then, *prima facie*, it is monophonic, and hence unitary. We have rejected these confluences, because they involve treating just one aspect of experience as if it were the whole. But there is, we suspect, another source of the single-track approach, one that explains why even polyphonic theorists tend to regard consciousness as a single thing. It is the widespread acceptance of a view that identifies consciousness with our phenomenal sense of being a single subject (our sense of *subject unity*).

Your conscious experiences do not just occur, they occur *to you*. The multifarious perceptual and understanding experiences that come into being as you read these words are somehow stamped with your insignia – they are yours and no-one else's. Somehow your brain manages to generate a *single* ongoing cognitive subject (a "self"); an entity to whom these individual experiences "belong" or whom these experiences somehow "constitute". One can only speculate as to how the brain does it. Perhaps this sense of subject unity arises out of our ongoing personal narrative, the story we tell about ourselves, and to ourselves, practically every waking moment. This narrative, a product of those centres responsible for natural language comprehension and production, comprises a serial stream of self-directed thought (one that non-language using animals presumably lack). Or perhaps it is connected with our experience of a single, cross-modal *point of view*. This point of view arises independently in every mode of experience, because each of them encompasses a space with a privileged focus, a point with respect to which every content is located, but its commonality or confluence across modes might give rise to our sense of unity.

However the brain does it, though, it is a mistake to identify consciousness with this phenomenal sense of subject unity. To identify consciousness with our personal narrative, for example, repeats the mistake of the monophonic theorists, because it involves mistakenly conflating one aspect of experience with a more complex whole. And while the various senses clearly do share a common point of view, they remain a plurality, since each sense carries its own, phenomenally distinct version of that point of view. The unity of the cognitive subject, in short, should not be illicitly transferred to consciousness.

It is time therefore to jettison the traditional doctrine of the unity of consciousness. While there is a sense in which it is correct to talk of instantaneous consciousness being "unified", it is merely that of *coherence*, not that of *oneness*. Once we accept the multiplicity of consciousness, once we accept its disunity, then we no longer need to search for an executive computational

device in the brain that broadcasts in either monophonic or polyphonic mode. What we need instead is a multi-track polyphonic model of consciousness; a computational model that acknowledges both the manifold nature of experience, and its distributed neural basis. What this model might look like, however, is a task for another time.<sup>11</sup>

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<sup>11</sup> Our own conjecture as to what such a multi-track, polyphonic, computational model of consciousness might look like can be found in O'Brien and Opie forthcoming.