Building Minds: Solving the Combination Problem

by Pat Lewtas

Abstract: Any panpsychism building complex consciousness out of basic particles of consciousness must explain how this composition goes. It thus faces the combination problem – the intuition that distinct subjects, with their distinct phenomenal fields and experiences, can't merge because of their *essential* isolation. And here critics have in mind the features of subject-hood underlying the problem of other minds. This paper maintains that the combination problem does not in fact prevent "mental chemistry". It considers the case of split-brain patients, arguing that they provide either actual instances of mental chemistry, or at least reasons for thinking it possible. The paper next develops constraints on any theory of mental chemistry – drawing upon results scientific and philosophical – which force ideally a unique account but at least a much narrowed range of accounts. It then puts forward models of mental chemistry which satisfy these constraints. The paper purports to solve the combination problem, where others have judged it insurmountable, only through the insight that mental chemistry *necessarily* involves transformation consistent with conservation of consciousness rather than aggregation followed by the creation of something in addition. Not only does this kind of mental chemistry uniquely yield a workable panpsychism. More, any other involves property emergence, which, the paper argues, deprives panpsychism of all warrant. Finally, the theory of mental chemistry offered here enables panpsychism to overcome the panpsychist version of the grain problem.

Most philosophers dismiss panpsychism out of hand. Some find it preposterous that basic physical objects have experiences, while others doubt that little minds could build big minds. These concerns hobble the view no matter how powerful the arguments for it. This paper argues that smaller minds can indeed sum; and it sketches the beginnings of a theory of "mental chemistry" – Nagel's (1979) term for the processes by which bottom-level experiences, subjects and phenomenal fields yield higher-level experiences, subjects and phenomenal fields. A companion paper explores the kind of consciousness basic physical objects have. Together, these papers show that panpsychism commits its supporters to doctrines nothing less than reasonable and fruitful.

Panpsyhism results from the conjunction of three claims: (1) consciousness exists as a property of physical objects (which rules out substance dualism); (2) consciousness doesn't reduce to anything non-conscious (which rules out physicalism); and (3) higher-level consciousness (token) reduces to basic properties of basic bottom-level entities (which rules out radical emergentism).[1] [2] Three tenets

[1] Panpsychism claims this of all entities, not just consciousness.

follow immediately: (1) basic conscious properties (i.e. basic experiences) characterize basic bottom-level physical objects; (2) higher-level experiences are built from basic experiences; and (3) these higher-level experiences characterize non-basic physical objects. A fourth tenet doesn't follow directly, but fits with and fleshes out the other three: (4) the structure of a non-basic object determines whether and how that object performs mental chemistry. These tenets entail that some, but not necessarily all, basic physical objects have experience. They don't entail that all non-basic physical objects have experience. Maybe brains, but not rocks, have structures that perform mental chemistry. Note that panpsychism is an explanatory theory: it aims for the best explanation of high-level consciousness.

I

We begin with some terms, concepts and a framework.[3] This paper understands a basic entity as a basic building block not composed of anything else. That makes a basic property a type of basic building block. Think of a quark's mass or an electron's charge.[4] Call these *strictly-basic* properties.

Composite entities, including composite properties, do consist of other and more basic entities. It helps to distinguish three types of composite properties: *compositely-basic*, *mixed*, and *non-basic*. A property is *compositely-basic* iff (1) its instances result (only) from instances of one strictly-basic property A; and (2) its instances confer all but only the same kinds of characteristics, powers and susceptibilities conferred by instances of A (except insofar as (3) its characteristics, powers and susceptibilities are affected by the spatio-temporal distribution of the A-instances). (The paper shortly defines "results-from" and "results-in". For now, understand them, respectively, as *arises from because consisting of* and *gives rise to because constituting*.) Think of your mass or a towel's electric charge. Note that a compositely-basic property differs from its strictly-basic constituents in that (1) its values exceed the values of its constituent strictly-basic constituents (e.g. the compositely basic mass of a

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2 Believers in gunk can replace "property whose instances obtain at the bottom-most level" with "property for which there is no level below which instances of it don't obtain". And so on.

3 Much of this the author develops elsewhere.

4 Some physical theories treat mass and charge as non-basic properties. The paper's example assumes otherwise.

planet exceeds the strictly basic mass of one of its quarks); (2) its values can vary over time (e.g. the compositely basic mass of a binge dieter yo-yos); and (3) it confers traits that can depend on how the relevant object sits in space and time (e.g. your center of gravity, a mass-property, changes as you spar).

A property qualifies as *mixed* iff (1) its instances result from instances of more than one type of strictly-basic property; but (2) these strictly-basic properties fall within the same family of strictly-basic properties. Because this definition involves stipulation (of sameness of family), it can't reliably single out a metaphysical type. This paper uses "mixed properties" to refer to composite *conscious* properties that result (only) from two or more types of strictly-basic conscious properties. (By contrast, a compositely-basic conscious property results from only one type of strictly-basic conscious property.)

N*on-basic* properties include all properties neither strictly nor compositely basic.[5] A non-basic property either (1) results from more than one kind of strictly-basic property; or (2) confers a characteristic, power or susceptibility of a kind different from those conferred by instances of any of the strictly-basic properties that result in it.[6] Wetness, for example, results from strictly-basic charge properties together with other properties of both the objects making up the liquid and the objects making up the wet thing. Furthermore, wetness confers traits of kinds different from those conferred by strictly-basic charge.

A simple property confers a single (kind of) characteristic, power or susceptibility. Recall strictly-basic mass.[7] A complex property confers more than one (kind of) characteristic, power or susceptibility. Think of the saltiness of blood.

This paper treats one type of experience A as *basic with respect to* another type of experience B when (1) we don't, and don't see that we could, see how instances of A could result from instances of

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[5] We can choose whether to treat mixed properties as non-basic. This definition does. It doesn't matter so long as the metaphysics remains clear.

[6] These conditions are coextensive. Why? Anything else involves both property emergence and an explanatory gap. Section V justifies those claims and explains why panpsychism can't accommodate either emergence or gap. Obviously this paper adopts a framework consistent with panpsychism.

[7] General relativity entitles us to identify inertial and gravitational dispositions.

B; and (2) we don't, and don't see that we could, see how instances of A and B could both result from experience(s) of the same type(s) C. For example, it seems plausible that any experience from one sensory modality (e.g. red-experience) is basic with respect to any experience from another sensory modality (e.g. salty-taste-experience). This paper later justifies the use of the explanatory gap as a criterion for the absence of a results-from/results-in relation.

The paper presupposes universal constitutive supervenience. We say that high-level entities B constitutively supervene on lower-level entities A when the B entities are built (only) of A entities. We say that constitutive supervenience holds universally when all high-level entities constitutively supervene on basic bottom-level entities. Universal constitutive supervenience ensures that all tokens/instances of high-level entities are identical to, and not merely correlated with, spatio-temporal arrangements of tokens/instances of basic bottom-level entities. It thus guarantees the asymmetric dependence of all high-level entities on basic bottom-level entities.

The paper uses *results-from*/*results-in* to encompass the ways a high-level entity B can relate to lower-level entities A such that B is nothing over and above A. The results-from/results-in relation covers relations like identity, composition, realization, etc. It holds (only) where constitutive supervenience obtains. Of course, A-entities can result from B-entities where B-entities don't compose A-entities, but the constituents of B-entities do.

The paper regards any experience as having three aspects conceptually distinct even if (most likely) metaphysically one. An experience requires a presentation (what is experienced), a subject (what experiences), and conscious awareness (what sets experience apart from the “perceptions” of an electric eye). These are (most likely) one because a subject, as such, *consists* of its conscious presentations. The subject might issue from non-conscious neural processing and ride atop a stew of unconscious drives. But, as a consciousness, it exists as and through its experiences. Experiences relate to their subject, not as contents to container, or vehicles to content, but as parts to whole. The directness/immediacy of experience derives from the metaphysics of identity.

Finally, this paper uses quarks as stand-ins for *conscious* bottom-level physical objects.

II

Mental chemistry builds a single subject having complex conscious properties arrayed in a single phenomenal field.[8] It works upon many basic subjects having strictly-basic conscious properties in many phenomenal fields. It thus crafts single subjects from many, single phenomenal fields from many, and single experiences from many.

A *theory* of mental chemistry must explain how single subjects and single phenomenal fields result from many subjects and many phenomenal fields. It must thus overcome the combination problem – the intuition that distinct subjects, with their distinct phenomenal fields, can't merge because of their *essential* isolation.

Our theory must also explain how complex experiences result from simple experiences. No doubt the brain uses many (and many very complicated) mental-chemical processes for many (and many very complicated) features of experience. Here we focus on three processes needed for most any experience. (1) How mental chemistry *chooses* experiences of a given type, from the many instantiated at the bottom-most level, to feed into a higher-level complex experience. For example, your high-level red-experience might result from bottom-level strictly-basic red-experiences rather than bottom-level strictly-basic salty-taste-experiences. (2) How mental chemistry *places* experiences of two or more distinct types within a complex experience. For example, to build an experience of red stripes interleaved with yellow stripes, mental chemistry must first choose strictly-basic red-experiences and strictly-basic yellow-experiences, then place them into a striped mosaic. (3) How distinct strictly-basic experiences *blend* to yield mixed experiences. For example, to get an orange-experience, mental chemistry might need to choose strictly-basic red-experiences and strictly-basic yellow-experiences,

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[8] Why think a subject unified? Single overall experiences are experienced all at once from one point of view. Could this unity be illusory? An illusion of what? See Tye 2003, p. xii and chapter 1.

then blend them into a mixed orange-experience. Here our theory confronts the *blending problem*: the worry that orange qualifies as a basic type of experience even though we can make orange paint by mixing red paint with yellow. In section XI we see that panpsychism must either overcome the blending problem or shoulder the staggering costs of no blending.

III

Seager (1999) identifies the combination problem as the "the problem of explaining how the myriad elements of "atomic consciousness" can be combined into a single, new, complex and rich consciousness such as we enjoy" (p. 241). William James (1890/1950) puts the problem forcefully.

> Take a sentence of a dozen words, and take twelve men and tell to each one word. Then stand the men in a row or jam them in a bunch and let each think of his word as intently as he will; nowhere will there be a consciousness of the whole sentence…. (p. 160)

The problem derives from (a misinterpretation of) a subject's inability to directly experience the presentations in another subject's phenomenal field(s) (the same inability that underlies the problem of other minds). Yet the walls around a subject would have to melt for mental chemistry to happen. Most philosophers see something of a contradiction here. Note that James' point depends on his assumption that the separate individual thoughts coexist with the overall combined thought.

James offers a second and different statement of the problem.

> Where the elemental units are supposed to be feelings, the case is in no wise altered. Take a hundred of them, shuffle them and pack them as close together as you can (whatever that might mean); still each remains the same feeling it always was, shut in its own skin, windowless, ignorant of what the other feelings are and mean. There would be a hundred-and-first feeling there, if, when a *group* or series of such feelings were set up, a consciousness *belonging to the group as such* should emerge. And this 101st feeling would be a totally new fact; the 100 original feelings might, by a curious physical law, be a signal for its *creation*, when they come together; but they would have no substantial identity with it, nor it with them, and one could never deduce the one from the others, or (in any intelligible sense) say that they *evolved* it. (p. 160)

Here James speaks of a combination problem *within* a mind. He suggests that each feeling has features of subject-hood – "shut in its own skin, windowless" – preventing the traffic between feelings that mental chemistry requires. He allows that a new feeling might radically emerge from the original 100.

But he rightfully denies that it would thereby result from them. Note that James' point depends on his assumption that, when feelings A and B at t_1 trigger the creation of feeling C at t_2, then at t_2 all three feelings exist together.[9]

James' first statement of the combination problem points to the difficulty of combining subjects A and B to yield subject C. His second statement points to the difficulty of combining feelings A and B within subject S to yield feeling C also within S. This paper addresses both problems and also a hybrid third: how experience A in subject S and experience B in subject T combine to produce experience C in a subject produced by combining subjects S and T.

IV

Many have wondered about the experiential lives of split-brain patients (veterans of commissurotomies – operations severing the corpus callosum, which connects left and right hemispheres allowing high-level communication between them[10]). Tye (2003) summarizes academic and clinical opinion.

> It has been variously suggested (a) that split-brain subjects are really two persons with two separate minds; (b) that the responses produced by the right hemisphere are those of an unconscious automaton; (c) that it is indeterminate how may persons split-brain subjects are and that the concept of a person is thrown into jeopardy by the experimental results; (d) that split-brain subjects have a unified phenomenal consciousness but a disunified access consciousness; (e) that split-brain subjects are single persons who undergo two separate streams of consciousness that remain two from the time of the commissurotomy; (f) that split-brain subjects are single persons whose phenomenal consciousness is briefly split into two under certain special conditions, but whose consciousness at other times is united. (pp. 111 – 113)

Tye favors the last.

> The conclusion I draw is that...split-brain subjects are single persons whose consciousness is unified except in certain very special experimental situations. On those

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[9] Everyday experience gives some reason to doubt this assumption. We often seem to witness breaches in the walls around feelings even if we never directly observe breaches in the walls around subjects. Thus, for example, pleasure seems to merge with fear to produce a thrill replacing both.

[10] This leaves the hemispheres connected through mid-brain structures letting them communicate indirectly and share certain emotional states (Dennett 1991, p. 423). Dennett (ibid, p. 198) describes a patient whose right hemisphere wanted to say "pencil." It had to bring the speech-responsible left hemisphere onside. So the hand it controlled jabbed a pencil into the hand whose sensations the left hemisphere felt.

> occasions, their stream of consciousness splits into two, which rejoin again once the experimental controls are removed – just as a river sometimes splits into two separate channels around islands, channels that merge again afterward. (p. 128)

Dennett (1991) acknowledges that most philosophers and many primary researchers believe split-brain patients have separate minds (p. 424). Yet he settles on an interpretation like Tye's.

> For brief periods during carefully devised experimental procedures, a few of these patients bifurcate in their response to a predicament, temporarily creating a second center of narrative gravity. A few effects of the bifurcation may linger on indefinitely in mutually inaccessible memory traces, but aside from these actually quite primitive traces of the bifurcation, the life of a second rudimentary self lasts a few minutes at most, not much time to accrue the sort of autobiography of which fully fledged selves are made. (p. 425)

Consider two scenarios: (1) the standard, which accords split-brain patients separate streams of consciousness; and (2) Dennett's and Tye's, which accords them single streams that split briefly during artful experiments. Focus first on (1). Suppose a surgeon performs a commissuroplasty rejoining the hemispheres. What results? Perhaps the reconnection shorts out consciousness. Perhaps the patient suffers a chaos of presentations. Perhaps the two streams carry on in defiance of the restored linkages (as brains ignore optical information after prolonged blindness). Perhaps the two streams persist, but with James' "windows" into one another. Perhaps the hemispheres war over brain and body. But maybe – and maybe most plausibly – the brain relearns its old ways. The patient recovers a single integrated consciousness, albeit perhaps gradually.[11] Even if you don't judge this outcome the *most* plausible, you likely don't find it *im*-plausible.

What experiences would our patient have? We'd expect them to differ from the experiences of his former "halves". We'd expect them to differ – maybe markedly – from the additive sum of those earlier experiences. The commissuroplasty hasn't thrown two sets of experiences into a single container. It has created a single experience-generating machine by integrating two separate experience-generating machines. It therefore shouldn't surprise us to discover the restored mind

[11] What memories would the patient have? From before the commissuroplasty? From before the original commissurotomy?

capable of experiences beyond the divided minds (just as it shouldn't surprise us to discover the divided minds capable of experiences beyond the restored mind). If the patient enjoyed a balanced mood before the original commissurotomy, but had a depressed left-hemisphere and a carefree right-hemisphere after, we shouldn't marvel if the commissuroplasty restored a balanced mood. Other outcomes wouldn't astonish either. But we wouldn't expect a single mind with two inconsistent moods running in parallel, or a mind that flip-flopped between sadness and joy.

We can think about the outcome diachronically and synchronically. From the diachronic outlook, we have two relatively simple objects, each supporting (what is probably) a relatively simple consciousness, combining to form a more complex object supporting (what is probably) a more complex consciousness. Either two subjects merge to become one, or else cease to exist when a third results from them. From the synchronic outlook, we have a composite object which supports a single consciousness and single subject because it contains as parts two objects which, if unconnected, would support separate consciousnesses and separate subjects.

If you find this plausible, you admit the possibility of mental chemistry – of overcoming the combination problem. In this case James' intuitions don't attack mental chemistry *per se* so much as bad ways of going about it. It won't do to stand twelve men in a row or jam them in a bunch. Nor will it help to slop two hemispheres into a jar. But reconnecting those hemispheres by way of a restored corpus callosum might do the trick.[12] Now, if we countenance mental chemistry at the level of human brains – where complexity likely renders the outcome exquisitely sensitive to detail – we have no principled reason for dismissing it at lower levels.

Now focus on the second scenario, where the split-brain patient has a single consciousness that briefly splits in contrived situations. Here we witness actual mental chemistry. The patient's

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[12] What would happen if we connected Sally's left hemisphere to Irma's right? Probably something sad. Similarly, we likely couldn't integrate your mind and mine by connecting our brains via something like a corpus callosum. To get a coherent whole, we'd likely have to break our minds down into more basic parts, then integrate the structures responsible for them. We likely wouldn't end up with anything much like the old you or the old me.

abnormality doesn't interfere with everyday mental integration. But the weird situation shuts down the usual integrating mechanisms and causes the patient's consciousness to divide. When the experiment ends, the integrating mechanisms kick back in. The separate streams merge to create a unified mind out of two pre-existing separate minds.

Although dissolved, the combination problem still holds important lessons. It suggests that mental chemistry happens only when lower-level conscious objects are appropriately *integrated*. This reinforces panpsychism's fourth tenet: that the *structure* of a non-basic physical object determines whether and how mental chemistry occurs. By the same token, the combination problem suggests that mental chemistry doesn't involve an aggregation of subjects/experiences, but rather their transformation, integration and unification. This means that a high-level subject/experience *can't* exist alongside the lower-level subjects/experiences from which it results. The lower-level subjects/experiences lose their identities, their separate existences, when mental chemistry acts upon them. Mental chemistry thus works like the metamorphosis of caterpillar to butterfly. The caterpillar, as such, loses its existence as the butterfly results from it. It serves merely as raw material from which the butterfly is built.[13]

V

This paper lays down constraints on a theory of mental chemistry. These force, ideally a unique account, but certainly a narrowed range of accounts. The paper justifies these constraints – sometimes proving them, always motivating and supporting them. Some constraints come from science. We want strictly-basic conscious properties that resemble strictly-basic physical properties, in their higher-order features at least. Otherwise we end up with a fragmented account of the world. Worse, our account could accommodate almost any sort of bottom-level consciousness. Similarly, we want lower-level conscious properties that result in higher-level conscious properties more or less the same way(s)

[13] These reflections show, incidentally, that panpsychism needn't attribute human-like minds/experiences to basic objects. It need only attribute the basic ingredients from which human-like minds/experiences result.

lower-level physical properties result in higher-level physical properties. Other constraints come from panpsychism. We need strictly-basic conscious properties that result in the kinds of experiences you and I enjoy. Still other constraints come from panpsychism's epistemological warrant. Panpsychism requires that higher-level consciousness reduce to bottom-level entities. But we have no reason to think consciousness reduces if property emergence occurs.[14] So our theory must forswear emergence. Similarly, if panpsychism posits bottom-level consciousness only to explain high-level consciousness, but contains explanatory gaps, then it fares no better than physicalism. On the assumption that physicalism has greater *prima facie* plausibility – on grounds of simplicity, etc. – we should prefer panpsychism only if it provides a *better* explanation. So our theory won't tolerate explanatory gaps. (This, by the way, justifies section I's use of the explanatory gap as a criterion for the absence of a results-from/results-in relation.)

The companion paper – about bottom-level consciousness – follows the same method. Here we build upon the constraints developed there (listed below without justifications).

Constraint 1: Panpsychism should attribute to basic physical objects all but only those types of experiences needed to explain higher-level consciousness.

Constraint 2: Panpsychism must eschew explanatory gaps.

Constraint 3: Panpsychism must eschew property emergence.

Constraint 4: Maximum possible complexity of experience varies with complexity of physical structure. "Structure" includes processes and activities – structures spread through time.

Constraint 5: Basic physical objects are perfectly simple. They lack parts, structure and internal processes.

Constraint 6: Where possible and appropriate, panpsychism should posit strictly-basic conscious properties similar, in their higher-order (i.e. structural and behavioral) features, to strictly-basic physical properties.

Constraint 7: Basic objects with strictly-basic experiences have them constantly and continuously. (This holds only of basic objects not part of mental-chemical structures. See below.)

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[14] If properties can emerge from suitable lower-level circumstances without resulting from them, then we have no reason to think consciousness couldn't arise in the same way – and thus without having to be built from bottom-level entities.

Constraint 8: Each basic experience-type, through its strictly-basic instances, characterizes (at least some) basic physical objects.

Constraint 9: There are fewer types of basic physical object than types of strictly-basic experience.

Constraint 10: All tokens of a given basic physical object type have the same strictly-basic properties.

VI

The companion paper argues that the above constraints entail a unique account of quark-consciousness. (1) Quark-consciousness is simple. A quark has an unstructured experience of a single basic experience-type. (2) Quark-consciousness is constant, continuous and independent. A quark has experiences as a stable consequence of its intrinsic nature. The quark doesn't perceive or respond to conditions external to its phenomenal fields.[15] The quark's experiences present but don't represent. (3) Quark-consciousness is multiple. At least some basic physical objects simultaneously experience instances of a plurality of distinct basic experience-types. Each such experience occupies its own wholly-separate phenomenal field with its own wholly-separate subject.

VII

This paper builds upon the following additional constraints.

Constraint 11: Consciousness is a conserved quantity. It can neither be created nor destroyed.

This constraint combines quantitativeness and conservation. Quantitativeness says that consciousness comes in amounts. You have a determinate amount, a lizard less, a quark a minimum.[16]

Justification: (1) Mental chemistry presupposes quantitativeness. A process can't build a whole out of ingredients unless each ingredient is less than or smaller than the whole. Otherwise we lose the metaphysical contrast between a building-relation (where the whole results from the ingredients) and an emergence-relation (where the whole has features over and above the ingredients), contrary to Constraint 3 (anti-emergence). (2) Quantitativeness follows from Constraint 6 (conscious/physical property resemblance) together with the quantitativeness of physical properties. (3) Our intuitions support the constraint. We think of a mouse's consciousness as smaller than a human's. We speak of brain-damaged patients as having lost some consciousness.

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[15] Subject to a qualification set out below.

[16] It follows that consciousness isn't a vague property.

Constraint 11 also states that consciousness is conserved – that it can neither be created nor destroyed.

Justification: (1) If consciousness isn't conserved, then new amounts are created *ex nihilo* or existing amounts are destroyed *ad nihilo*. But both processes/events involve property emergence, contrary to Constraint 3. (Emergence involves destruction *ad nihilo* because emergent properties disappear *ad nihilo* when their subvenient bases cease to obtain. Destruction *ad nihilo* involves emergence because such disappearance involves the creation of nothing (taken as a substantive) out of something. But nothing (taken as a substantive) can't constitutively supervene upon something. Nothing (taken as a substantive) stands over and above something.[17]) (2) Panpsychism presupposes mental chemistry (tenet 2), mental chemistry involves building, and without conservation we lose the metaphysical contrast between building and emerging, in violation of Constraint 3. (3) Most basic physical properties obey conservation laws, so, by Constraint 6 (property resemblance), consciousness should too. (Here we must distinguish basic physical properties like mass-energy and charge that obey conservation laws from basic physical properties like baryon number and parity that don't. Properties like mass-energy and charge exist as basic building blocks whereas baryon number and parity exist as abstract features of micro-physical interactions – natural bookkeeping devices. Conservation laws hold only of building blocks. And, according to panpsychism, consciousness counts as a building block and not a bookkeeping device.)

The paper noted earlier that subject-hood, conscious awareness, and presentation (most likely) come to the same thing. It follows that mental chemistry conserves the *amount* of all three. But it doesn't follow that it conserves their *number*. In fact, mental chemistry *must* conserve the amount of point-of-view-edness (since it obeys Constraint 11) and *can't* conserve the number of points of view (since it merges many subjects into one). Think of small water droplets coming together to make a bigger drop. The total mass-energy remains the same even though the number of droplets and their collective surface area fall. We can compare the walls between subjects, which define the number of subjects, to the surface-films marking off the individual droplets.

Constraint 11 says much. It tells us that lower-level parts lose consciousness when they contribute to the consciousness of a higher-level whole (while leaving open whether they surrender all or only some[18]). It also throws light on changes like falling asleep, waking up, and dying. Falling asleep and dying can't destroy consciousness any more than waking up can create it. Probably death and dreamless sleep turn off the mental-chemical mechanisms responsible for higher-level

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[17] Another argument against destruction *ad nihilo*. If creation *ex nihilo* can't happen (because of Constraint 3 – no emergence), but destruction *ad nihilo* can, then the stock of consciousness should fall through time. But we have no reason to think it has. In fact, most believe the stock grew from nothing to something when complex brains evolved.

[18] We'll see later that some lose all while others keep some.

consciousness. The mental whole de-composes: the lower-level objects recover their former conscious properties. Conversely, mental-chemical mechanisms turn back on when sentient creatures wake up. (This fits with our conclusions about split-brain patients on Tye's and Dennett's understanding of the facts.)

Now a constraint that prevents consciousness from moving about.

Constraint 12: Consciousness can't move from a conscious basic object to a non-conscious basic object in such a way that the latter becomes a free-standing conscious object.[19]

Justification: (1) Strictly-basic physical objects don't seem to change their basic natures.20 Constraint 6 tells us that strictly-basic physical and strictly-basic conscious properties share higher-order features. (2) Strictly-basic properties can't change because they don't have parts. If a strictly-basic property seems to gain a feature, then the new entity is a non-basic composite consisting of the original strictly-basic property plus something else. If a so-called strictly-basic property loses a feature, then the original entity couldn't have been a basic building block in the first place. We lose sight of what it means to be basic if we let strictly-basic properties change. (3) If strictly-basic properties either change or come and go, then property emergence occurs – as creation *ex nihilo* and/or destruction *ad nihilo* – contrary to Constraint 3. (4) Constraint 7 provides that free-standing conscious basic objects have strictly-basic experiences constantly and continuously. It follows that a (free-standing) non-conscious basic object can't acquire consciousness any more than a (free-standing) conscious basic object can lose it.

The next two constraints derive from biology.

Constraint 13: Mental chemistry occurs at many levels, from simple molecules (or atoms or non-basic subatomic particles) to brains. Complex consciousness needn't result from high-level mental chemistry performed on strictly-basic experiences. Complex consciousness can result from mental chemistry at different levels hierarchically integrated.

This constraint combines two ideas: mental chemistry occurs at many levels, and higher-level mental chemistry works upon the results of lower-level mental chemistry.

Justification: (1) Assume that consciousness has or bestows causal powers.[21] Then higher-level consciousness evolved because it enhanced fitness. Evolution typically proceeds by small steps starting from structures/characteristics simple enough to arise by chance.[22] Mental chemistry (in organisms) therefore probably occurred first in very simple structures, the results of which later fed into more complex mental-chemical structures, and so on.[23] (2) The brain apparently evolved by adding new

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[19] The qualification allows non-conscious basic object to "share in" the consciousness of a mental-chemical whole they form part of.

[20] See Ford (2004), p. 100.

[21] See [insert] for an account of mind-body interaction consistent with panpsychism.

[22] See Futuyma (2005), pp. 43 – 66, and Dawkins (1991), pp. 223 – 228.

[23] This assumes mental chemistry didn't evolve by exaptation from already-complex structures.

structures to, and expanding existing structures within, an inherited core.[24] At each stage, tissues serving new functions built upon and connected to tissues serving older functions. Add in the supposition that many of our ancestors had consciousness of one sort or another.[25] All this suggests that new structures performed mental chemistry on the mental-chemical outputs of older structures. (3) Psychologists hypothesize that many human emotions result from blending operations performed on a limited palette of primitive and ancestral emotions.[26]

Constraint 14: Mental-chemical laws (with structure-types in their antecedents and mental-chemical operation-types in their consequents) are simple and modular.

A law's simplicity increases as the entities it refers to decrease in number, number of types, and complexity, and bear fewer and simpler relations one to another. Modular laws govern processes at multiple, and ideally all, levels. Separate justifications follow.

Justification (simplicity): (1) All basic physical laws seem simple.[27] Extending Constraint 6 (property resemblance) to basic laws argues for simple basic mental-chemical laws.[28] (2) Positing complex basic mental-chemical laws leads to a fragmented account of the world. (3) Regardless, some mental-chemical laws must be (relatively) simple, since, by Constraint 13, mental chemistry takes place at low levels where only (relatively) simple laws can govern. (4) High-level mental-chemical laws could preserve simplicity as (a) simple basic laws which apply the same structure-types to all levels; or (b) non-basic resultants of simple basic laws.

Justification (modularity): (1) Parsimony favors a few simple basic laws governing all levels over many basic laws of varying complexity governing the same types of mental-chemical operations at different levels. (2) Basic laws limited to higher levels would have complex antecedents in violation of the simplicity requirement (see above). (3) Modular laws facilitate the evolution of complex consciousness by allowing organisms to apply the same biological inventions to all levels. Otherwise evolution would have to discover new mental-chemical structures as consciousness becomes more complicated. Worse, some of these structures might lack simpler adaptive forerunners, making them unattainable through a process dependant on adaptive intermediate stages.

And a final constraint about place.

Constraint 15: Strictly-basic conscious properties obtain where their instantiating basic objects obtain.

Justification: (1) Anything else would be arbitrary and unmotivated. The experience characterizes the basic object, after all. (2) Anything else would saddle panpsychism with the problems substance dualism faces linking minds and bodies. (3) Constraint 12 (no transfer) makes little sense otherwise.

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[24] See Macphail (1982), pp. 330 – 343.

[25] This supposition on two counts fits well with panpsychism. It tends towards inconsistency to attribute consciousness to quarks, which don't have brains, while denying it to fish, which do. And panpsychism's intolerance of explanatory gaps leaves it averse to changes in kind which supervene only on changes of degree.

[26] See Wade and Tavris (2000), pp. 406 – 408, which surveys research suggesting that fear, anger, sadness, joy, surprise, disgust, contempt and love are basic or *primary* emotions, with other, *secondary*, emotions constructed out of them.

[27] See Ford (2004), pp. 57 – 59. See also the discussion in [insert].

[28] If we understand laws as artifacts recording the dispositional capacities of existing entities, and bear in mind Constraint 6 (property resemblance), then this extension follows straightforwardly.

VIII

Where does mental chemistry put complex consciousness? Constraint 15 (location) sites strictly-basic consciousness with the basic objects that have it. Constraint 12 (no transfer) stops conscious properties from moving to free-standing non-conscious basic objects. Constraint 4 (dependence on complex structure) keeps free-standing basic objects from having complex consciousness. These constraints allow, but don't oblige, complex consciousness to sit with the non-basic object whose conscious parts give rise to it. But any other location runs afoul of Constraint 15's justifications, not to mention panpsychism's overall thrust.[29]

The non-basic conscious object might have parts without conscious properties. It might also have conscious parts whose experiences don't feed into the overall experience. So complex consciousness characterizes the object that *contains* the basic objects whose conscious properties result in the overall experience. Thus a brain, or brain region, can instantiate complex consciousness even if, say, its quarks have strictly basic conscious properties but its electrons don't.

Because experience, subject and phenomenal field (most likely) come to the same thing, complex consciousness locates experience, subject and phenomenal field together.

IX

Recall that bottom-level consciousness is multiple (section VI): at least some basic physical objects have a plurality of experiences of distinct basic types; and each such experience occupies its own wholly-separate phenomenal field with its own wholly-separate subject. A non-basic conscious object must therefore (be able to) *choose* which strictly-basic conscious properties feed into its overall experience. Thus structures in the visual cortex must choose visual experience-types and not olfactory experience-types. Choosing is fairly straightforward: the relevant structure picks one of the strictly-

[29] It follows that composition yields metaphysically real entities – entities marked off independently of our classifications.

basic properties "waiting in the warehouse". How might this work?

We begin with some consequences of Constraint 11 (conservation). Since mental chemistry doesn't create new (amounts of) consciousness in addition to the strictly-basic conscious properties it takes as inputs, it must work a transformation upon those inputs (a conclusion arrived at, for other reasons, in section IV). Recall from section I that consciousness comes in basic types marked off by the results-from/results-in relation. Thus visual experiences are basic with respect to olfactory experiences because they can't result either from olfactory experiences or from the strictly-basic experiences from which olfactory experiences result. More generally, no strictly-basic property (conscious or otherwise) can result from strictly-basic properties of other kinds. It follows that conservation applies individually to each kind of basic experience-type and not just to consciousness overall. Thus each kind of strictly-basic conscious property fed into a mental-chemical operation survives it both as to kind and amount. It follows that mental chemistry involves a transformation of strictly-basic conscious properties which nevertheless persist intact. How should we address this apparent contradiction?

Consider an example. Suppose someone has a complex experience of a single basic experience-type – red, say. The relevant basic conscious constituents must have their own red-experiences (Constraint 11 – conservation). But they also instantiate, multiply, many other basic experience-types (section VI) – perhaps yellow, taste-of-sweet, smell-of-rotten-eggs, feel-of-disgust. Constraint 13 (nested levels) suggests an integrated hierarchy of successively more complicated red-experiencers, from basic objects to the relevant brain structure.[30] Suppose some simple molecule chooses red-experiences from the conscious properties of its basic parts. Then a more complex molecule, containing one or more of the simple molecules, works mental chemistry on their experiences so as to experience red itself. And so on. Constraint 14 (simplicity/modularity) says the same kind of structure or mechanism operates at each level.

Attend to lowest-level choosing. And suppose – to keep it simple – that all basic physical

[30] A suggestion qualified shortly.

objects are identically conscious: each possesses equal amounts of every kind of strictly-basic conscious property. Let simple molecule M possess a structure S_1 that chooses red-experience(s). How might this go? An elegant model understands choosing on analogy to quantum collapse. Each basic object, when incorporated into M, undergoes a collapse of its original multiple experiences into a single red-experience. But this model violates Constraint 11 (conservation), since all of the basic object's strictly-basic experiences, other than its red-experience, vanish *ad nihilo*.[31] The following model does better. M's structure S_1 chooses the red-experiences of M's basic parts, combining them into a single red-experience characterizing M. M's basic parts now no longer experience red (Constraint 11).[32] M, for its part, has only its red-experience: not being basic, it has only the conscious properties fed to it. Conservation tells us that M's basic parts retain the strictly-basic conscious properties not chosen by S_1. So choosing yields one "big" red-experience had by M alone and many "little" experiences, of other basic kinds, had by M's basic parts.[33]

Now run through the example again, this time focusing on subjects and phenomenal fields rather than experiences. M's structure S_1 chooses red to yield an overall red-experience characterizing M. The red-filled phenomenal fields of M's basic parts merge into a single red-filled phenomenal field of M's. The subjects associated with the red-filled phenomenal fields of M's basic parts merge into the single subject associated with M's overall phenomenal field. M's basic parts thus cease to exist as red-experiencing subjects. But, with M's gains, nothing disappears *ad nihilo*. Note that the other

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[31] Also much red-experience emerges *ex nihilo*. Otherwise there's a reduction in the total amount of consciousness.

[32] Unless some basic objects feed only part of their red-experiences into M's overall red-experience. In this case the basic objects continue to experience red (in lesser amounts). The paper sets this possibility aside as needlessly adding complexity and multiplying subjects.

[33] [Insert] (personal communication) argues that this conclusion – that basic conscious objects lose certain experiences when mental-chemically worked upon – conflicts with Constraint 7 – that basic conscious objects have experiences constantly and continuously as a consequence of their intrinsic natures. But both theses follow from considerations solid enough to warrant living with the apparent conflict (Constraint 7 issues from considerations about what features a basic building block necessarily has). In section XII the paper, responding to a different difficulty, attributes to basic objects dispositions to react mental-chemically in various settings. The same move could avail here. Then strictly basic experiences would stand immune to all but mental-chemical outside influences. Note that the apparent conflict softens if we regard lower-level conscious objects as continuing to experience the conscious properties they feed up the chain – but only as constituents of the higher-level conscious whole (see section VIII). (This issue, by the way, underlies Constraint 7's restriction to free-standing basic objects.)

phenomenal fields and subjects of M's basic parts – those tied to basic experiences other than red – persist unchanged. Now, since all input strictly basic conscious properties survive, either unchanged or as transformed in a manner preserving type and amount, the contradiction three paragraphs back reveals itself as merely apparent.

Earlier we took Constraint 13 (nested levels) to entail a chain of red-experiencers from M's basic parts on up. This now needs qualification. M's basic parts lose the subjects associated with their former red-filled phenomenal fields whilst retaining the subjects associated with their other phenomenal fields. But M loses more when mental chemistry works on it. As a non-basic object, it lacks multiple experiences, multiple phenomenal fields and multiple subjects. It therefore endures as a conscious subject only so long as its conscious property remains unincorporated into a higher-level consciousness. When that happens, its phenomenal field becomes incorporated into a higher-level phenomenal field and its subject into a higher-level subject. It no longer experiences in its own right. (The same thing happened to the split-brain patient. Once his two hemispheres were re-connected, he regained a brain supporting a unified consciousness. The hemispheres lost their individual capacities to experience.)

The real work of choosing falls to structure S_1, left here as a black-box. Philosophy can't specify what S_1 is or how it does its job – partly because these questions deal with contingencies beyond the reach of philosophically defensible constraints, partly because they ask what lies behind basic laws of nature (which makes them non-questions or questions without answers, since nothing lies behind basic entities). Philosophy can only characterize S_1 functionally.

X

Placing takes already-chosen lower-level experiences and places them within a single higher-level phenomenal field. A "mosaic" results, containing instances of different basic experience-types – side-by-side if visual and therefore straightforwardly spatial, otherwise compresent if not. Placing

matters because complex consciousness requires variegated experiences. Placing presents no new problems.

Consider a mental-chemical operation resulting in an experience of red on the right and yellow on the left. Imagine a molecule O which consists of or contains red-choosing M-molecules (with structure S_1) and yellow-choosing N-molecules (with structure S_2). Suppose that O has structure S_3 which takes the Ms' red-experiences and the Ns' yellow-experiences and places them so as to yield an overall experience with red on the right and yellow on the left.[34] The subjects of the Ms and Ns result in O's single subject; the phenomenal fields of the Ms and Ns result in O's single phenomenal field. We can speculate about mechanisms affecting the proportions of red and yellow in O's phenomenal field. Maybe S_3 allows O to "connect" or "disconnect" the experiences of its constituent Ms and Ns, ideally in response to outside influences.[35] In this case S_3 represents a family of structures with generically similar but specifically different effects. This would add to the number of basic mental-chemical laws. Note that placing, by working upon already-chosen experiences, occurs at least one level higher than choosing.

XI

Blending builds mixed experiences out of instances of distinct basic experience-types – for example, an orange-experience out of red-experiences and yellow-experiences. Blending causes trouble because, maybe, orange-experiences stand over and above red-experiences and yellow-experiences even though orange paint results from red paint and yellow paint. More generally, perhaps all experience-types deemed mixed in fact qualify as basic experience-types instantiated, as strictly-basic properties, by basic objects.[36] Call this *the blending problem*. Blending also raises open-ended issues. Not only can panpsychism make do without it – at terrible cost – but also blending might occur in

[34] Assume for simplicity that borders aren't basic experience-types.
[35] If in response to outside influences, then the experience more easily represents entities external to it.
[36] This problem doesn't apply to placing. The experience with red on the right and yellow on the left straightforwardly results from, because in a sense it contains, instances of two basic experience-types. It therefore can't itself be an instance of a basic experience-type.

different ways.

This paper considers blending *the* issue facing panpsychism. Unfortunately it doesn't see clear to a satisfactory solution to the blending problem. Overall it descries three cases. (1) Panpsychism could deem blending impossible and carry on without it. But then it shoulders a bloated ontology and nasty implications for choosing (see ahead). (2) Panpsychism could deem blending possible, on the grounds that we can see, not only that the blending problem likely has a solution, but also the rough outlines of it. (3) We can judge the blending problem insoluble, the costs of forgoing blending prohibitive, and treat the impasse as a reductio of panpsychism.

If panpsychism forgoes blending, it must stomach hugely many strictly-basic conscious properties, with very many of these nearly the same as very many others (think of the hues of orange). Worse, it must posit a distinct choosing-mechanism for each strictly-basic conscious property capable of feeding into higher-level consciousness. This puts heavy demands on objects supporting higher-level consciousness. Human brains would need a vast amount of nearly-but-not-quite redundant machinery. This would interfere with their evolution, since nature would have to discover all these mechanisms and then combine and coordinate them in an already expensive organ. This paper judges these costs unacceptable.

Panpsychism could differently avoid blending, but only with big changes to bottom-level consciousness. Suppose all color-experiences result from a single strictly-basic conscious property existing as (something like) a superposition of all of them. And suppose it works this way with other families of experiences. Quarks then have multiple phenomenal fields each containing one of these "superposed" conscious properties.[37] Choosing therefore becomes a two-step process. The relevant structure first chooses a family of experiences by choosing a phenomenal field. Then it chooses a

[37] Constraint 4 says that complexity of experience varies with complexity of structure, and Constraint 5 says that quarks lack all complexity. It follows that quark-experiences lack all complexity. The "superposed" property therefore involves a "superposition" of distinct phenomenal fields each with its own subject. Otherwise the quark has a single subject experiencing many things – complexity. So the "phenomenal field" containing the entire superposed property is really a collection of phenomenal fields and not itself a phenomenal field. The paper ignores this wrinkle in the interests of clarity.

specific experience by "collapsing" the "superposed" property within that field. This paper considers this alternative unacceptable. It's ad hoc. It doesn't cohere with quantum mechanics, which envisions superpositions of property *values* rather than superpositions of properties. And it postulates complex strictly-basic properties that require complex basic objects: only complex basic objects could instantiate such properties and respond to the necessary choosing-mechanisms. But Constraint 5 (simple basic objects) rules this out.

It seems that panpsychism must solve the blending problem or fail as a mind-body theory. How, then, might blending work? Suppose simple molecule M has structure S_1 that chooses red and simple molecule N has structure S_2 that chooses yellow. Suppose more complicated molecule P contains M and N molecules. And suppose P has structure S_4 that blends the Ms' red-experiences and the Ns' yellow-experiences yielding a higher-level orange-experience had by P. Maybe the hue depends on the proportion of Ms to Ns. Or maybe, as we speculated with placing, variations of S_4 feed different numbers of M-experiences and N-experiences into P's overall experience. This way P might experience different and changing hues.

As before, P retains consciousness (experience, phenomenal field, subject) only until incorporated into a higher-level conscious structure. Similarly, its constituent Ms and Ns lose consciousness (experiences, phenomenal fields, subjects) when their experiences feed into P's. (This coheres with Constraint 11 (conservation) only if orange-experiences result from red-experiences and yellow-experiences in such a way that the underlying strictly-basic conscious properties somehow persist within the orange-experience. But this merely restates the blending problem.) Blending, like placing, occurs at least one level higher than choosing since it works upon already-chosen experiences.

But how might S_4 overcome the blending problem? This paper canvasses two unsuccessful proposals and then offers a palliative.[38] The palliative suggests that a solution must lie to hand even though we don't yet have it.

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[38] [Insert] (personal communication) suggested the would-be solutions and the palliative.

(1) Perhaps orange-experiences result from a pointillist illusion. The phenomenal field mingles "tiny" red-experiences and yellow-experiences and the subject confuses their locations and runs them together. Here the orange-experience results from a first-order experience coupled with a type of ignorance about it. Unfortunately this proposal calls for a higher-order subject who confusedly experiences the red-experiences and yellow-experiences the way we confusedly experience pixels on a screen. But mental chemistry can't work this way. First, the higher-order subject must result from the first-order subjects, not exist alongside them; otherwise it emerges from them. Second, everything must happen internal to the relevant subjects; otherwise we base our theory on telepathy – perceptions of other subjects' experiences. Third, the proposal doesn't in fact *build* orange-experiences out of anything; it therefore doesn't supply a model of blending (it involves emergence instead). Fourth, by generating orange-experience out of ignorance and confusion, the proposal relabels the explanatory gap instead of dispelling it. (2) Perhaps orange-experience results when the subject has a red-experience and a yellow-experience at the same phenomenal location. This proposal also fails to build big subjects out of small. Worse, it *assumes* that orange-experiences result from red-experiences and yellow-experiences. But this begs the question.

This paper doesn't see how to tackle the blending problem head on. It nevertheless finds reason to judge it tractable. Note that orange-experiences resemble red-experiences and yellow-experiences more than blue-experiences. Although these relations could hold primitively, this wouldn't sit well with panpsychism. Panpsychism eschews explanatory gaps, not only to keep physicalism at bay, but also because it cleaves to a fairly robust principle of sufficient reason. Thus panpsychism rejects radical emergence out of distaste for high-level properties not composed of, *and therefore not strongly enough caused by*, bottom-level entities.[39] It likewise insists that similarly constitutive causes underlie, and thereby ground explanations of, the similarity-and-difference relations touching orange-experiences. This paper therefore proposes, as a best explanation, that orange-experiences share constituents with

[39] See [insert] for a discussion of emergentism that addresses this issue.

red-experiences and yellow-experiences but not with blue-experiences.[40] We must take care, however. Orange-experiences and blue-experiences do resemble as experiences of colors, just as red-experiences and yellow-experiences resemble as experiences of warm colors. But these subtleties don't matter so long as we focus on the possible explanatory gap between orange-experiences and red-experiences/yellow-experiences. Although orange-experiences and blue-experiences resemble as color-experiences, we can't see that orange-experiences could result from blue-experiences. And although red-experiences and yellow-experiences resemble as warm-color-experiences, we can't see that either could result from the other.[41] These reflections ground a distinction between the possible explanatory gap between orange-experiences and red-experiences/yellow-experiences on the one hand and the (real) explanatory gap between experience and things physical on the other. The experience/physical gap has two parts. We neither see constitutive links between experience and the physical, nor even the possibility of such links. But the possible gap between orange-experiences and red-experiences/yellow-experiences has at most one part. Even if we don't see constitutive links, we have no trouble envisioning their possibility. More, our intuitions urge that such links must exist. This suggests – but doesn't prove – that orange-experiences result from red-experiences and yellow-experiences even though we (perhaps) don't yet see how.

XII

The above models risk violating Constraint 3 (anti-emergence). They envision *basic* mental-chemical laws whose antecedents refer to high-level structures S_1, S_2, S_3, etc. These structures therefore have *basic* but high-level capacities (high-level capacities that don't result from bottom-level entities). Emergence. Panpsychism therefore faces a dilemma. If emergence occurs, panpsychism loses all

[40] Sharing constituents with red-experiences and yellow-experiences here comes down to resulting from them.

[41] Red-experiences resemble blue-experiences only as experiences of colors – as the same type of entity. They can do this without sharing constituents (otherwise we wouldn't have to recognize more than one basic color-experience type). Hence the different types of explanatory gaps between red-experiences and blue-experiences on the one hand and between orange-experiences and red-experiences/yellow-experiences on the other. Similarly, red-experiences resemble yellow-experiences only as experiences of warm colors – which resemblance we can understand in terms of similar extrinsic effects on our emotional systems.

warrant. But if emergence doesn't occur, mental chemistry can't happen and panpsychism fails.

A related difficulty. Constraint 14 (modularity) says that basic mental-chemical laws apply at many levels. This means the structures mentioned in their antecedents can't refer to determinate level-specific structures. They must refer instead to *features* or *types* of structures that can obtain at many levels. Perhaps this threatens to accord causal powers to something like abstract form.

The following amendments suggest ways, albeit speculative, of overcoming these problems. Allow that structures S_1, S_2, S_3, etc. encompass not merely spatial (or spatio-temporal) properties of molecules M, N, O, etc., but also some of the external influences upon them. And understand these influences in terms of the brain's dynamic electromagnetic (EM) fields. Suppose that each strictly-basic conscious property has a strictly-basic disposition to respond to several frequencies of EM radiation. Suppose further that different EM frequencies allow otherwise identical mental-chemical structures to "tune into" one or another strictly-basic conscious property.

Consider choosing. Previously, simple molecule M had structure S_1 that chose the red-experiences of M's basic conscious constituents. Suppose instead that M has shape Sh_1 – old S_1 relabelled – and that new S_1 consists of Sh_1 under EM radiation of frequency F_1 (EM-of-F_1). Perhaps Sh_1 channels the ambient EM-of-F_1 onto M's basic conscious constituents. Suppose also that each strictly-basic red-experience has a strictly-basic disposition to respond to EM-of-F_1. When thus irradiated, it combines with other similarly irradiated strictly-basic red-experiences to form a higher-level red-experience characterizing the object channelling the EM-of-F_1. S_1 thereby merges the red-experiences, red-filled phenomenal fields, and red-experiencing subjects of M's basic conscious constituents into, respectively, M's one red-experience, one phenomenal field and single subject. The red-experience can then work its way to higher levels, provided the strictly basic sensitivities to EM-of-F_1 result in similar higher-level dispositions characterizing higher-level red-experiences. At each step an object with shape Sh_n channels EM-of-F_1 onto lower-level red-experiencing objects and comes to experience red itself. Sh_n can be any old high-level structure that, like a parabolic disk, say, suitably

channels electromagnetic radiation. At no point does the revised model resort to emergent entities or basic laws dependent on high-level structure. It accounts for choosing solely in terms of the strictly-basic properties of bottom-level objects.

Now turn to blending. Previously, molecule P had structure S_4 that blended the red-experiences of its constituent M-molecules and the yellow-experiences of its constituent N-molecules to yield P's orange-experience. Suppose instead that M-molecules choose red through S_1 – shape Sh_1 channelling EM-of-F_1 – and N-molecules choose yellow through S_2 – shape Sh_2 channelling EM-of-F_2. The next steps could unfold in (at least) two ways. (1) Perhaps P has shape Sh_4 which channels EM-of-F_4 to P's constituents. Assume that EM-of-F_4 doesn't prevent the Ms and Ns from continuing to choose red and yellow (maybe EM-of-F_4 has lower frequency and lower frequencies don't block the effects of higher frequencies). Suppose that all strictly-basic conscious properties have a strictly-basic receptivity to EM/F_4. When thus irradiated, they combine with other conscious properties similarly irradiated to yield a blended experience characterizing the object channelling the EM-of-F_4. And assume that this disposition results in a similar higher-level disposition characterizing the experiences of the Ms and Ns. Thus S_4 merges the experiences, phenomenal fields and subjects of the Ms and Ns into P's single experience, phenomenal field and subject.

This accounts for blending without recourse to emergence. But it packs a lot of dispositions into strictly-basic conscious properties. Maybe this doesn't matter. But blending could happen otherwise if it does. (2) Suppose, as before, that red-experiences have a strictly-basic receptivity to EM-of-F_1 and yellow-experiences to EM-of-F_2. Suppose also that P has shape Sh_4 that channels to P’s constituents a 40-hertz EM field oscillating between EM-of-F_1 and EM-of-F_2. Assume that each strictly-basic conscious property has a basic receptivity to EM oscillations. When thus irradiated, and when receptive to one of the oscillating frequencies (here F_1 and F_2), it merges with all conscious properties similarly irradiated to yield a blended experience characterizing the object channelling the oscillating field. And assume that this disposition results in a similar higher-level disposition characterizing any higher-level

experiences. Thus, as with (1), S_4 merges the experiences, phenomenal fields and subjects of P's constituents into P's single experience, phenomenal field and subject. Note that this model might allow blending without previous choosing. It also suggests an elegant account of placing (based, say, on 60 rather than 40-hertz oscillations). But it fails if strictly-basic receptivities to complex entities – in this case oscillating fields – involve an unacceptable dependence of basic properties on non-basic properties.

These revised models are less arbitrary than they look. Mental chemistry demands that strictly-basic conscious properties have basic receptivities to some external influences, and, given what we know about neurons and brains, electromagnetic fields are promising candidates. The electromagnetic interaction also has discrete effects, at short and medium ranges, on levels high and low, that mental chemistry requires and that none of the other basic physical interactions has. Nor should we forget Crick's and Koch's (1990) correlation of 40 – 60 hertz oscillations with binding processes underlying conscious visual experience.

XIII

Chalmers (1996) raises a panpsychist version of Sellars' grain problem.

> On the face of it, our conscious experience does not seem to be any sort of sum of microphenomenal properties corresponding to the fundamental physical features in our brain, for example. Our experience seems much more holistic than that, and much more homogeneous than any simple sum would be.... If the roots of phenomenology are exhausted by microphenomenology, then it is hard to see how smooth, structured macroscopic phenomenology could be derived: we might expect some sort of "jagged," unstructured phenomenal collection instead. (p. 306)

In the same vein, [insert] (personal communication) remarks: "Instead of consciousness as a magic lantern or the silver screen, on this view [panpsychism] we have *pixels* of consciousness! (A thousand points of light.)"

Both the pixel image and the panpsychist grain problem misunderstand mental chemistry. The pixel image presupposes a homunculus who gazes upon the pixels and whose experience of them

mirrors their particulate structure. Somewhat differently, the grain problem presupposes that macro-experiences are mere aggregations of micro-experiences. Both assume that micro-experiences survive intact when wrought upon by mental chemistry. They therefore take mental chemistry to *increase* the number of subjects. But we've seen that mental chemistry can't work this way. Constraint 11 (conservation) rules it out on pain of emergence. Instead, mental chemistry takes micro-experiences as raw material which it refashions into a single unified macro-experience. It therefore necessarily *decreases* the number of subjects. Recall what happens when the split-brain patient's two streams of consciousness merge at experiment's end. Two points of view cease to exist when a distinct and unified third results from them. It goes thus with all mental chemistry. The red-experience of molecule M need no more display grain than the patient's re-unified mind need exist as two adjacent "panels" of experience.

XIV

How much should we trust our constraints? And how much slack do they leave? The first ten, developed in the companion paper and set out in section V, seem solid enough. This paper doesn't easily envision a nonarbitrary panpsychism without them. More, they force a unique account of bottom-level consciousness – the one sketched in section VI. Constraints 11 (conservation), 12 (strictly-basic consciousness can't migrate) and 15 (strictly-basic consciousness obtains where its instantiating object obtains) also seem unexceptionable.[42] Conservation, in particular, lies at the heart of panpsychism: no genuine panpsychism can flout it; most misunderstandings ignore it. On the other hand, Constraints 13 (mental chemistry occurs at many levels) and 14 (simplicity/modularity) carry less weight. For the most part they capture features desirable but unnecessary and also have weaker justifications. Still, our models wouldn't change much without them. Mental chemistry might first occur at higher levels. It might involve more, and more complicated, laws. But nothing important

[42] Subject to a qualification mentioned below with respect to Constraint 15.

would change.

The 15 constraints nevertheless do leave some slack. (1) This paper speaks about simple molecules performing mental chemistry. But maybe mental chemistry first occurs in non-basic subatomic particles like protons. Or maybe it doesn't happen short of living tissue. These uncertainties don't affect our models' overall shape, however. (2) The paper assumes, on grounds of simplicity, that a conscious object surrenders the entire conscious property fed "up the chain". But maybe it doesn't. (3) The paper speculates, in section XII, about possible roles for electromagnetic fields. But perhaps electromagnetism affects mental chemistry differently, or not at all. Perhaps other mechanisms allow for mental chemistry without emergence. (Or maybe none does and panpsychism fails.) (4) The paper extends the reasoning behind Constraint 15 (location) to conclude that higher-level conscious properties obtain where their "generating" objects obtain. But location is a fraught issue, one treated too briefly here. Where actually does the merged property lie? And what might this mean for its nature? In particular, does it force a view according to which conscious properties exist as *fields* centered on their instantiating objects? This could have big effects on our understanding of consciousness.

XV

Almost everyone deems the combination problem panpsychism's Achilles heel. Critics think it fatal (see Coleman 2006 and Goff 2006). Even panpsychists blanch before it: James (1909/1996), Strawson (2006) and Skrbina (2006) all wonder whether we can solve it only by renouncing logic for intuitive apprehension of metaphysical truth through nondiscursive contemplation. This paper exposes the combination problem as an oversold bugbear. It offers, in section IV, reasons, independent of panpsychism, for thinking it soluble. Then, in sections VIII through XII, it puts forward models exploring ways mental chemistry might go. All progress made here flows from the insight, stressed often, that mental chemistry necessarily involves transformation consistent with conservation rather than aggregation followed by the creation of something in addition.

This paper doesn't offer the last word on mental chemistry, of course. It surely makes mistakes. Its models are first attempts. It doesn't do justice to the blending problem. And it says nothing about the mental chemistry underpinning complex conscious states like understanding, reasoning and occurent propositional attitudes. Much work for tomorrow.

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