# Walking in the Shoes of the Brain: An "Agent" Approach to Phenomenality and the Problem of Consciousness

by Dan Bruiger
dbruiger [at] telus [dot] net
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Abstract: Given an embodied evolutionary context, the (conscious) organism creates phenomenality[1] and establishes a first-person point of view with its own agency, through intentional relations made by its own acts of fiat,[2] in the same way that human observers create meaning in language.

## 1. Introduction

Beginning with Leibniz, it has seemed to many that there is an unbridgeable category gulf between one's conscious subjective experience and objective events in the brain[3] that presumably cause it. Even though many neural correlates of consciousness have been identified, it remains unclear how physical processes could bring about vivid conscious subjective states such as feelings, sensory experience of color, smell, sound, and touch, as well as more subtle experiences such as memories, mental images, volition, thoughts, and dreams. Indeed, it remains unclear why in a material world there should be any such thing as conscious experience or exactly what purpose it serves [Chalmers 1995].

Part of the problem is that the method and ontology of science have excluded from consideration the very subjectivity and teleology that are the traditional fundaments of mind, so that the challenge to understand the mental in strictly physical terms of efficient causation understandably meets with frustration. The traditional obstacle to understanding mind in a materialist framework is that a *causal* explanation is sought for processes that must rightly be considered *intentional*. It is thus necessary to regard the physical brain not only as a causal system, but quintessentially as an intentional or virtual system as well—an agent with its own purposes and point of view distinct from those of the scientific observer. Therefore, let us here consider a system such as the brain to be such an *agent* as well as being a *patient* (in the archaic sense of the term). The challenge will be to understand the role of intentionality in mental agency, why it is required for an explanation of consciousness, and how and why an agent creates its phenomenality.

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[1] For clarity, I use the term 'phenomenality' to refer to the entire domain of what can enter consciousness, which includes sensory experience, emotion, imagination and memory, dreams, thought, etc. In short, everything for which there is "something it is like" [Nagel 1974] to be in that state. In many cases, it will refer in context to sensory experience.

[2] *Wiktionary:* fiat: "An arbitrary or authoritative command or order to do something; an effectual decree." *Online Etymological Dictionary*: " 'authoritative sanction,' from Latin *fiat* 'let it be done'…, third person singular present subjunctive of *fieri* 'be done, become, come into existence'…, used as passive of *facere* 'to make, do.'" [http://www.etymonline.com/index.php?term=fiat]

[3] I use 'brain' as an abbreviation for the whole information-processing system of an embodied environmentally embedded organism with a co-evolutionary history among other organisms—not merely the central nervous system or the matter inside the skull.

The computational metaphor has been widely used for insight into the representational aspect of the mental, but widely criticized for endorsing a view of mind as disembodied. It has also been challenged for keeping the terms of discussion within the framework of efficient causation associated with mechanism [Rychlak 1994]. Yet, the deeper significance of computation as an approach to mind may be just the opposite of its mechanist association. Despite assimilating mind to machine ontologically, it invokes the intentionality of the human programmer who is, so to speak, epistemically put in the shoes of the brain. One is thereby positioned to grant the system itself a point of view.

Toward this end, I propose the active and autonomous nature of mental agency as *original cause*, the very opposite of the traditional passive dependence of the physical that is enshrined in the notion of efficient cause. Reductive explanation in this context will not appeal to efficient causes transmitted throughout a physical system, as identified by an external observer. Rather, the system will be treated as an originating cause with a point of view and reasons of its own. The appropriate explanatory strategy is then to identify with that point of view in order to engage the cognitive tasks facing the system.[4]

## 2. Distinguishing among agents and points of view

Intentionality is widely held to be a telltale sign of mental agency, to be contrasted with the causality that characterizes inanimate matter. Intentionality typically involves reference, of something to something else ("aboutness"). However, reference is not a property, state, or relationship inhering in or between things, but an *action* (i.e., intending) performed by an agent that needs to be specified. It is an operation of relating or mapping one thing or domain to another. These domains may differ in their fundamental nature—again, as defined by some agent. A picture, for example, might be a representation, in the domain of painted images, referring to a real landscape. (As such, it is the painter who first does the referring.) Similarly, a person might represent her thought, perception, or intention in a verbal statement, to which others may subsequently refer in various ways. The relevant agents, domains, and mappings must be specified before intentionality can be properly characterized.

The rings of a tree, for example, may seem to track the age of the tree, or periods or environments favorable to growth [Montague 2010]. Yet, it is the external observer, not the tree itself, who establishes this relationship and who makes the reference or connection and does the tracking. Connections made by the tree itself (if such exist) are of a different sort. In all likelihood, the tree rings involve *causal*, but not *intentional* connections. On the other hand, we must assume there *are* systems besides human beings that do the kind of things we mean by referring, intending, and representing. In the case of such systems, it is paramount to distinguish clearly the intentionality of the system itself from that of the observer.

The understanding of intentionality that descends from Brentano generally fails to make this distinction, largely because it is tied to human language usage. "Reference" is

[4] Note that such an approach does not imply an indefinite recursion of agents within agents, but points rather to a special executive function within the brain where the buck stops. The interloper is the investigating observer, not some part of the system required to serve as another interior observer.

taken for granted to mean linguistic reference or something modeled on it. Intentionality is thus often considered inherently propositional, without the explicit caveat that—strictly speaking and so far as we know—only people formulate propositions. Toward a more useful notion of intentionality, we need a broader notion of 'proposition' as an assertion or connection *made by a system itself, for its own ends and reasons*. Intention must be thought of in an appropriately abstract sense, as a mapping made by an agent.

While human observers, following their own intentionality, make assertions of causality, intentional systems in general perform operations that must be viewed in their own right, quite apart from whatever physical processes a human observer may propose to account for them. This runs counter to Dennett's [1987] understanding of 'intentional system' as a system to which a human observer imputes intentionality as a matter of convenience, according to the "intentional stance." Effectively, his bias excludes systems other than human beings from having their own intentionality. This reflects the longstanding mechanist bias of western science from its inception: that matter inherently lacks the power of original causality we attribute to humans (or gods) as agents, and can only passively suffer the transmission of efficient causes [Bruiger 2016].

The upshot of all this is that the project to explain consciousness scientifically requires some distinctions that are often glossed over. One must clearly distinguish causal relations (between brain states and environment) from intentional relations. And one must distinguish the observer's speculations from the brain's actual strategies considered from its own point of view. In other words, an observer is free to speculate concerning both causal and intentional connections occurring between organism and world; but, we should bear in mind that such speculations are literally assertions made by the observer, from her perspective. With that caveat, the observer may propose specific connections that she believes the brain (organism) makes, in order to try to understand the latter's intentionality. That is, she may attempt to model brain processes from the organism's own perspective, as involving *its* assertions, as much as that is feasible from an outside perspective. Such modeling is, in effect, an attempt to "walk in the shoes of the brain."

To grasp phenomenality as an expression of a system's proper intentionality, one must also distinguish the phenomenality itself from propositions (facts) that may be asserted about phenomenal content or derived from it. While I am the unique witness of my own phenomenality, I am also an agent who may formulate propositions regarding its content. These enter the public domain when expressed, either as facts about the world or about the experience itself. Effectively, an intentional analysis of brain processes is obliged to proceed in terms of propositions, as a third-person description.[5] This is least problematic when dealing with human cognition, since humans are language users who normally translate their thoughts into verbal sentences. It is more problematic when dealing with other creatures. We must be clear, however, that in all cases the propositions concerned are put forward by the observer, even when imputed to the subject or system observed, and even when the subject and the observer happen to be the same individual. That said, the theorist can do no better than to formulate propositions that theoretically correspond to operations of the system in question, putting herself in the place of the system to try to fathom its strategies. This does not, of course, imply that a brain "thinks"

[5] The view that intentional relations *necessarily* involve propositions, or something like them, has been dubbed *propositionalism* [Montague 2010]. Following Dennett, one might also call it the *propositional stance.*

in human-language sentences any more than does a computer (which "thinks" rather in machine language).[6]

In the perspective presented here, phenomenality is grounded in intentionality, rather than the other way around. *All* mental activity is necessarily intentional, insofar as the connections involved are made by the organism for its own purposes. Phenomenal states are thus a subset of intentional states, produced by a specialized function within the system, and serving a different purpose from non-conscious processes. This does not preclude that intentional connections can be about representations or phenomenality, since phenomenal content itself can be earmarked as an object of consciousness. The point to bear in mind is that two domains of description are then involved. Intentional description is the observer's third-person domain of speculation about the intentionality of the subject, while phenomenal description is a first-person description by the subject herself. Talk of phenomenality as though it constitutes a public domain—to which multiple subjects or the outside observer have access—only leads to confusion.[7]

## 3. An "agent" approach

As noted, consciousness is a special function, serving a different purpose from non-conscious representation or simple reflex. While a great deal of human behavior is performed without conscious attention, if the action cannot be done by rote, if it confronts a novel, demanding, or otherwise mobilizing situation or requires planning and forethought, conscious attention is brought into play. This suggests that phenomenality makes real-time sensory input available to higher centers to deal with situations that are not already handled automatically.[8] Phenomenality is "what it is like" to be an agent engaged in that special function, which an observer would characterize in terms of the agent's internal operations. The explanatory task is to relate these disparate perspectives or domains, rather than to attempt a reduction to efficient causes.

Let's say you experience a tickle in the throat and immediately you begin to cough. What is the relation between the tickle sensation and the behavior of coughing? The experience does not *cause* the behavior, in the sense of efficient causation, for scientific

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[6] Similarly, we cannot strictly say that a brain "processes information", which is a conscious-level notion circularly projected back upon the brain that produced it.

[7] Montague [2010], for example, asks whether two people thinking the same thought share the same cognitive phenomenology. My answer is no, for two reasons. First, the notion of "the same cognitive phenomenology" commits the error described above: a first-person experience is not available to multiple subjects; the notion that it *could* be available derives mistakenly from treating it third-personally (as an object in the public world). Second, the "thought" in question is probably a linguistic proposition; for two agents to have "the same thought" means only that they would express their respective experiences or intentions in identical (or equivalent) verbal statements.

[8] While awareness of initiating motor activity, for example, comes *after* the neural processes that have actually caused the activity, this awareness serves as the basis for choosing *future* action, or action in a larger context [Frith and Metzinger 2013]. The conscious experience indicates *acknowledgment*, after the fact, of the particular unconscious processing, and constitutes a monitoring function.

description does not allow anything outside physical processes or entities as causally effective. Yet the tickle sensation does play a functional role by representing a state of your organism. The tickling signifies a state of affairs upon which you (an agent) might act voluntarily, independently of the cough reflex. While coughing *behavior* can be an unconscious reflex, the *sensation* serves further to inform you about the occurrence of the reflex and the condition to which it responds.

Similarly, there is more or less programmed behavior associated with other sensations, whether somatic (such as itching, pain, hunger, thirst, desire) or externally oriented (such as sweetness, bitterness, or attractive and repulsive odors). Certainly, these latter sensations bear information about the proximal stimulus and the appropriate response. They also bear implicit information about the organism's priorities. The associated behavior contains the *meaning to the organism* of the sensation—that is, what it should do about the stimulus on the basis of its priorities. However, other sensations—such as provided by sight and hearing—often lack any obvious behavioral concomitant and even a proximal stimulus in the above sense. What is the "meaning", for example, of specific color sensations? Yet, even the relatively detached information gathering by the visual sense must have its evolutionary roots in affective values [Dennett 1991, p181]. The very existence of color categories (hue) indicates an affective significance, since they clearly reflect priorities of the organism more than properties of light or surfaces.[9]

Having priorities is a matter of intentionality, which doesn't of itself require consciousness. In many circumstances, it is enough to take appropriate non-conscious action with regard to various stimuli. In large part, however, the very nature of the distance senses removes them from the urgency for *immediate* response involved in direct physical contact, thereby allowing higher-level valuation. Because of distance, there is time to *consider* response on a distinct level of behavior. In contrast, the event with most immediate consequence is direct physical contact, of which the sense of touch yields a perception in which the phenomenality (where it exists) and the behavior associated with it form a unified whole with the valuation underlying them.

A paradigm example is pain, which is at once feeling, evaluation, and response. To the conscious organism, the meaning of pain lies in the associated behaviors of withdrawal, wincing, avoidance, protection of an injured part, etc. But the pain response has two phases, corresponding to two neural pathways (c-fibers and a-fibers).[10] One is a quick (unconscious) reflex reaction—for example, removal of the hand in response to contact with a hot surface. The slower response of lingering conscious painful sensation reflects an ongoing, *internally generated* stimulus, which acknowledges the tissue damage during the process of healing over time. It comes too late to avoid damage from the original encounter, but serves to avoid further or future damage and to facilitate

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[9] Human beings enjoy color vision because they are primates, which occupy a common niche with birds and insects. The diets of Old World primates consist significantly of fruits that (when ripe) are yellow, orange or red [Tsou 2013]. It makes sense for these food items to stand out as significant from a background of foliage. In the forest context, at least, the color red serves to alert the creature to something singular.

[10] As Dennett [1978, p200-202] points out, the physiology of pain is more complicated than this, involving separate channels through the "old brain" and the "new brain," and also the possibility of other pathways influencing the experience of pain. This does not affect the argument here, which concerns the grounding of the felt quality of pain in the associated response.

healing. It forces the organism to favor that part.[11] The associated response is protective behavior and (in the case of social animals) expressions of the injured state to others.

A similar divide between quick and slow pathways exists in the visual system, where an initial fast wave of visual processing happens outside consciousness, and is made available to subsystems for immediate responses. This is followed by a slower phase of "recurrent processing" that involves integration of various brain areas leading to conscious experience [Revonsuo 2010]. There is neurological evidence that phenomenality in general involves self-generated efferent nerve activity, as well as passively received afferent signals [Ellis 2000, p44].

## 4. How the brain creates phenomenality

How does a system of intentional relations come to have phenomenality? Any answer must involve the meaning of these relations to the system itself. I propose that the meaning to itself of the brain's internal connections should be understood on the model of the meaning that emerges for a human language user in the acts of reading, writing, speaking or hearing speech. A person communicating translates conventional linguistic symbols (written or aural) into mental images, thoughts, and feelings, or vice versa. Similarly, the brain assigns meaning to its own internal representations, evoking phenomenality in the way that words evoke mental images, namely by fiat and convention.

It might be objected that it is as much a mystery how mental images arise through communication as how phenomenality arises. However, more than analogy is involved; for, meaning emerges in language and qualia alike through simple predication.[12] Qualia are thus intelligible meanings asserted by an agent, as are the meanings the language user assigns to the babble of spoken syllables, the squiggles on a written page, or the significance the mathematician lends to given algebraic symbols by fiat: '*let x stand for such and such...*' By the same token, pain *stands* for tissue damage, even in those instances when there is no actual damage.

We do not normally question our own brain's reasons for its internal connections, nor have conscious access to them. Yet, it is only from an observer's perspective that they would appear *merely* conventional or un-compelling, because the observer is not in the position of being the agent that assigns the meaning. It may then appear mysterious that neural connections carry or imply meaning at all, and leave us unsatisfied concerning the relation between experience and behavior, mental and physical. This is because the observer is then, by default, looking for causal connections, while the relevant connections are not causal but intentional, even when explainable in causal terms. These

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[11] One may infer that insects, which do not seem to favor damaged parts, do not experience pain as a result of such injuries [Eisemann et al 1984]. In my opinion, this justifies the belief that insects do not experience anything at all: they have no phenomenality.

[12] The notion of 'fiat' here parallels Rychlak's [1994] 'predication', but includes more generally the elementary levels of neural connection made by the brain as an agent. 'Predication' is tied to categorization in the context of Rychlak's logical approach to the study of human psychology [p.15, p.309]. Our views about the nature of 'agency' are in general agreement, but a point of difference is that he seems to believe that a machine cannot possibly become an agent [p.1].

respective levels of explanation may overlap in the case of simple behavior, such as reflexes. One may then mistakenly think that some stimulus in the environment causes the response, without invoking the mediating agency of the organism. The *reasons* for the response in the case of reflex may lie hidden in the organism's evolutionary history and be said to belong to the agency of Nature.

Now, evolutionary advantage can explain, for example, the observable behavior of color *discrimination*—and why things appear to be *differently* colored—but not why a particular wavelength of light appears just so and not otherwise. It does not tell us why the chlorophyll of foliage does not appear red and the ripe fruit green, which would maintain the same relative contrast for discrimination. It does not tell us why it should not appear as some unimagined color experience. What is it about the qualitative experience of greenness that commends it to represent foliage in the vocabulary of the senses? And what about redness commends it to represent things that must stand out against that particular background?

This is rather like asking why a particular meaning is denoted in a given language by a particular word, written and pronounced its specific way, rather than by some other symbol. For the native language user, the association of the word with what it represents seems natural and unquestionable, though of course it is actually a social convention. The internal language of the organism may be no less conventional and historically contingent in its use of symbols. Given a symbolic system, s*ome* symbol must be chosen. However arbitrary, it will inevitably come to seem *imbued* with the meaning it conveys. Hence, it is backwards to ask why grass appears green; rather, greenness is what it is by virtue of the association with grass. Given consciousness as a symbolic system, greenness is the way we visually experience the totality of associations related primarily to chlorophyll.

One can acknowledge the arbitrariness of words because human languages use different terms for what is presumably the same phenomenal experience. The phenomenal experience itself, however, cannot be compared interpersonally. The *sensation* of greenness, unlike the words *green* or *vert*, is not merely a linguistic convention interchangeable with other conventions or subject to social change. Rather, it is a convention of neuro-logical organization, with the force of long genetic precedent. While the words of a natural language are transient and relative to culture, the meanings of qualia are more universal and enduring, backed by the relative stability of biology and the natural environment. Indeed, the human cognitive system adapts to the distortions of colored lenses or filters in such a way that color experience—of verdant foliage, for example—is eventually restored to normalcy [Neitz, et al 2002]. The sensation of greenness is what it is, and different from the sensation of redness, precisely because of the real-world things it refers to in our common evolutionary history, from which it cannot be arbitrarily dissociated.[13]

Sensory qualia are thus not something gratuitously added to the information they represent, nor are they "caused" by it, any more than words are caused by the things they represent. Rather, they are a *version* of that information an internal agent presents to itself synoptically in consciousness. Qualia, in other words, are a way the embodied subject first-personally presents to herself physical information that an observer also might detect

[13] This is why there can be no "inverted spectrum," which is the "apparent possibility of two people sharing their color vocabulary and discriminations, although the colors one sees... are systematically different from the colors the other person sees." [Wikipedia: inverted spectrum].

by means of laboratory equipment and describe in terms that are third-personal, physical, propositional, and quantitative. If the specific phenomenal quality of greenness (for example) seems to convey privileged or ineffable information beyond that involved in the public analysis of light, this is because it also bears information about the organism's internal communication system, its relationships to the world, its priorities and evolutionary history. One could compare this to the connotations of words implicit in their etymological history, in contrast to explicit dictionary definitions.

## 5. Fiat

I propose further that qualia in general involve the same sort of acts of fiat as demonstrated in the visual blind spot and other perceptual completion effects. In the case of the blind spot, the experience of continuity of the visual field is the brain's way to represent to itself its (true) belief that (despite the blind spot) the external world is visibly continuous. The brain affirms that conviction by an act of fiat, which ignores the sensory discontinuity, or "fills in" phenomenal experience in the visual field between the enervated retinal areas on either side of the un-enervated area.[14] However, all enervation is discrete, with gaps between receptors, which *in turn* must be "filled in" phenomenally, but on a finer scale, and temporally as well as spatially (so that there is continuity of motion). That is, in all cases the brain asserts continuity across discrete structures or events when their discreteness is irrelevant, just as it asserts continuity between frames of a motion picture. This is how the world has an analog look despite sensory digitation.

Such phenomenal assertion may be expressed propositionally. Suppose you notice a painting or photograph on the wall in your peripheral vision or from a distance. You might at first only recognize *that* it is a painting or photo, with a certain variety of colors and shapes and of a certain size. You perceive more when you approach or focus on a particular area; attention is directed to search out details within the limited visual area of the fovea. Noticing a "detail," however, is much the same as noticing that it is a painting, but on a finer scale: in both cases it is a matter of making an assertion.[15] "Seeing" a detail is seeing *that* something is so, just as you recognized that it was a painting. And seeing that something is so is a matter of cognitively *deciding* that it is so.[16] In other words: an act of fiat.

The agent does not encounter its own representations, as one encounters external objects, but *makes* them as ongoing notations to itself. These tend by nature to be definite

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[14] Dennett [1987] has famously criticized the notion of filling in, while others have disputed his interpretation. However interpreted, my point is that this phenomenal effect occurs broadly as a feature of perception.

[15] Even perceptual images are only relatively detailed. The impression of unlimited detail in sensory experience is illusory, since it is actually no more than the assertion *that* there is unlimited detail. This assertion is backed up by the fact that the senses (in contrast to mental images) can usually access additional information about the external world upon demand.

[16] This decisiveness gives perception its digital nature. One may speculate that qualia are built up essentially from primitive assertions at a lower level, in the way that a digital image is built from pixels [MacLennan 2005, sec3B]. Each "pixel" may represent a simple decision (1 or 0), to be integrated as the basis for assertions on higher levels.

and decisive acts even when mistaken. In some anomalous cases there is no *definitive* assertion (as illustrated by the Necker cube and other ambivalent figures about which the brain cannot make up its mind). Yet, in the moment, until countermanded by further assertions, the act is made with the tautological, if provisional, finality of all declarations by fiat (such as the divine 'Let there be light!', the captain's 'Make it so!', or the infamous 'Let them eat cake!'). And it is only this act of fiat that makes it so, without which there could be no presentation in consciousness at all. This unequivocal action is the basis of phenomenality in particular and of the intentionality of mind in general. Without taking it into account, a traditionally causal explanation of consciousness and behavior alike remains unintelligible. With it, one can at least begin to grasp the brain's challenges in terms that we can humanly relate to, since our very experience reflects the brain's pragmatic solutions.

## 5. Summary Conclusion

For historical reasons, science has been largely preoccupied with efficient causation and the observer's point of view, to the exclusion of teleology and subjectivity. By definition, such an approach precludes a scientific explanation of phenomenality. To overcome this obstacle to understanding consciousness scientifically, an "agent" approach is necessary (and perhaps sufficient). Even within a mechanistic framework, brain processes must be deemed to occur in an intentional system, whose agency must be considered from its own point of view. The human brain creates phenomenality as an efficient way to monitor the world, the body, and their ongoing relationship with respect to the future. Such conscious monitoring plays a role distinct from non-conscious behavior. A conscious physical system generates qualia by its own acts of fiat, effectively on a linguistic model, as internal notations. While conventional, the meanings of these notations are stably informed by the organism's priorities, established through embodied participation in an evolutionary history.

## REFERENCES


Bruiger, Dan (2016) *The Found and the Made: Science, Reason, and the Reality of Nature* Transaction Publishers (Routledge)

Chalmers, David J. (1995) "Facing Up to the Problem of Consciousness" http://consc.net/papers/facing.html, p16 (postprint from *Journal of Consciousness Studies* 2(3):200-19

Dennett, Daniel C. (1978/1981/1996) *Brainstorms* Bradford (MIT Press)

Dennett, Daniel C. (1987) *The Intentional Stance* MIT Press.

Dennett, Daniel C. (1991) *Consciousness Explained* Little Brown & Co

Eisemann, C.H.; Jorgensen, W.K.; Merritt, D.J.; Rice, M.J.; Cribb, B.W.; Webb, P.D.; and Zalucki, M.P. (1984) "Do Insects Feel Pain? – A biological view" *Experientia* 40

Ellis, Ralph (2000) "Efferent Brain Processes and the Enactive Approach to Consciousness" *Journal of Consciousness Studies* 7, no. 4

Frith, Chris D. and Metzinger, Thomas K. (2013) "What's the Use of Consciousness?" *(https://www.blogs.uni-mainz.de/fb05philosophie/files/2013/04/Frith_Metzinger_Regret_2016_penultimate.pdf)*

MacLennan, B. J. (2005) "Consciousness in Robots: The Hard Problem and Some Less Hard Problems", preprint of ROMAN 2005. IEEE International Workshop on Robot and Human Interactive Communication

Montague, Michelle (2010) "Recent Work on Intentionality" Analysis Reviews Vol 70 | Number 4 | October 2010 | pp. 765–782

Nagel, Thomas (1974) "What Is It Like to Be a Bat?" *The Philosophical Review*, Vol. 83, No. 4., pp. 435-450

Neitz, J., Carroll, J., Yamauchi, Y., Neitz, M. & Williams, D. R. (2002) "Color Perception Is Mediated by a Plastic Neural Mechanism that Is Adjustable in Adults" *Neuron*, 35, pp783–792

Revonsuo, Antti (2010) *Consciousness: the Science of Subjectivity* Psychology Press

Rychlak, Joseph (1994) *Logical Learning Theory* U. of Nebraska Press

Tsou, Jonathan Y. (2013) "Origins of the Qualitative Aspects of Consciousness: Evolutionary Answers to Chalmers' Hard Problem" preprint for chapter in Liz Swan (ed.), *Origins of Mind* Springer, pp259-269