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How Well Are We Moving Toward a Most Productive Science of Consciousness?

*Commentary on the Toward a Science of
Consciousness Conference, Tucson 2008*

This will be a commentary on TSC 2008, not a summary, so I should say something about the perspective I bring. Consciousness is, after all, the medium in which we live our lives — the very subject of the founding of a science psychology, rejected by behaviourists on irrelevant metaphysical fears, and then treated only gingerly in the computational and information processing metatheories that have dominated much of the discipline and beyond over the last half century (Dulany, in press). For that matter, I can say this of studies I read in a range of psychology journals, including those submitted to me in my 20 years as Editor of the *American Journal of Psychology*: it seemed rather clear to me that conscious states and contents of the experimental subjects were centrally and causally involved in the production of their experimental effects — consistent, by the way, with a mentalistic metatheory I have presented (e.g. Dulany, 1997; 2004). In an increasing number of studies those effects are specifically investigated.

Shouldn't a most productive science of consciousness focus on *what consciousness explains* — on what it permits in mentation and in action? With the symbolic contents of conscious states we represent events out there in perceptions, in the past in remembrances, even of our own conscious experience, and in a future as expected or wished

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or intended or feared or only imagined. These are contents carried by well-known modes of consciousness that can quantitatively vary. Some of these contents are propositional, some non-propositional, and they appear in mental episodes, some deliberative and some associative, with states interrelated by nonconscious operations. We would examine the lawful relations among these contents of consciousness within mental episodes, and their lawful relations to prior conditions and actions in the mental phenomena we consider significant.

Examples? Mental episodes of remembering that are a recollection or only a belief or just a 'sense of', whether correct or false. Conceptual judgments and learning of those concepts — and learning in general. Problem solving and reasoning of various kinds, especially the causal and explanatory reasoning we need in science. Beliefs about and momentary senses and feelings of self, as well as that conscious sense of the possession of a conscious state. Perceptions of others and with what they can vary. Recognition and subjective meaning of linguistic forms. A subjective but variable sense of well-being. The automaticity that can express what is conscious and also activate it. Sources and consequences of various attentional phenomena. Counterfactual thinking. Reflections upon and control of thought. Anticipations and evaluations that lead to intentions and actions, as well as to later reflections that can range from regret through satisfaction to exhilaration. Even Freud believed that emotions were conscious states. The list is only a selection, drawing on phenomena already widely investigated in the mainstream psychological literature, but too often with too little focus on the role of conscious modes and contents.

What of the search for neural correlates? Those correlates would take a valuable place in this strategy to the degree they are identified with sufficient specificity and validity to enter into lawful relations with specific conscious states — and thereby enrich the theoretical networks we need for understanding how consciousness functions in these significant mental phenomena. We also need an understanding of the non-conscious neural networks activated in conscious remembering, explicit or implicit, as well as in the sensory and motor transduction that precedes and follows those mental episodes. Philosophers can also bring deeper and broader conceptual analyses undistracted by the demanding needs of working in the data world.

As we better understand what consciousness explains, wouldn't that in turn provide the better explanation of consciousness — its evolutionary adaptive value in those significant mental phenomena?

‘Explaining consciousness’ would not be the futile attempt to ‘explain it away’, and it would be more than identifying its neural correlates. Correlation, as we remind our first-year graduate students, does not in itself explain a correlate — and NCCs are consistent with any classical position on the mind-brain question. Within common theoretical networks, brain states and conscious states would together provide theoretical explanations of those significant mental phenomena.

Earlier reviews of conferences in this series, and even this meeting’s program (Hammeroff *et al.*, 2008) ask ‘Are we there yet?’, and the enduring title of this meeting implies a ‘No, it’s off beyond the horizon somewhere’. As you can see, my emphasis will not only be on how far along we are, but also on what does or doesn’t seem to be on a road toward what I believe would be a most productive science of consciousness.

At this meeting, I believe I saw four dominant themes under which the plenary sessions fall, and still another theme running throughout, that search for neural correlates. With so many speakers describing so many studies in such detail throughout five days — over and above the pre-conference workshops and the numerous concurrent sessions and poster boards, I will only try to extract the essence of the plenary claims and then comment, often raising questions.

1. Is Consciousness Epiphenomenal for Perception and Action?

Indeed one of the questions raised in the meeting’s program asks whether consciousness is an epiphenomenon — as in the computational view of mind, with cognition running like a program in the brain and consciousness only sometimes exuded. That fundamental question seems to animate some experimental tests for a dissociation of mental states or actions from consciousness.

Attention and consciousness

Early in the cognitive ‘revolution’ consciousness was identified with an attentional subsystem within a working memory system, on a reassuringly physical computer metaphor. All three of these speakers challenge this claim of a perfect association, although in somewhat different ways. **Christof Koch** recognized a close relationship between selective attention and consciousness, but he presented data interpreted as providing for a double dissociation. In the absence of top down attention, conscious attention may nevertheless go to some particular object or aspect of a scene. On the other hand, subjects may

give top down attention to stimuli said to be ‘invisible’, through one of several techniques — most often with masking but also with flash suppression, or other techniques — yet nevertheless they present evidence interpreted here as unconscious processing indexed by fMRI. This topic was earlier elaborated in a workshop conducted by **Naotsugu Tsuchiya and Koch**.

The work reported by **Stanislas Dehaene** focused on the tracking of neural activation, with an emphasis on the neural locus of what is conscious and what not within a global neuronal workspace model, a version of Baars’ (2003) model. On this view, consciousness occurs in that limited work space, with the activation of a distributed parieto-prefrontal system together with top-down amplification of relevant posterior networks. Considerable processing is said to occur non-consciously. The reported experiments used stimuli that were presented masked or in a psychological refractory period (or during an ‘attentional blink’ or with a secondary task), with high density ERPs and high-temporal resolution fMRI used to track the loci of what were interpreted as non-conscious and conscious stages of processing. In essence, those processes that interfere with attentional identification of the stimulus were found to interfere not only with reports of awareness, but also with the expected brain imaging indices, fMRI for parietal and prefrontal areas, and the P3 component of ERP for those areas as well as ventral temporal regions. Earlier activation was said to be ‘subliminal’ (a measurement claim) or ‘preconscious’ (a theoretical claim).

Michael Tye also argued for a dissociation of attending to and seeing a thing in the sense of being conscious of that thing. The classical Sperling (1960) experiments (and many that followed) convincingly demonstrate that briefly presenting a display (e.g. 50 ms) with three lines of four letters is more than can be fully attended, although the letters must be ‘seen’ in some sense, a literal representation, if a line of letters randomly selected within 300 ms or so can be attentionally identified. Furthermore, the subject gives top-down attention to the full display (with what Charles Eriksen called the ‘internal eyeball’), even if unable to ‘see’ all letters with a 50 ms exposure in the sense of being perceptually identified. ‘See’ is a vernacular term that can be applied to conceptually different conscious states. There was also discussion of Dan Simons’ change blindness experiments, with the reasonable interpretation that awareness of change could only occur with fallible inference from attentional identification of both the original and changed aspects of a scene.

What then can be said about evidence for consciousness as epiphenomenal? Both **Koch** and **Tye** present evidence and arguments for a dissociation of top-down attention and consciousness, in the sense of awareness of a surround for **Koch**, and in the sense of pre-identification literal awareness for **Tye**. There is abundant evidence for the literal awareness of a surround in decades of research within Eriksen's flanker task — as well as in our own constant experience. We don't live in an attentional tunnel surrounded by The Grand Scotoma. There is also abundant evidence for pre-identification literal awareness in decades of research within Sperling's (1960) partial report and similar tasks, as recognized in Block (2007) and earlier in Baars (1988): 'Now we can be quite confident that subjects in the Sperling experiment do have momentary conscious access to all elements in the visual display' (p. 16). But these are very interesting dissociations *within* consciousness, not the kind of dissociation of consciousness *from* mental states that might argue for consciousness being epiphenomenal.

What **Koch** and **Dehaene** seem to interpret as unconscious perception, the 'invisible' or 'preconscious', could be taken as evidence that consciousness is sometimes unnecessary and therefore epiphenomenal for perception. But we should first recognize that this is a literature with an unusual number of methodological critiques focused on criterion bias in subjective reports and on the conditions of obtaining objective reports (e.g. Fisk & Haase, 2005; Perruchet & Vinter, 2002). In fact, even direct objective reports don't rule out the possibility of indirect effects produced by the kind of pre-attentive, literal awareness identified in Sperling's and related paradigms. This is *literal awareness*, a mode we can remember, but carrying a content that can fade prior to report when lacking the attentional identification long known to be essential for establishing that *content* in memory (Dulany, 2001). In fact, I see that this pre-attentive consciousness is recognized in Koch & Tsuchya (2007).

Furthermore, the use of brain imaging for the indirect index of 'unconscious' perception raises new validity questions when not submitted to a rigorous and standard signal detection theory measurement (a d' or non-parametric A') — an index of the association of presence-absence of the obscured stimulus with presence-absence of the imaged activation, specifically localized or timed and specifically identified only with the obscured stimulus. It is an especially interesting possibility, however, that these brain imaging measures, with the needed precision and validation (with a pattern analyser and specific controls), might be viewed as tapping that well-established

pre-attentive awareness — thus demonstrating a significant dissociation *within* consciousness.

Free will and agency

This topic, too, goes to that fundamental question, with a focus now on whether conscious representation of ‘will’, ‘intention’ or ‘decision’ temporally follows its unconscious neural representation and is therefore only an epiphenomenon. The symposium was preceded by a two-session workshop on the topic by **Lynn Nadel**, **Walter Sinnott-Armstrong**, and others, a tribute to **Benjamin Libet**. All of these presentations were inspired by the famous Libet lag: a reported time of intention or decision to act, even if preceding the act, can follow a ‘readiness potential’, an EEG component, by 300 ms or so.

With the basic thesis that ‘we infer rather than perceive the moment of decision to act’, **William Banks** and associates reported three interesting experiments. In one experiment, the estimated time of response was delayed by a post-response beep. In a second, a video image of their hands responding was delayed 78ms and the reported decision time was then also delayed — but by only by 40ms. A third experiment presented a video of another person responding, and the subjects estimated a decision time that preceded the response by about the amount reports of their own decision times preceded their own responses. So as reasonably interpreted, decision time was inferred from the time of response, and therefore this conscious reflection of volition did not precisely reflect the volitionally controlling brain activity.

I believe we must agree that reported awareness of decision time is really a report of content of a higher-order awareness — with contents remembered from and inferred from something experienced earlier. For Experiment 3 we could think of that as an inference from what they see in the video and what they remember of subjective decisions preceding their own actions. We also can see that post response blinks and delayed video can produce inferences that are response time and decision time ‘illusions’, although interestingly the latter isn’t as strong as the former. In any case, cleverly engineered volitional illusions don’t really imply a *general* illusion of volitional control — the Wegnerian leitmotif (Wegner, 2002) — any more than cleverly engineered visual illusions have ruled out veridical perception. Both, however, have provided interesting theoretical challenges.

Francesca Carota and associates report evidence directly bearing on the Libet effect. On evidence that a lesion within the left parietal

cortex altered ability to report movement intention, they used magnet-encephalography (MEG) to track right parietal activation associated with reported intention, and they report that this activation preceded reported time of intention to speak by 400ms — the Libet lag.

Could there be some kind of ‘retroactive modulation of subjective intentions’, as **John Jacobson** and associates propose? Their dismissing ‘subjective intentions, intentional control of action, and their responsiveness to learning’ as nothing but ‘folk notions’ was clear enough, but I unfortunately had difficulty understanding their interpretation of briefly sketched experiments. I will only quote from their Abstract: ‘... paradoxically, our intentions arise from both our past and the future of their associated actions ... these occur in possibly rare cases in which a random quantum transition breaks us from a Laplacian causal chain, and we maintain a narrative, surf the neurogeist, such that our retroactive, subjective intention is non-capriciously ours’. Retro-causation?

Two physicists entered the arena at this point, with **Daniel Sheehan** presenting ‘Consciousness and the physics of time’. Since physical laws are time symmetric, some theory and research of the past three decades has attempted to explore the possibility of a system’s ‘past’ being revised in the sub-atomic domain by ‘tens of nanoseconds’ and even by ‘micro-seconds’. It was proposed that this had relevance to Libet’s concept of ‘subjective backward referral’ — given the suggestion that it might take that long for the neural basis of an intention to reach consciousness, or that it could take that long to form the reported higher order representation of an earlier conscious intention’s time. Interpretation can vary.

My first thought was that it would be quite a conceptual leap from causal anomalies in nanoseconds and microseconds in the sub-atomic realm, even if well substantiated — to temporal disparities of 300–500ms or so for someone deciding to press a button. In any case, **Susan Pockett** rejected ‘retro-causation’ on the grounds that this ‘temporal symmetry’ is only in the formalism of these physical equations. She has also rejected Libet’s ‘subjective backwards referral’ and has summarized evidence against the claim that it would take 500ms for activation to form the conscious intention (e.g. Pockett, 2006).

The Libet effect has been too extensively and controversially examined since the early 1980s for me to offer more than a general impression I take away from this spirited interchange. (See e.g. Pockett *et al.*, 2006, and various published symposia). Since first reading about the effect (Libet, 1985), I have thought that the ‘readiness potential’,

however measured, probably tapped not an unconscious cortical decision or unconscious intention but what its label says — any of various prior thoughts and motor activities that precede and make us ‘ready’ to decide and form an intention and act. It would also take time to form the higher order awareness of that intention. We now have differential brain images of what is said to be a ‘what, when, and whether’ of intentional control (Brass & Haggard, 2008), what could actually be components of that prior conscious reflection — and we may soon see evidence for ‘this, that, and the other’ that can ready us for that decision, intention, and action. Certainly there should be evolutionary adaptive value in a brain that perks up a bit, measurably, to be ready with whatever is needed for a decision to be made, an intention to be formed, an action to be executed. Within any particular paradigm, adequate confidence in causal control of a conscious intention will come from a relatively rich network of data competitively supporting a theory according an intention that causal status — a theory not disconfirmed by a temporal disparity between two imperfectly valid and variously interpretable temporal indices.

This has not been an assembly for the suppression of scary consciousness, but we can wonder why ‘studies of the conscious’ have been so widely and energetically focused on what is controversially *unconscious* (Dulany, 2003) — and hence my relative focus on this theme. One reason, I believe, is the historically influential but mistaken view that a theory of control by conscious intention entails the philosophical assertion of ‘free will’ in the sense of indeterminism — as for example, in seeing that with ‘Libet’s main legacy...[we could] perhaps finally solve, the metaphysical debate about free will and determinism’, p. 624 of Pockett (2006). Causally controlling and conscious intentions in no way entail free will in the sense of indeterminism: They have their own causal antecedents, which we theoretically assert and experimentally support on the methodologically useful assumption of determinism. For that matter, evidence for an epiphenomenal status of conscious perception is logically irrelevant to questions about the ultimate ontological status of consciousness. We can make the useful assumption of a physical status for consciousness, but our theoretical assertions should not be confused with metaphysical assertions. The former are empirically testable; the latter are not within the science as we now know it. That is the epistemological distinction — which, if ignored, can stand in the way to that most productive science of consciousness.

2. Quantum Neurodynamics: Does Quantum Theory Specify the Sub-neuronal Necessity for Consciousness? From Quanta to Quale?

This theme shares with others a concern for what it is in the brain that is necessary for conscious states — and is a theme announced in the meeting summary, but it stands apart from the other themes in drawing on quantum physics. It was also preceded by a workshop directed by **Stuart Hameroff**, **Gustav Bernroider**, and **Daniel Sheehan**, and that summary usefully expresses a central view: what is said by many to be the best measurable correlate of consciousness, gamma synchrony EEG, is not fully explained by classical physics (they argue), and ‘appears to require non-local quantum correlations’.

In essence, **Bernroider & Summhammer** argue that the classical physics analysis of Hodgkin and Huxley fails to account for more recent experimental observations of short action potential initiation within cortical neurons. They see a need to replace the classical view of stochastic ion motion with a quantum mechanical account of the interaction between ions and surrounding protein. Nevertheless, they present the view that quantum processes in the brain are then transformed into the classical signaling registered in brain imaging — and offer the view that this may ‘narrow the gulf’ between physical accounts and phenomenology.

On **Stuart Hammeroff**’s view, consciousness is initiated in quantum computation within microtubules, the Penrose-Hameroff Orch OR model. When consciousness arises, gamma synchrony spreads throughout various parts of the brain or globally, with cortical or thalamo-cortical synchrony. This is said to occur within dendritic webs connected ‘sideways’ and gamma synchronized. This synchrony is then usefully tapped with EEG recording and said to accompany, to be responsible for, consciousness. With that we have the ‘conscious pilot’ in the title of his talk, and the non-conscious copilot was illustrated by a relatively inattentive but successful phase of driving. Here it is said to be enough for there to be integration of spike-mediated synaptic inputs reaching criterion and firing axonal outputs.

But ‘*non-conscious*’? Wouldn’t experiences we don’t remember, in this case successful driving, be better interpreted as experiences we don’t attentionally process into memory? That would be inattentive awareness, and it should have a distinctive neural substrate, whether spike-mediated or otherwise. ‘Falling asleep at the wheel’ is a lapse into the non-conscious, but it has predictably different consequences.

Evaluation of the central claims in these presentations, however, would require detailed examination of this literature, at least from Hameroff (1994) to Bernroider (2003) and beyond — with special concern for the degree to which the views are now experimentally supported. This is a wondrously complex and controversial topic with well-known scientists and philosophers on both sides of this issue — usefully reviewed online, I find, in NationMaster-Encyclopedia: Quantum Mind. My own view is simply this: the specific role of quantum processes in mediating the general conscious state is something for research in the area of physics of neural activity, and I believe it is a significant question. I did not, however, hear reference to studies rigorously relating the presence and absence of some specifically describable quantum process to presence and absence of any in the enormous range consciousness states.

And quanta to quale? In the Bernroider-Sumhammer abstract, I read a reference to ‘how QM can possibly narrow down the gulf between physical accounts and phenomenology in an observing agent’. But are there discernible quantum signatures for any of these *particular* conscious states — specific quantal states that could be part of the theoretical networks explaining these significant human phenomena I listed? With the extraordinary gap in level of explanation, temporal and spatial, between quantum processes and our complex mental activity, with its specific conscious modes, contents, and sense of agency, we can only wonder whether there can ever be a specific quantum account of specific conscious states — something that could ‘bridge that gulf’. The analysis could be valuable, however, if it contributes to understanding the source of whatever indices are sufficiently valid indices of conscious states in general.

3. Altered States, Anomalous States — from Orgasmic to Psychedelic ... to Telepathic?

I approached this set of symposia with an unusual thought for a professional meeting. Was this for one generation to be a reminiscence of that Age of Aquarius? And for others simply a ‘Sorry you missed the party’? A Woodstockian sex-drugs-and ... telepathy this year, but maybe rock ‘n’ roll next year? Actually I found studies ranging from hard-core science, to those somewhat loose and preliminary, to still others quite controversial and unconvincing.

Sex and consciousness

This session was very well attended — attentively attended.

Barry Komisaruk reported a set of studies, a little oddly entitled 'Where is I', but we could see that this was really use of fMRI in an attempt to identify the locus of possession of conscious experience, the 'I', during sexual arousal and orgasm in women (e.g. Komisaruk & Whipple, 2005). In essence, orgasm following vaginal self-stimulation was found to activate 'nucleus accumbens, insula, anterior cingulate cortex, and hypothalamic paraventricular nucleus' — and pleasure as possessed. This was contrasted with findings from a study in which women with traumatically severed spinal cord responded reflexively to foot stimulation, but without activation of sensory cortex and report of the sensation as 'mine'. This generated a number of interesting but unanswered questions surrounding the core query: what is the specific brain locus of that sense of possession of the experience of pleasure, the 'I', the possessor of that experience.

With an even more provocative title, 'In my flesh I shall see God: Sex as a natural trigger for "Varieties of Religious Experience"', **Jenny Wade** described 14 (by my count) reported varieties of orgasmic experience — sudden knowledge of the 'truth', deity possession, experience of past lives, out-of-body experience, visions of deities or angels or demons, etc. By interpretation, these were said to be '... altered states phenomenologically identical to those considered hallmarks of spiritual attainment in indigenous and established religions ...' (Abstract). Interesting as these reports were, many of us would like to know more about those described as 'naive subjects aged 20–70', as well as the circumstances of reporting, and something about the validity of the assessment questionnaire. If subjects providing these data really are highly representative, a standard question to raise would be this: why are these matters not more widely discussed in the literature — or in the culture? If not, what sets this evidence apart? Put in conventional terms for a science of consciousness, we would also like to know how these orgasmic states are related to other conscious states, and how well these states are predicted by situational, and/or individual difference variables. How might this exploratory data lead to more advanced studies?

Stanley Krippner and associates reported an interesting study in which they mailed a 55-page 'Psychological Dimensions of Sexual Experiences Inventory' to 1,000 persons, but were limited in their analysis to the responses of a first 100 willing to devote the needed 4–5 hours. They acknowledge some lack of confidence in representativeness. The result they emphasize was that both males and females, especially in their elaborated answers, emphasized love or mutual sharing as important in their sexual arousal — but that females more

often reported 'ecstatic' or 'transcendent' states. The use of such an inventory is important, and so are the qualitative reports, but I still felt the need for more clarity in the phenomenological reference for terms such as 'transcendent' and especially of 'transpersonal' when the title is 'Transpersonal phenomenological parameters of human sexual experience'. Again, I would say that this could be viewed as valuable data that could lead to more advanced studies in a science of consciousness.

Torsten Passie's title suggests interesting research for a science of consciousness: 'An empirical study about altered states of consciousness and subjective experience during sexual intercourse and some implications'. We were presented a summary of a study with 25 males and 25 females, ages 25–56, each presented a questionnaire that might tap altered states of consciousness during sexual activity. But as with the other studies, conclusions were limited by various methodological challenges. In general, phenomenal reports best meet their validity conditions when obtained very close in time to the particular phenomenal experience — and that presents a particular problem in attempting to directly assess sexual experiences, in this and the preceding studies. There is also the need to set criteria for categorizing an experience as 'altered'. Extraordinary in some specifiable degree? Having a particular qualitative characteristic? After all, any sexual experience is an 'altered state' compared with walking around the block.

A productive science of consciousness? In short, I saw these studies as limited at this stage, but valuable in providing some evidence and setting still more interesting questions for further research: what are the antecedents of, and interrelations among, these various sexual conscious states?

Psychedelics and consciousness

The emphasis in this symposium was on research strategies, strategies for relating various psychedelic drugs to particular forms of mental activity.

Thomas Ray laid out a strategy for examining the effects of dozens of psychedelics on various types of mental activity in a presentation interestingly entitled 'Psychedelics and the chemical architecture of the mind'. In essence, these psychedelics have chemical profiles, and this research attempts to identify the receptors that are selectively activated and thereby mediate a variety of mental activities. We also need to be more specific about these dependent variables referred to, the aspects of self, or senses of power, volition, and depth of thought or

feeling, assessments that raise various psychometric questions. But the focus of the talk was on hard science from the chemistry laboratory, ‘the chemical architecture of the brain’ — with a significance best interpreted by pharmacological chemists.

In contrast, **Frank Eschenhofer** in his talk, and in an earlier workshop, focused on one substance, ayahuasca, used together with meditation. He described a strategy for exploratory field research, what would be part of the science of discovery rather than the science of testing prior hypotheses. The strategy, he emphasized, should also have ecological validity in the sense of going to the cultures where the drug is used, precede it with discussion, present the brew and obtain EEG measures, in some cases along with meditation. One study, illustrated with an interesting video, was conducted in Dharamsal, India, in the Dalai Lama’s monastery and preceded by a discussion with the Dalai Lama. A second study was conducted partly in Peru and partly in Brazil. But the focus throughout was less on available results than, as the Abstract put it, ‘where to start, what to do’.

A productive science of consciousness? There should be a place for examining the effects of psychedelic drugs and their neural mediators on various conscious states and their interrelations — though I would be surprised to find great ecological validity for combining ayahuasca and meditation across this mainland.

Telepathy?

This is an unusually difficult topic for a brief comment. As is very clear from Freeman’s (2005) editorial introduction to this journal’s symposium, Sheldrake’s (2005a,b,c) two articles and response, as well as several other authors’ ranging views and evidence, this is not just a controversial theoretical issue, it is an issue that has raised difficult questions as to the place of the topic within science. So I will say first that I am a sceptic — but not in the common sense of believing that the question necessarily lies outside the domain of science. Indeed, Sheldrake (2005b) points analogously to gravitational and magnetic fields, and says ‘There is nothing unscientific or dualistic about extended fields of influence pervading material bodies and reaching out beyond their surfaces’ (p. 42). I am a sceptic in the sense of (a) according low *a priori* credibility to asserting perceptual fields beyond the brain — Sheldrake’s ‘morphogenetic fields’ — relative to the *a priori* credibilities of alternative interpretations, and (b) I believe there is a low likelihood that experimental evidence can shift the *a posteriori* credibilities so as to favour the telepathic interpretation,

given likely biasing artifacts. Just Bayesian rationality — but it doesn't rule out openness to surprising scientific advances analogous to those in the history of science.

So what did I see and hear? What seemed to influence the audience most was a film strip of a dog going to the door shortly prior to the arrival of his owner, despite randomly engineered arrival times. We didn't learn enough about prior trials, however, and I saw nothing to rule out a well-known artifact: der Kluge Hans effect. There could readily be actions of those filming which could provide the critical cue — cues hard to control. We also saw a film strip of a parrot on one side of a wall somehow labeling what the experimenter was signaling on the other side of the wall, but we can only wonder what kind of cues might have inadvertently resonated through or around the wall. In short, these visuals were compelling for many but lacking a report of the rigorous controls that would be essential for confident interpretation.

With the title, 'The evolution of telepathy', **Sheldrake** offered the view that telepathic sensing of unperceived but present danger would have adaptive value. I think we could say, however, that there would be adaptive value in experiencing a sense of danger in response to various cues, even if the cues are imperfectly, or even randomly, associated with the actual presence of danger. A probabilistic defence is better than none. And could groups of animals in the field communicate telepathically? For evaluation of this claim we would need the most rigorous ethnological observation with the controls that rule out forms of more ordinary sensory communication, or simply common instinctive response patterns.

In elaborating his own explanation, Sheldrake is in essence implying that consciousness extends out beyond the brain, a claim developed in a workshop entitled 'Panpsychism', by **David Skrbina**, **Stephen Deiss** and others. I will also mention the keynote address of **Auten Clark** here, an address that began, surprisingly apart from his title and abstract, with the question 'Is consciousness really all in the head?', a question with a 'No' treated sympathetically throughout the talk. Nevertheless, the 'direct perception' and 'realism' in interacting with the environment, a common assumption within ecological psychology from Gibson (1979) onward, someone cited by Sheldrake (2005b) and others in this context, are not equivalent to consciousness inhering in the environment.

Dick Bierman and associates briefly summarized experiments focusing on anticipation of stimuli, reported as enhanced by certain meditative experiments — effects they alternatively interpret as

'time-reversal'. With Bierman's report that effect sizes were generally small and in some cases not replicated, I won't comment further.

Two avowed sceptics, **Jon Allen** and **Steven J. Barker**, discussed the 'sense of being stared at', as well as 'a sense of who is calling on the telephone', and raised questions about possible artifacts, noted failures of replication, and pointed sensibly to the need for rigorous signal detection theory analyses.

Some of what is presented within these three topics has led some in various societies to a less favourable image of this meeting. The important question, however, is this: Is the work in these three categories on a road to a most productive science of consciousness? For presentations of the first two, I would say 'In an early and quite limited way, probably'. Of the third, I would think it unlikely and possible only with findings and theory that would be dramatic and revolutionary.

4. Basic Elements of a Science of Consciousness

The science of a domain can be more productive under the influence of one or more metatheories, a more general formulation that can imply or suggest more specific theories for more specific sub-domains. We also need specific and valid assessments of those conscious states entering into mental episodes. And if there is reason to believe that the nature of the states or their lawful relations might differ with early development, we need studies examining that question.

Metatheory

In this presentation, as well as in their workshop, **Bernard Baars** and **Katharine McGovern**, addressed a fundamental question for the Global Workspace Theory, a framework that has been variously elaborated and highly influential: 'Is consciousness local or global?' As the Abstract concisely puts it, this workspace is global in providing access to multiple experiences including access by the observing self to objects of experience, a view of kinds of access elaborated in Baars (2002). But it can also accommodate more 'local' functions, as when there is limited work space for what can be attended. In his talk, Baars also drew upon studies of brain imaging that reveal wide spread activation in some cases, more localized activation in others. His view of 'contrastive analysis', elaborated in Baars (2003), was said to be the key, drawing here on Dehaene & Naccache (2001) for evidence of wide-spread activation with conscious perception and activation of

sensory regions with masked perception, interpreted — though controversially — as ‘unconscious’ perception.

Rafael Malach challenged the common finding that conscious perception ‘globally’ activates not only posterior visual areas but parietal and frontal areas — attributing this more wide ranging activation to the use of paradigms in which the subjects are instructed to respond to the stimuli. With subjects watching an engaging movie he found much less parietal and frontal activation, taking this to mean that the *perceptual* activity was principally mediated by posterior visual cortex. Fronto-parietal spread (and temporal?) was then hypothesized to reflect other common functions, such as attentional modulation, calls upon working memory, the introspection required for higher order awareness, and motor planning of the response and report.

Naotsugu Tsuchiya and his associates take the question to the monkey domain. They presented monkeys with ambiguous ‘structure from motion’ figures, and in another condition non-ambiguous figures, training them to ‘report’ their conscious perceptions, by responding, as the images flipped back and forth, then tracked accompanying brain activation indexed by temporally correlated spikes in neighboring neurons. Using a trained pattern classifier, an A' from SDT was computed and compared with a comparable measure for the ‘report’. Differential activation shortly after the stimulus was less correlated with the ‘report’ than later differential activation — and was interpreted as reflecting the physical stimulus properties.

In a keynote address entitled, ‘Is consciousness a dynamical state?’, **Wolf Singer** summarized evidence that I include in this section because it seemed to follow the same logic of contrastive analysis, contrasting conscious and subliminal perceptions (interpreted as unconscious), and coming to a similar ‘globalist conclusion’. On his view ‘functional states required for conscious experience are distributed in nature’, and ‘synchronization of oscillatory neuronal responses in the high frequency range (beta, gamma) plays an important role in gating the access of sensory signals to the work space of consciousness’ (Abstract).

Obviously there could be extended commentary on this general topic, but I will restrict this. Let’s notice first that asking whether *consciousness* is ‘global or local’ is to frame consciousness study within a *spatial* metaphor — a ‘workspace’ in Baars (1988) or the theatrical stage in Baars (1997). When asking about a particular conscious state we can recognize a ‘local’ focus of attention with a more ‘global’ background, but that kind of distinction seems limited to momentary conscious states. Brains literally have spatial dimensions, however,

and so the questions about *where* in a work space becomes asking how global or local *neural activation* is for some conscious function. But the *conscious* states within the illustrated global function — literal pre-attentive, attentional, reflective, associated thought, some plan or intention to respond, etc. — is a set of conscious states *temporally* rather than spatially distributed. We could say the same of an inference or decision. So we naturally ask: what is the form of the mental episodes by which the states are interrelated?

The global workspace framework has been more influential than any other in reviving the study of consciousness. It is a framework strongly analogous to the information processing framework within the computer metaphor, a metaphor that gave cognitivists the courage to ask about ‘cognition’ instead of just behaviour. (That, by the way, is what I saw as needed for a more widely acceptable focus on consciousness when I favourably read the manuscript draft of Baars, 1988). Nevertheless, I have believed that a central role for consciousness in the explanation of significant mental activities calls for something more analytic — for representation of the specific modes and contents and their interrelations within kinds of mental episodes, as well as their relationships to prior conditions and action. These significant mental activities are widely recognized, including in the writings of Baars, but in the ‘contrastive analysis’ of this framework, they are spatially placed, in consciousness or out, in more of the brain or in less, rather than submitted to specific theoretical analyses.

Development of consciousness

‘Why babies are more conscious than we are’ was **Alison Gopnik’s** title, one that draws our attention to the more subtle distinctions she extracts from the evidence. So does the metaphor she uses — a ‘lantern’ of consciousness for babies, but a ‘spotlight’ of consciousness for us. Attention for them is less focused and probably less often focused. More specifically, infants are said to have more ‘exogenous’ attention, drawn by the interesting and unexpected in the surround, and we have more ‘endogenous’ attention, that top down attention driven by more specific goals. Drawing on brain imaging, parietal and sensory systems were said to be peripherally activated at an early age, but we had to wait longer to get more out those frontal regions with top down activation (Gopnik, 2007). In essence, as I see it, babies are said to have ‘more’ consciousness in the sense of breadth of attentional spread, perhaps in the moment but also over the range of successive events, undistracted by more limited top down attention.

In answering Yes to the question in his title, ‘Does consciousness develop?’, **Philip Zelazo** could be seen as taking a contrary position, but I see what he and Gopnik present as complementary. Gopnik presents evidence for greater ‘breadth of consciousness’ in babies, and Zelazo is presenting evidence that the number of ‘levels of consciousness’ increases with development — both useful metaphors. On the Zelazo’s (2004) LOC model, there is the minimal conscious of something (literal awareness), the recursive conscious ‘labeling’ of it (attentional identification), self consciousness, and the reflective consciousness which itself has sub-levels, permitting iterative processing and the reflective use of more than one type of rule (e.g. sorting by shape or by colour in the experimental work he described). The summarized evidence pointed to an increasing ability to use these higher levels with increasing age — and in some work, evidence of developmental increases in prefrontal activity.

The third presentation, by **Sarah Ahter** and **Russell Hurlburt**, reported the results of a study directed at greater understanding of adolescent’s phenomenology and how it might differ from that in other age groups. The assessment procedure was the Descriptive Experience Sampling (DES), the use of a randomly activated beeper providing the signal for the subject to report their subjective experience of the moment, an event preceded by training of the subject and followed by conceptual analysis of the reports by the investigators. That training and analysis were directed at expunging ‘narrative, history, and presuppositions’ (Abstract). Interestingly, inner speech, sensory awareness, and unsymbolized (presumably nonverbal) thinking were most common, and imagery and feeling were the least common. The subject sample was small, and systematic comparisons with younger and older samples were not reported, but the preliminary results seemed to be that inner reflection and emotion, were less common than in adult samples. There was the speculation that adolescents felt emotion less, although they might infer its possession from their actions, as executed and as perceived. This could be viewed as a useful preliminary study.

In all three talks, the findings in themselves make a contribution by addressing interesting questions about development, and they also point to development of the kinds of conscious states that could participate in theoretical explanation of, and indeed make possible, some of the significant human phenomena I listed at the outset.

Assessment: First-person methodologies and the richness of consciousness

This symposium included conflicting views of the promise of first-person reports for a science of consciousness, a conflict with both sides earlier represented in a workshop directed by **Russell Hurlburt** and **Eric Schwitzgebel**, as well as in their jointly authored book appearing in 2007. The third, **Susanna Siegel**, brings a modern analysis to a classical problem — to what level of conscious content can visual perception go?

Chris Heavey and **Hurlburt** summarized results of several studies using Hurlburt's Descriptive Experience Sampling, summarized above for the study of adolescents. When a beeper sounded in these studies, one of six random beeps a day, subjects wrote a description of the experience at the moment, followed the next day by the usual interview and interpretation of their reports. The five experiences most frequently reported were inner speech, imagery, feelings, sensory awareness, and 'unsymbolized' thinking. In general, they found no significant differences across the genders, but they did find wide variation over persons in the frequencies of these various experiences.

Schwitzgebel described two extreme views, the 'rich' view that we have constant awareness of the identities of surrounding objects, and a 'thin' view that we are aware only of what is in the focus of attention. But isn't the answer, 'Neither'? We have awareness of identities in the focus of attention, 'identity awareness', but also what is only 'literal awareness' of the unattended surround. For the serious use of phenomenal reports, he raises the problem of memory loss and the classical perception theorist's problem of the 'stimulus error' — describing things as they are known to be rather than how they are perceived. Nevertheless, today we can recognize that 'how it is perceived' and 'how it is believed to be' are both conscious contents that can participate in significant mental activity. He does, however, point to the important general need to meet memory conditions when using phenomenal reports.

In a talk usefully entitled 'Phenomenal contrast and the high-level contents of consciousness' **Susanna Siegel** reviews evidence in which discrimination procedures have been used in order to demonstrate differences in various types of stimulus inputs, asking whether they produce different levels of perception. This kind of evidence has led to the interpretation that higher order contents, those beyond colour and shape and motion are represented in phenomenal perception. Evidence has pointed to higher level perception of kinds, of

emotions, and of properties such as expensive and threatening, and of that special relation of causation — the latter consistent with earlier but controversial findings of Michotte (1963).

With the title of ‘first-person methodologies’, I would have liked to see a more general methodological discussion, although I did find evidence that raised important methodological questions. First of all, should first-person reports be treated as *first-person data* (as, for example, in Chalmers, 2004)? *Data reports* take as their referents what an *experimenter* observes, and thus must meet certain well established criteria of acceptability, including replicability over observers for common experimental conditions. That clearly is not possible in these studies, or in the many others in which conscious states vary interestingly and significantly over subjects — one of the principal reasons for the failure of ‘classical introspection’ with its subjects unacceptably in the role of a co-experimenter and actually termed the ‘observer’. The problem can be bypassed by recognizing that first-person reports can be reported in the experimenter’s *third-person data* language, with the conscious states specified in the experimenter-theorist’s *theory language*. We must in fact describe their relations theoretically, and in doing so we can have the same aims as those proposing a first-person data language. Second, what can be said about confidence in report validity? We first meet certain conditions, such as constrained focus on specific states, verbalizability of those states, avoidance of bias, and meeting of the memory conditions for the assessed state to be represented in higher order awareness. If validity challenges remain, we can rely on competitive support of the formulation, since theoretical and assessment hypotheses are both necessary for prediction and receive support from successful prediction. Subjective reports are suspect when they are used for the demanding claim of ‘null awareness’, but can enter into strong and validated quantitative relations among themselves and to other variables (e.g. Carlson & Dulany, 1988). This is a general logic of assessment validation.

A methodology of that kind goes beyond a too demanding classical introspection (Titchener, 1912), unconstrained ‘verbal protocols’ (Ericsson and Simon, 1993) — and it disregards the common but irrelevant objection that subjects can fail in explaining their own actions (Nisbett & Wilson, 1977). Theory is our business not the subjects’. In this context, I see these presentations as very interesting and valuable, but preliminary to the more systematic research needed.

Assessment: Brain imaging as mind reading technology

That was the title, but the presentations were more realistically limited. Two of these presentations addressed questions about the utility of available brain imaging techniques for answering significant questions about the presence of consciousness in coma and the presence of deception in legal testimony. The third illustrates the use of pattern analysis.

The work presented by **Adrian Owen** has asked whether it is less likely that patients with diagnosed coma would show evidence of mental activity as the complexity of the possible mental activity increases, using fMRI indices that have been associated with those kinds of mental activity in normal subjects. In essence, the findings have been positive in some cases with comparison to normals, but progressively less so with increasing complexity of the possible mental activity. A significant minority of vegetative patients showed the normal superior temporal-lobe activation in response to sound and speech. Fewer patients showed the more complex pattern of activation associated with understanding the meaning of sentences, and they were unable to express these meanings. Given the variability of the coma state and these results, the need for further confirmation was acknowledged.

Taking on another question of practical significance, **Daniel Langleben**, reviewed a number of studies using fMRI in an attempt to identify the activation accompanying deception. Since we know that deception can involve a number of mental processes, including emotional reactions, the preliminary nature of this work was made clear and was well summarized in his Abstract: ‘Specifically, the mostly unexplored contribution of emotion, memory, and theory of mind (Greze *et al.*, 2004) to brain activity during deception may determine the extent of individual variability of the brain’s fMRI response patterns during deception ... [and reveal] ... the limits of accuracy and the true clinical potential of fMRI-based lie-detector’. This work is important but at an early stage — for a science of consciousness when there is revelation of states within the mental episodes that constitute deception.

In his presentation, **Frank Tong** reported studies in which brain imaging is directed toward distinguishing conscious perceptual states that would be readily reported, in this case vertical or tilted grating, leftward or rightward motion, or a blue jay or a sparrow. In essence (and described more fully in Kamitani & Tong, 2005), a pattern decoder was trained to identify the linearly combined fMRI voxel

inputs for the different presented stimuli, with weights determined by a statistical algorithm ‘(weighted sum plus bias; bias component not shown)’ p. 680, then the trained decoder is used to identify the state experienced. Further tests of this kind were directed at distinguishing which of competing orientations was attended. Orientation was predicted by activation within sensory areas (V1–V4), and information specific to objects by activation of higher areas.

My comment? Brain imaging can be expected to become more technologically advanced and can be increasingly useful in assessment of *brain* states, especially with pattern analysing — and thus increasingly valuable in specifying brain states within theories of various mental activities. Certainly, too, uses of brain imaging could have a unique role when first-person reports are unavailable in coma and of questionable reliability in some legal interviews. Nevertheless, when a symposium presents brain imaging as ‘mind reading’, as assessment of *conscious* states, one kind of question to ask is just how good and useful that ‘mind reading’ is now compared with what is possible now with first-person reports of conscious states. For each of the experiences we can report, would the pattern analyser’s output (or any other available index) be constant over contexts, and persons, and insensitive to involuntary associations? Could we expect a dictionary of those outputs? That calls for precise identification beyond reliable discrimination. And is there a technique that will distinguish the *images* of two different absent objects — or two different *abstract* concepts such as justice and empathy? And what about propositional assertions about the self or others or anything? Or the degree of a mode carrying that content — the clarity of a perception, the strength of belief, the value of an experience, or an amount of pleasure or displeasure? Or for that matter, the degree that state is subjectively possessed — which can be diminished in neuroses and absent in some psychotic episodes?

5. The Name and the Aim

The meeting did have a Theme 5 that laced the various plenary sessions — ‘brain imaging and the brain’. Since it is common, however, for what is already known about consciousness to be used in order to learn something about a where, when, and perhaps a how of correlated brain states, we can see this work as contributing now primarily toward a science of the brain. The name and aim of this assembly does continue to suggest another focus. This commentary presents a particular perspective on what might move us toward a most productive science of consciousness.

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