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Origins of the Qualitative Aspects of Consciousness: Evolutionary Answers to Chalmers' Hard Problem

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ABSTRACT: According to David Chalmers, the hard problem of consciousness consists of explaining how and why qualitative experience arises from physical states. Moreover, Chalmers argues that materialist and reductive explanations of mentality are incapable of addressing the hard problem. In this chapter, I suggest that Chalmers' hard problem can be usefully distinguished into a 'how question' and 'why question,' and I argue that evolutionary biology has the resources to address the question of why qualitative experience arises from brain states. From this perspective, I discuss the different kinds of evolutionary explanations (e.g., adaptationist, exaptationist, spandrel) that can explain the origins of the qualitative aspects of various conscious states. This argument is intended to clarify which parts of Chalmers' hard problem are amenable to scientific analysis.

In several works, David Chalmers (1995, 1996, 2003) has formulated the hard problem of consciousness in terms of various 'why-questions': Why does subjective experience arise from a physical basis? Why should the physical processing of the brain give rise to a rich qualitative inner life? Why is the performance of brain functions accompanied by experience? Chalmers suggests that these questions are mysterious and that science cannot satisfactorily answer them. In this paper, I argue that either Chalmers' why-questions do not fall within the proper purview of science, or there are evolutionary answers to them. With respect to the latter issue, I discuss evolutionary explanations of the subjective aspects of various conscious states. While these evolutionary explanations can address Chalmers' why-questions, they do not provide the kind of *global philosophical answer* that his questions demand. I suggest that such a global demand is an unreasonable constraint to place on a satisfactory theory of consciousness.

The main argument of this chapter is that evolutionary explanations can address Chalmers' why-questions. The paper proceeds as follows. In the first section, I explicate Chalmers' presentation of the hard problem as a challenge for reductive explanations of consciousness. Part of Chalmers' challenge for the reductionist is to explain *why* the qualitative aspects of experience (i.e., 'qualia') accompany brain states. In the second section, I suggest that Chalmers' challenge is misguided insofar as his why-questions either place an unreasonable constraint on what counts as a satisfactory explanation of consciousness, or there are evolutionary explanations that can address them. In the third section, I discuss evolutionary explanations for the origin of the subjective aspects of various conscious states (e.g., pain, color vision, orgasms). The different kinds of evolutionary explanations that can be given reveal the

sense in which Chalmers' demand for a global philosophical answer to his why-question (and hence, the hard problem) is misguided.

At the outset, it should be stated that the argument of this chapter does not address Chalmers' hard problem *in its own terms*. Chalmers' formulation of hard problem is a request for a *causal or proximal explanation* that can explain how and why consciousness is produced by the brain. The analysis of this chapter will not address this question. A fundamental assumption of this chapter is that Chalmers' formulation of the hard problem is ill-posed and in order to make steps towards addressing it, it is first necessary to reformulate Chalmers' general formulation of the hard problem into a set of more narrowly defined questions. The analysis of this chapter focuses on how science can address why-questions related to the origins of the qualitative aspects of consciousness. In engaging in this task, my aim is to clarify which parts of Chalmers' hard problem are capable of being addressed through empirical and scientific means.

Chalmers' Hard Problem and Why-Questions

Chalmers' hard problem is intended to pose a challenge for physicalist explanations of consciousness, and more generally, reductive explanations that aim to reduce the subjective aspects of consciousness to something more objective (e.g., brain states or functional states). In this regard, Chalmers' analysis augments Thomas Nagel's (1974) argument that any satisfactory explanation of consciousness must capture its qualitative aspects, or 'what it is like' to be an organism. Like Nagel, Chalmers contends that the subjective aspects of consciousness should not be neglected or eliminated in scientific explanations. Indeed, for Chalmers, explaining the subjective aspects of consciousness ("experience") constitutes the hard problem of consciousness:

> The really hard problem of consciousness is the problem of *experience*. When we think and perceive, there is a whir of information-processing, but there is also a subjective aspect. As Nagel (1974) has put it, there is *something it is like* to be a conscious organism. This subjective aspect is experience. . . . *It is widely agreed that experience arises from a physical basis, but we have no good explanation of why and how it so arises*. Why should physical processing give rise to a rich inner life at all? (Chalmers 1995, p. 201, emphasis added)

Here, Chalmers presents the hard problem as the task of explaining *how and why experience arises from a physical basis*. On this formulation, neither physicalist nor functionalist explanations can adequately address the hard problem since these explanations proceed precisely by reducing the subjective features of mentality (qualia) to objective (physical or functional) states, thereby circumventing the hard problem altogether (Chalmers 2003, pp. 104-105).

Chalmers' formulation of the hard problem can be distinguished into the following questions:

(1) How does experience (qualia) arise from a physical basis?

(2) Why does experience (qualia) arise from a physical basis?

Distinguishing the hard problem in this manner deviates from the spirit of Chalmers' analysis; however, there are good philosophical reasons for distinguishing Chalmers' how-question from his why-question (cf. Flanagan and Polger 1995, p. 321). Chalmers (personal communication) has indicated that what his hard problem is intended to solicit is a *proximal or causal explanation*, i.e., what I present in this chapter as the 'how-question' of (1). With Chalmers, I agree that (1) is a mysterious question, and science has made surprisingly very little progress in addressing this question. At present, we lack a strong scientific understanding of how our qualitative experiences (e.g., the felt quality of an emotion, the subjective experience of blue) arise from brain states. While I think that Chalmers' how-question is a hard problem that science cannot address, I will concede this point and not pursue the issue further in this chapter.[1]

This chapter focuses on critically examining Chalmers' hard problem as formulated in (2), which will clarify which aspects of Chalmers' hard problem are amenable to scientific analysis. While I maintain that the how-question of (1) is not answerable by scientific or empirical means, I suggest that the why-question of (2) is. Chalmers' presentation of the hard problem as a why-question is somewhat ambiguous, but at the very least this question asks *why*—in addition to the functional aspects of mentality—does consciousness include a qualitative experiential component? As Chalmers puts it:

> What makes the hard problem hard and almost unique is that it goes *beyond* problems about the performance of functions. To see this, note that even when we have explained the performance of all the cognitive and behavioural functions in the vicinity of experience – perceptual discrimination, categorization, internal access, verbal report – there may still remain a further unanswered question: *Why is the performance of these functions accompanied by experience?* (Chalmers 1995, p. 203, emphasis in original)

Chalmers suggests that explaining the performance of particular cognitive functions (e.g., the integration of informational contents) by specifying a physical mechanism (e.g., 35-75 hertz neural oscillations in the cerebral cortex) constitute the 'easy problems' of consciousness, and cognitive science is well-equipped to address these problems. However, the *further* question of why the performance of various cognitive functions is accompanied by experience is a hard problem:

> This further question is the key question in the problem of consciousness. *Why doesn't all this information-processing go on in the dark, free of any inner feel?* Why is it that when electromagnetic waveforms impinge on a retina and are discriminated and categorized by

[1] It should be noted, however, that from the perspective of materialists, (1) begs the question on behalf of the dualist. If 'mental states' simply *are* brain states (as in identity theory), then the question of how mental states *arise from* brain states is a pseudo-question for which there is no meaningful answer. Other materialists would reject Chalmers' (and Nagel's) methodological assumption that a satisfactory theory of consciousness *must* explain the phenomena of experience (or qualia). Some materialists object that this controversial assumption has not been sufficiently argued for, that it rests on a set of flimsy intuitions, or that it ultimately relies on a fallacious appeal to ignorance (Churchland 1996; Dennett 1996; cf. Chalmers 1997). Moreover, some eliminativists argue that the class of things regarded as 'qualia' are too poorly defined to constitute a proper explanandum, and hence, qualia should be eliminated (rather than explained) in a theory of consciousness (Dennett 1988; Churchland 1996).

> a visual system, this discrimination and categorization is experienced as a sensation of vivid red? We know that conscious experience *does* arise when these functions are performed, but the very fact that it arises is the central mystery. (Chalmers 1995, p. 203, emphasis added)

For the purposes of this chapter, it is useful to distinguish Chalmers' why-question into a more general and more specific formulation:

(a) Why are neural states accompanied by subjective experience?

(b) Why are particular neural states accompanied by subjective experience?

These two questions pose different kinds of challenges for reductive explanations of consciousness.[2] The more specific question in (b) demands that an adequate explanation of a neural state (e.g., associated with pain or color perception) must—in addition to specifying a physical mechanism—explain why it is associated with a particular subjective experience. The more general question in (a) is more demanding insofar as it requires that a satisfactory theory of consciousness must explain why the subjective aspects of experience (in addition to its physical and functional aspects) exist at all. Neither of these demands is adequately met by materialist (or functionalist) analyses of consciousness.

A Dilemma for Chalmers

In this paper, I argue that Chalmers' presentation of the hard problem as a why-question does not provide a grave challenge to materialist (or reductive) explanations of consciousness.[3] More specifically, I maintain that in its more general formulation, Chalmers' why-question falls outside the proper domain of science (and hence, an adequate scientific explanation of consciousness is not required to answer it) and that there are evolutionary answers for its more specific formulation. This argument can be formulated as a dilemma:

1. If Chalmers' why-question is (a), then there is an answer to this question, but it is not a question that science is required to address.

2. If Chalmers' why-question is (b), then there will be evolutionary answers for different mental states, but one can only expect to find answers for particular mental states on a case-by-case basis.

[2] Although I have distinguished Chalmers' why-question into a more general and specific formulation, these two questions are clearly related. In the conclusion of this chapter, I suggest that evolutionary answers to (b) will help to make progress on answering the more general question asked in (a). With respect to (a), I maintain that neural states are accompanied by qualitative experience because of evolutionary history; however, I resist drawing the stronger (*adaptationist*) conclusion that qualitative experience exists *because it was adaptive*. While the origins of the qualitative aspects of consciousness can often be explained in terms of their adaptive function (e.g., pain states or hunger states), I maintain that some conscious states are better explained by non-adaptationist explanations.

[3] The analysis of this chapter is intended to be neutral on metaphysical issues concerning dualism versus materialism. The main goal of the paper is to show that there are scientific explanations available for the reductionist and materialist to address Chalmers' why-question.

3. Thus, either Chalmers' why-question is not a question that science is obligated to answer, or there are evolutionary answers to it.

This dilemma suggests that Chalmers' hard problem—formulated as a why-question—should not be regarded as an intractable problem for materialists.

The more general interpretation of Chalmers' why-question asks: (a) why is subjective experience conjoined to neural states at all? Put in this form, this question is a query into why neural activity is accompanied by subjective experience (over and above its functional aspects). While I believe that there is an answer to this question, it is not the kind of question that science is obligated to answer. From this perspective, explaining *why*—for humans (and many animals)—neural activity is accompanied by qualitative aspects would appeal to contingent facts about the kinds of sensory organs and nervous systems that humans (and animals) have evolved to possess. As such, the answer to (a) would appeal to evolutionary history and explain *what it is like* to be a human (or bat, bee, dog, or shark) in terms of the sensory organs and nervous system possessed by that species. Accordingly, there is an answer to be given to (a); however, this answer might not be very interesting from a scientific perspective. At the very least, science would not provide the *specific global kind of answer* to (a) that Chalmers' question solicits.

By analogy, consider the question 'why is the sky blue?' To answer this question, one would appeal to facts such as the kinds of eyes that humans have evolved to possess and the kinds of wavelengths of visible light that normal human eyes can detect. If after being told these facts, Ruth thought that there was a *further fact* required to provide an *adequate scientific explanation*, then Ruth is making a conceptual error about what constitutes a satisfactory explanation. Similarly, if Tom is told that consciousness is accompanied by experience because of the kinds of sensory organs and nervous system that humans have evolved to possess, and he protested that there is a further fact needed to provide an adequate scientific explanation, we should conclude that he is confused. This analogy highlights some characteristics of (a). First, there is an answer for (a), but the proffered explanation would not fall within the class of questions that science normally addresses. Second, addressing (a) would appeal to contingent facts. Finally, it is simply confused to think that there is a *deeper explanation* to be given for such questions beyond pointing to various contingent facts (cf. Chalmers 1996, p. 111). Thus, a reductive answer can be given for (a); however, it is not the illuminating sort of explanation that Chalmers is seeking when he asks, "Why *should* physical processing give rise to a rich inner life at all? (Chalmers 1995, p. 201, emphasis added).

The more specific interpretation of Chalmers' why-question asks: (b) why are particular neural states accompanied by subjective experience? I think that there are evolutionary answers that can address this question. Chalmers alludes to this kind of response when he writes:

> There is an *explanatory gap* (a term due to Levine 1983) between . . . functions and experience, and we need an explanatory bridge to cross it. A mere account of the functions stays on one side of the gap, so the materials for the bridge must be found elsewhere. This is not to say that experience *has* no function. Perhaps it will turn out to play an important cognitive role. But for any role it might play, there will be more to the explanation of experience than a simple explanation of the function. Perhaps it will even turn out that in the course of explaining a function, we will be led to the key insight that allows an explanation of experience. If this happens, though, the discovery will be an

> *extra* explanatory reward. There is no cognitive function such that we can say in advance that explanation of that function will *automatically* explain experience. (Chalmers 1995, pp. 203-204, emphasis in original)

Chalmers maintains that the explanatory methods of cognitive science and neuroscience are insufficient to address (b). In this paper, I argue that evolutionary biology has the resources to help to bridge the apparent gap between functions and experience. In articulating this view, I assume that the *kinds of why-questions* that evolutionary explanations can address take the form: 'why is there any subjective aspect (as opposed to no subjective aspect) attached to a particular neural state?' This captures the thrust of Chalmers' (1995) question: "Why doesn't all this information processing go on in the dark, free of any inner feel?" (p. 203). *If* the kind of explanation that Chalmers is seeking is an answer to the question 'why is a particular subjective experience attached to a neural state *rather than another subjective experience*?' (cf. Chalmers 1996, pp. 99-101), then I think that this places the standard of explanation too high. I assume that humans *could have* evolved such that *some other subjective experience* accompanies a brain state (e.g., a pain state); however, it is a contingent fact that *this subjective experience* has evolved (which is the relevant explanandum that evolutionary explanations can explain). Since it is a contingent evolutionary fact, the demand to explain why *this subjective experience rather than some other* (functionally equivalent) *subjective experience arose*, in my view, sets the bar of explanation too high (far higher than is set in science).

While I believe that evolutionary explanations can address the question of why particular neural states are accompanied by subjective experience, we must be cautious about our expectations regarding what this research can tell us with respect to (b). If Chalmers wants to discover a ubiquitous kind of answer to (b) that tells us what *the function* of experience is (*in general*), then I think that no meaningful answer is forthcoming (cf. Chalmers 1996, pp. 120-121). At best, evolutionary research can provide explanations of why particular neural states are accompanied by specific subjective experiential aspects.

Evolutionary Explanations of Qualia

The kinds of evolutionary answers that can be given for (b) are discussed in William James' analysis of consciousness in his *Principles of Psychology* (1890, chs. 5-6). In the context of an argument (against epiphenomenalist theories) that consciousness has causal efficacy (cf. Robinson 2007), James points out that there is a certain correspondence between (i) beneficial and detrimental conscious states and (ii) the subjective experiences appended to such states:

> *It is a well-known fact that pleasures are generally associated with beneficial, pains with detrimental, experiences.* All the fundamental vital processes illustrate this law. Starvation, suffocation, privation of food, drink and sleep, work when exhausted, burns, wounds, inflammation, the effects of poison, are as disagreeable as filling the hungry stomach, enjoying rest and sleep after fatigue, . . . are pleasant. Mr. Spencer [1855] and others have suggested that these coincidences are due . . . to the . . . action of natural selection which would certainly kill off in the long-run any breed of creatures to whom the fundamentally noxious experience seemed enjoyable. . . . [I]f pleasures and pains have no efficacy, one does not see . . . why most noxious acts, such as burning, might not

> give thrills of delight, and the most necessary ones, such as breathing, cause agony. The exceptions to the law are . . . numerous, but related to experiences [e.g., drunkenness] that are either not vital or not universal. (James 1890, pp. 143-144, emphasis in original).

In this passage, James suggests that there are *good evolutionary reasons* for why certain conscious states are accompanied by particular subjective experiences. In particular, evolutionarily detrimental states (e.g., starving, being wounded, sickness) are associated with painful experiences, whereas evolutionarily beneficial states (e.g., being nourished, rested, or healthy) are associated with pleasurable experiences because these subjective experiential states themselves play a vital (causal) role in helping organisms survive and reproduce.

The Jamesian framework outlined above provides a beginning of an answer to (b): certain neural states are accompanied by qualia because these qualitative experiences play an important role in facilitating some function (e.g., seeking sustenance, avoiding physical damage) that promoted a species' survival and reproduction (cf. Cole 2002, p. 43). For conscious states that fall in this class, *adaptationist explanations* can explain the origins of the qualitative aspects of these states. For example, the qualitative experience of acute pain states (i.e., hurting) is evolutionarily adaptive insofar as these qualitative states helped teach organisms to avoid stimuli and situations (e.g., fire) that can damage their bodies (Polger and Flanagan 2002, p. 21). A creature that lacked qualitative pain states would be evolutionarily disadvantaged (see Pucetti 1975), and we can explain the origins of the qualitative aspects of pain states in terms of their evolutionary benefits. Hence, adaptationist explanations can provide answers to the question of why *some* conscious states (e.g., pain states, states of fatigue) are accompanied by particular qualitative experiences (e.g., hurting, feeling tired).

While it is tempting to think that the qualitative aspects of consciousness can always be explained in terms of their evolutionary benefits (e.g., see Tye 1996; Gray 2004), this assumption is mistaken (cf. Chalmers 1996, pp. 120-121). In this paper, I take a pluralist stance, which assumes that there are different kinds of evolutionary explanations (besides adaptationist ones) that can explain the origins of the qualitative aspects of various conscious states (cf. Polger and Flanagan 2002). This follows the recommendation of philosophers of biology (e.g., Gould and Lewontin 1979; Gould and Vrba 1982; Gould 1991; Lewontin, 1979; Lloyd 1999) who have warned against the adaptationist ("Panglossian") tendency to view all traits that organisms presently possess as *invariably* being naturally selected because they served some adaptive function. These philosophers emphasize that there are multiple evolutionary reasons for why various traits have arisen. Besides adaptationist explanations, other evolutionary explanations that can explain why a trait (e.g., qualia) exists include: (i) a trait emerged due to random factors (e.g., genetic drift, demographic events), (ii) a trait exists because of developmental effects (e.g., pleiotropy, allometry), (iii) a trait was once adaptive but is no longer so, (iv) a trait is itself not adaptive but a by-product of an adaptive trait (i.e., 'spandrels'), and (v) a trait is an evolutionary by-product but subsequently acquired adaptive value (i.e., 'exaptations').

As an example of a qualitative aspect of experience that was once adaptive but is no longer adaptive, consider the question of why humans have the particular qualitative experience of colors (e.g., red) when we perceive objects. Human color vision is trichromatic insofar as it is based on three photopigments contained in different retinal cones, which allows humans to distinguish over two million colors (Gray 2004, pp. 85). Most mammals are dichromats, and trichromacy is thought to have evolved 30 million years ago with the evolution of Old World primates. An explanation for why trichomacy evolved is that trichromacy allowed Old World primates to distinguish more sharply between colors in the red to blue range and their diets consisted largely of fruits that were yellow, orange, or red (Nathans 1999; Gray 2004, pp. 85-86). From this perspective, humans have a particular experience of the color red because we have descended from a species whose color vision conferred upon them an evolutionary advantage. While these qualitative aspects of color experience may have been adaptive in the past for early homo-sapiens, they are not necessarily adaptive in current evolutionary niches (e.g., where color-blindness will not significantly compromise an individual's inclusive fitness).

As an example of a qualitative experience that has a less obvious evolutionary history, consider the example of female orgasm. Among evolutionary biologists, it is widely agreed that the qualitative aspects of male orgasm (i.e., pleasure and ecstasy) evolved because it promoted reproductive success. However, this adaptationist answer cannot adequately explain female orgasm since females can become pregnant without experiencing orgasms. In a Chalmersian spirit, one could ask: why are female orgasms accompanied by a particular subjective experience? Elisabeth Lloyd (2005) has examined various competing answers to this question, including the following theories:

(1) Female orgasm evolved because it promoted an enduring attachment between males and females (i.e., pair-bonding).

(2) Female orgasm evolved to stimulate male orgasm.

(3) Female orgasm evolved because it promoted a higher rate of intercourse for females.

(4) Female orgasm evolved because it increased the likelihood of fertilization by facilitating a suction mechanism of the uterus.

(5) Female orgasm evolved as an evolutionary by-product of male orgasm.

Lloyd argues that the scientific evidence favors (5), which maintains that female orgasm did not emerge because it was evolutionarily adaptive, but as a by-product of male orgasm (i.e., as a spandrel). On this account, the evolutionary history of female orgasm is similar to that of male nipples. Male nipples exist because female nipples are adaptive and both sexes go through similar stages in embryological development. Analogously, female orgasm exists because male orgasm is adaptive and both sexes share the same embryological developmental history (such that the penis and clitoris share the same embryological origins).

The examples of color vision and female orgasm illustrate the *different kinds* of evolutionary reasons why conscious states might be associated with particular subjective features. While the reason why these subjective aspects exist can *sometimes* be explained in terms of the adaptive function of such experiences (e.g., pain states, states of nourishment), sometimes the subjective aspect of particular conscious states (e.g., female orgasm) will be explained as contingent evolutionary accidents (e.g., spandrels, exaptations). For this paper, what is important is not what the correct explanations are, but the fact that there are evolutionary answers that can be given for (b). If this view is correct, then there are respectable reductive (and materialist) explanations that can be given for (b).

Conclusion

In this chapter, I argued that evolutionary biology has the resources to address aspects of Chalmers' hard problem, and in particular, the question of why particular neural states are accompanied by specific qualitative features. In its more general interpretation, I argued there is an answer to the question of why neural activity is accompanied by subjective experience (which would appeal to contingent facts about the sensory organs and nervous systems that humans and other species possess through evolution), but it is not very scientifically illuminating. In its more specific interpretation, I argued that there are evolutionary answers to the question of why particular neural states are accompanied by subjective experience, but there will be a multitude of explanations. With respect to the relationship between these two questions, evolutionary explanations of why particular neural states are accompanied by qualia can be helpful for formulating a more precise answer to the more general question of why neural activity is accompanied by qualia (see note 3 above). The analysis of this chapter suggests that brain activity is accompanied by qualia because these qualitative aspects either are themselves adaptive insofar as they help organisms survive and reproduce, or they are (sometimes accidental) consequences of other adaptations. To assume that there is a *deeper philosophical explanation* to be given to these questions, however, is to commit a conceptual error.

In offering a naturalistic analysis of the hard problem, my discussion has shifted away from Chalmers' focus on identifying a causal mechanism that connects brain states to subjective experience (the 'how-question' of this paper). This neglect was intentional as I think that this issue is ultimately a metaphysical question that science does not have the resources to answer (and arguably, for which no meaningful answer can be given). By reframing Chalmers' why-question into a narrower question concerning why particular conscious states have specific qualitative aspects, my aim has been to show that there reductive explanations (viz., evolutionary explanations) available to account for the origins of qualia. While reframing Chalmers' hard problem in this way will be unsatisfactory to some insofar as it deflates the ambitions of Chalmers' challenge, I contend that the most promising route to progress on understanding the

phenomenon of consciousness is by addressing modest questions in a naturalistic manner, rather than trying to answer ambitious questions via conceptual analysis.[4]

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REFERENCES

Chalmers, David J. (1995) Facing Up to the Problem of Consciousness. *Journal of Consciousness Studies*, 2(3), 200-219.

_____. (1996). *The Conscious Mind: In Search of a Fundamental Theory.* New York: Oxford University Press.

_____. (1997). Moving forward on the problem of consciousness. *Journal of Consciousness Studies*, 4(1), 3-46.

_____. (2003). Consciousness and Its Place in Nature. In Stephen P. Stich and Ted A. Warfield (eds.), *Blackwell Guide to the Philosophy of Mind* (pp. 102-142). Malden, MA: Blackwell.

Churchland, Patricia S. (1996). The hornswoggle problem. *Journal of Consciousness Studies*, 2(5-6), 402-408.

Cole, David (2002). The Functions of Consciousness. In James H. Fetzer (ed.), *Consciousness Evolving* (pp. 43-62). Amsterdam: John Benjamins.

Dennett, Daniel C. (1988). Quining Qualia. In A. J. Marcel and E. Bisiach (eds.), *Consciousness in Contemporary Science* (pp. 42-77). New York, Oxford University Press.

_____. (1996). Facing backwards on the problem of consciousness. *Journal of Consciousness Studies,* 3(1), 4-6.

Flanagan, Owen, and Polger, Thomas (1995). Zombies and the Function of Consciousness. *Journal of Consciousness Studies*, 2(4), 313-321.

Gould, Stephen J. (1991). Exaptation: A Crucial Tool for Evolutionary Analysis. *Journal of Social Issues*, 47(3), 43-65.

Gould, Stephen J., and Lewontin, Richard C. (1979). The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme. *Proceedings of the Royal Society, London, Series B*, 205(1161), 581-598.

Gould, Stephen J., and Vrba, Elisabeth S. (1982). Exaptation: A Missing Term in the Science of

Form. *Paleobiology*, 8(1), 4-15.

Gray, Jeffrey (2004). *Consciousness: Creeping Up on the Hard Problem*. Oxford: Oxford University Press.

James, William (1890). *The Principles of Psychology*, vol. 1. New York: Henry Holt & Co.

Levine, Joseph (1983). Materialism and Qualia: The Explanatory Gap. *Pacific Philosophical Quarterly*, 64(October), 354-361.

Lewontin, Richard C. (1979). Sociobiology as an Adaptationist Program. *Behavioral Sciences*, 24(1), 5-14.

Lloyd, Elisabeth A. (1999). Evolutionary Psychology: The Burdens of Proof. *Biology & Philosophy*, 14(2), 211-233.

_____. (2005). *The Case of the Female Orgasm: Bias in the Science of Evolution*. Cambridge, MA: Harvard University Press.

Nagel, Thomas (1974). What is It Like to Be a Bat? *Philosophical Review*, 83(4), 435-450.

Nathans, Jeremy (1999). The Evolution and Physiology of Human Color Vision: Insights from Molecular Genetic Studies of Visual Pigments. *Neuron*, 24(2), 299-312.

Polger, Thomas and Owen Flanagan (2002). Consciousness, Adaptation and Epiphenomenalism. In James H. Fetzer (ed.), *Consciousness Evolving* (pp. 21-42). Amsterdam: John Benjamins.

Robinson, William S. (2007). Evolution and Epiphenomenalism. *Journal of Consciousness* Studies, 14(11), 27-42.

Spencer, Herbert (1855). *The Principles of Psychology*. London: Longman, Brown, Green, and Longmans.

Tye, Michael (1996). The Function of Consciousness. *Noûs*, 30(3), 287-305.