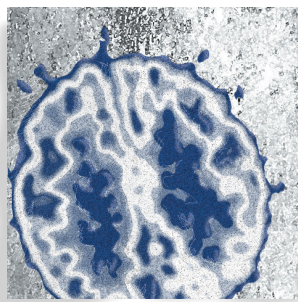


Consciousness regained? Philosophical arguments for and against reductive physicalism

Thomas Sturm, PhD



This paper is an overview of recent discussions concerning the mind–body problem, which is being addressed at the interface between philosophy and neuroscience. It focuses on phenomenal features of consciousness or “qualia,” which are distinguished from various related issues. Then follows a discussion of various influential skeptical arguments that question the possibility of reductive explanations of qualia in physicalist terms: knowledge arguments, conceivability arguments, the argument of multiple realizability, and the explanatory gap argument. None of the arguments is found to be very convincing. It does not necessarily follow that reductive physicalism is the only option, but it is defensible. However, constant conceptual and methodological reflection is required, alongside ongoing research, to keep such a view free from dogmatism and naivety.

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Origins and direction of the present debate

In the beginning there was skepticism. In a speech on the limits of knowledge of nature given in 1872, the eminent physiologist and physician Emil du Bois-Reymond demanded that mechanistic explanation be considered the hallmark of scientific treatment of a given subject matter. He then claimed that, alongside free will, we do not know, and will never know—*ignoramus et ignorabimus*—how to explain consciousness in physical terms:

What conceivable connection is there between specific movements of atoms in my brain on the one side, and the for me primary, not further definable facts that ‘I feel pain, feel lust; I taste something sweet, smell the scent of roses, hear the tone of an organ, see red’....¹

Note the examples used here: tastes, smells, sounds, and colors as a subject perceives them. Current discourse calls such phenomenal features of conscious states “qualia,” a term we owe to Clarence Irving Lewis.^{2,3} Roughly, our perceptions and feelings have a qualitative character to them—there is something *it is like* to be in those states or, stated differently, they are *phenomenally conscious* to the subjects who undergo these states. Examples may help to understand what is meant by such obviously not very lucid philosophical jargon. If I look at the color of a pair of socks inside a gloomy shop, it

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Basic research

may appear differently to me compared with how it appears outside in bright daylight; if I am pricked by a needle on different occasions, my experience feels a certain way to me, and it might also vary with my mood or attention. To use a more important example, one might also think of the distinctive kind of anxiety or depressive feeling a psychiatric patient suffers from when faced with a situation that healthy people perhaps find merely a bit worrying. However, regardless of such variations, what is most important about the qualia of feelings and perceptions is that they are distinctive to these mental states: they would not be what they are if they did not possess certain qualitative features.

Are qualia reducible to material states of the brain? This is sometimes said to be “the”—the only, or the most difficult, or the “hard”—problem of consciousness.⁴ Skepticism has often been the default position, not only among philosophers but among cognitive scientists as well:

Consciousness is a fascinating but elusive phenomenon; it is impossible to specify what it is, what it does, or why it evolved. Nothing worth reading has been written about it.⁵

John Searle makes a different but related point:

Until recently, most neuroscientists did not regard consciousness as a suitable topic for scientific investigation. This reluctance was based on certain philosophical mistakes, primarily the mistake of supposing that the subjectivity of consciousness made it beyond the reach of an objective science.⁶

Nowadays, in influential encyclopedia entries, one also reads such musings as: “Questions about the nature of conscious awareness have likely been asked for as long as there have been humans.”⁷ This is probably not so; and even if one “merely” claims that the topic of consciousness has been around since ancient times, that is misleading too. The problem of whether states of phenomenal consciousness can be identified with appropriate brain states cannot be found in Descartes or Kant. Attempts to read it into those and other authors distort their assumptions, arguments, and indeed their whole agendas.^{8,9}

For much of the 20th century, discussions about qualia often arose from epistemological questions—How do we *know* that a certain system has states of phenomenal qualia?—or from semantic problems—What is the precise meaning of the relevant terms?^{10–12} U. T. Place,¹³ J. J. C. Smart,¹⁴ and others defended the idea that the

mind is simply the brain, with new arguments. Their “reductive physicalism” was in turn attacked, especially in influential papers by Thomas Nagel,¹⁵ Frank Jackson,^{16,17} and Joseph Levine.¹⁸ Du Bois-Reymond’s skepticism was revived in various ways, provoking a flood of consciousness studies over recent years.^{4,6,7,19–28}

The relation between qualia and brain states is now primarily discussed from *ontological* and *explanatory* perspectives: are states of phenomenal consciousness and brain states two or one? Can we reductively explain qualia in neuroscientific terms? That is, in a first approximation, can we state neuroscientific laws that explain why a system is (and also why it is not) in a certain state of phenomenal consciousness, similar perhaps to the physical explanations for why a system is solid, liquid, or gaseous, or why it possesses the (objective) color or temperature that it possesses? Epistemology (including scientific methodology) and semantics clearly cannot be ignored in such debates; however, much current work in cognitive neuroscience and philosophy aims at clarifying whether a reductive explanation or identification of phenomenal and brain states can be achieved, and if so, how.

Conceptual preliminaries

What reasons ground the philosophical doubts? Are they plausible? Three preliminary remarks need to be made before any serious discussion can start.

Consciousness and mind

One should not identify thinking about the nature of consciousness with thinking about the nature of the mind in general. Consciousness is but one aspect of the mind, so the problem of consciousness is not identical to what is often called “the mind-body problem.” There are other philosophical problems regarding the mind. For instance, the problem of *intentionality*: How can it be that certain mental states (beliefs and desires, say) refer to entities or states of affairs that are external to themselves? Or the problem of *rationality*: How can it be that certain mental states are not merely causally related to other events, but can also be right or wrong, good or bad, reasonable or unreasonable? These and other issues regarding mental states need not involve consciousness; at least, it is not trivial to assume that they do and would require argument.

Meanings of “consciousness”

The term “consciousness” has different meanings (as do its cognates in other languages—French *conscience*, German *Bewusstsein*, and so on). We speak of people being conscious when they are generally aware or open to sensory stimulation, as opposed to being asleep, anesthetized, or in a coma. This basic consciousness is a precondition, but not identical to, phenomenal consciousness; the different feelings of pleasure and pain, or the sensations of various kinds hinted at in du Bois-Reymond’s statement. The distinction is important. Flohr maintains that anesthesia studies may well point to a physical explanation of consciousness, and argues more specifically for the role of N-methyl-D-aspartate (NMDA) synaptic activity as a necessary and sufficient condition for the presence of consciousness.^{29,30} However, what explains our being aware *at all* need not be what explains *specific* qualitative features of consciousness. Among those who have produced alternative neuroscientific accounts of basic awareness, Crick and Koch³¹ have carefully avoided conflating it with phenomenal consciousness. Theories that connect the two aspects of consciousness, eg, through notions of information and its integration, also respect the difference.³²

Next, there is “access-consciousness”³³ of what one thinks, believes, or desires. We can verbally report these states, reflect on them and reason about them, and, to some extent, even control them. Such consciousness need not possess any phenomenal features. I may be conscious of my believing that $F=ma$, or of my decision to buy one sort of toilet paper rather than another, but that consciousness does not require any qualitative features. Beliefs and decisions can perhaps be experienced in certain ways, but if they have qualitative features at all, these are not essential to them.

Furthermore, there is the questionable idea that consciousness and self-consciousness are the same. Mirror experiments show that great apes, elephants, and even bird species such as keas and European magpies can react purposefully to spots on their own bodies, and thus reveal a kind of self-recognition.³⁴ Many animals do not pass the test, but we would not say that they are unconscious or that their sensations or feelings are devoid of qualitative features. These and other possible meanings of the term “consciousness”^{22,24} must be separated if one does not want to confuse what one aims to explain, or what one’s neuroscientific data are about.

Problems of consciousness

There is not merely one philosophical problem that calls into doubt the possibility of a scientific treatment of consciousness. First, all problems depend on what we mean by “material states”—a question about which there is little clarity. The concept of matter has changed through history and will probably continue to do so.³⁵ It is also controversial what constitutes a reductive explanation of phenomenological generalizations—about temperatures of gases, say—to microphysical laws—in this case, the kinetic theory of heat.³⁶ Furthermore, with respect to all the aforementioned kinds of consciousness, we can ask whether they are reducible to brain states or processes. Even when we focus on only one kind of consciousness, there are further distinctions to be made. For instance, it is one thing to ask (i) whether brain states are *identical* to qualia; and another (ii) whether it is possible to *explain* qualia in physicalist terms. We will see the importance of this distinction below.

A short guide through major philosophical debates

In what follows, the focus is on phenomenal consciousness alone, although some of the following considerations can be recast for other aspects of the mind. I present a number of influential skeptical arguments concerning reductive physicalism about qualia in an order from less to more plausible, each followed by the most straightforward and plausible replies (often somewhat simplified). Sometimes, I also mention counter-replies, thereby indicating that the critic of the skeptical argument needs to do better, by giving another reply or by addressing further skeptical arguments as well.

Knowledge argument 1

Neuroscience has not yet helped us to understand the nature of phenomenal consciousness. “How can technicolor phenomenology arise from soggy grey matter?”²⁵ It is at least an open question as to whether physicalism is correct.

Reply 1

This is a weak appeal to ignorance. In the past, we did not understand the nature of combustion or electrical phenomena, and had mistaken views about many things from planetary motions to the composition of matter.

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Science does better now. Perhaps future neuroscience will similarly come to discover relevant laws and thus help us to explain how colors look the way they do to us or why our modes of smelling or experiencing pleasure are the way they are.³⁷

Counterreply

Science has also discovered that some problems are in principle unsolvable. For instance, mathematicians spent several hundred years trying to solve polynomial equations of a degree ≥ 5 before it became clear that there cannot be any general solution for such equations. Betting on the future of science is no compelling argument either.³⁸

Reply 2

True, the matter is an open issue; but nothing more than that.

Knowledge argument 2

A more radical version: assume physicalism is true, and neuroscientists have discovered all the relevant laws about the structure and functioning of the brain. Now imagine a neuroscientist who possesses this knowledge but lacks color perception from birth. It seems that the scientist's knowledge would leave out something important: he would not know, for example, what a red object looks like. He would learn something *new* if he came to acquire color sensation. Hence, physicalist explanations do not cover all the truths that there are.^{16,17}

Reply

Here is one way in which this fictive situation may be obtained while physicalism is true. Perhaps we are looking at the same thing from different angles. When we give a physicalist explanation of seeing a rose, we do so in terms that are objective or given from a third-person point of view, but this does not mean that we are not thereby getting at exactly the same event or property when considered from a subjective or first-person point of view.^{37,39} To use an analogy: do you know who Farrokh Pluto Bulsara was? Well, he was the same person as the singer Freddy Mercury. If you did not know, it does not matter: it does not follow from your ignorance that

Farrokh Pluto Bulsara was not Freddy Mercury. Likewise, Bruce Wayne is the same (fictional) character as Batman, but within the comic series only a select few know this. However, in principle any character could come to know it if they only followed Bruce Wayne's movements through space-time consistently until the moment when he pulls his black underpants over his gray costume. Sometimes, new knowledge is about the same objects and facts that you already knew in a different way.⁴⁰ It is certainly arduous to figure out which brain states are identical to which phenomenal states; it requires extensive correlational and experimental work. But we cannot infer from such difficulties that phenomenal states and brain states are not identical.

Conceivability arguments

These arguments raise the bar for the reductive physicalist by combining doctrines of modal logic with further thought experiments. First, it is a valid principle of modal logic that if identity statements using so-called "rigid designators" *a* and *b* are true ($a = b$, as in Farrokh Pluto Bulsara = Freddy Mercury) then they are also *necessarily* true. It follows by strict logical conversion that in cases in which it is not necessary that *a* and *b* are identical, then *a* and *b* must be distinct; and if that is so, it simply means that if it is possible that *a* and *b* are distinct (or describe distinct entities), then they actually are distinct.⁴¹ Note: This claim holds for identity statements using names or also "natural kind" terms—terms that pick out classes of things that share some sort of natural essence. For instance: water = H₂O. Now, we can conceive of or imagine systems that are physically and functionally completely identical to us, but that: (i) have radically different phenomenal states (perhaps their spectrum of tastes is entirely switched, analogous to color spectrum inversions imagined since John Locke) or (ii) do not have any phenomenal states at all. Such creatures might be able to respond to the question of what a Cuba libre tastes like, but without ever perceiving its mild and cool bitterness. If that is possible, then—due to the principles of modal logic mentioned before—qualia cannot be identical to brain states.⁴²

Reply

Conceivability does not imply possibility. The modal logical principles mentioned are only about actual possibil-

ity, not about conceivability or imaginability used in such a thought experiment. Thought experiments of the “zombie” kind will not suffice to show that phenomenal states cannot be brain states.^{43,44} Another point that might be questioned is the assumption that terms for qualia are natural kind terms, but that requires more laborious semantic discussions.

The argument from multiple realizability

Even if conceivability arguments are not convincing, there is a similar problem for reductive physicalism about the mind in general, which must affect physicalism about qualia. It has been argued that perhaps types of mental states can be realized in different physical systems.^{45,46} Again, an analogy helps: this text can be printed on paper, be presented on a computer screen, or read aloud. So, the text can be realized in different physical ways and still remain the same (type of) text. Why should the brain be the only way mental states can be realized? Furthermore, computer programs can realize the same logical inference steps that humans sometimes perform in their thinking. Indeed, when Herbert Simon and Allen Newell were working on their first computer program, called *Logic Theorist*, they tested it by using human components; namely, Simon’s wife, children and several graduate students.⁴⁷ Similarly, would it not reveal “chauvinism” about the brain to assume that only brain states can realize phenomenal states?⁴⁸

Reply 1

Typically, this argument has been used to show that it may be unrealistic to demand that *types* of mental states can be reductively explained in physical terms. However, *tokens* of such states (the specific instances of them, such as my seeing pink at a certain specifiable time and place) may nevertheless have to be realized by (tokens of) physical states. After all, how could mental states be causally related to physical states if such a moderate physicalism was not true?⁴⁹

Counterreply

That is no longer a *reductive* kind of physicalism; we could no longer expect neuroscience to provide us with explanations of why types of phenomenal qualia are the way they are.

Reply 2

At least two points suggest compatibility between multiple realizability and reductive physicalism about qualia. First, perhaps we can group together certain brain states into *neurophysiological* types without requiring that these types share all their *microphysical* properties. These neurophysiological types might then be identical to types of phenomenal consciousness while allowing for multiple realization at the microphysical level.⁵⁰ Second, temperature is also a property that is multiply realized: in the Earth’s atmosphere, in the atmospheres of other planets, and so on. Does it follow that we cannot reductively explain temperature in physicalist terms? No: the temperature of a gas is always the mean molecular energy of its constituent molecules, and their behavior follows strict physical laws. Similar examples can be given from other areas. Multiple realizability therefore does not undermine the possibility of reducing types to types.⁵¹

The explanatory gap

Let us grant that we know the laws governing the motions of molecules and the initial conditions of a given physical system; so we can explain why it is, for instance, gaseous, liquid, or solid, or why it behaves the way it does in other respects. That is, let us grant that there are correct reductive explanations of phenomenological regularities in terms of microphysical laws and ignore the—actually complicated—debate surrounding this assumption.^{36,52} Now, assume that we were in the situation of knowing all the laws governing neural processes. Assume also that it is possible to describe precisely a situation where my nose is located above a glass of Cuba libre, and everything is working well. Could we then derive how the drink smells to a being like me from the laws and initial conditions? It does not seem as if one would thereby grasp why the state has the phenomenal features it does. To use a different example, sharks, like other fish, possess a sensory organ called “lateral line” that detects movement and vibrations in the surrounding water, and perhaps even magnetic fields. If we knew the structure and mechanism of this organ, we would still not have an explanation of how sharks experience movement and vibrations. We may understand the brain activities of bats navigating by means of ultrasonic echolocation pretty well, but we will be at a loss when asked what it is like to navigate this way.⁴⁶ This is an “explanatory gap.”^{18,23}

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A deeper way of presenting this argument is as follows. According to a widely accepted conception of reductive explanation, any such explanation must start from an analysis of the *functional* properties that one wishes to explain reductively—the properties that are relevant for the causal relations of the objects or states. One can then look for the microphysical properties that can be used to explain the behavior of the system on a macrolevel. For instance, assume we wish to explain that water dissolves salt. We start by analyzing water as the odorless, drinkable, colorless liquid in lakes and rivers, thus fixing the reference of “water.” Next, we (i) can cite experiments showing that H_2O dissolves salt; (ii) explain – on the basis of microphysical properties of H_2O and salt—why this is so; and (iii) identify H_2O as the odorless, drinkable liquid etc. From our prior analysis of water as the odorless, drinkable liquid etc, and (i)-(iii), we can explain why water dissolves salt.⁴⁰ Unfortunately, so the argument continues, qualia do not allow for any functional analysis. Rather, we characterize them by their qualitative features alone.⁴¹

Note that the explanatory gap argument is not about ontology but epistemology. It does not support the conclusion that qualia are not brain states after all. However, it is also not good news for the physicalist, since it reveals that it is unclear what purported neuroscientific “explanations” of phenomenal states really show.

Reply 1

It is a mistake to assume that there is an explanatory gap. If Farrokh Pluto Bulsara really was Freddy Mercury, there is nothing to be explained reductively about this fact: he just was who he was. If this reply is not convincing in the case of the identity of qualia and brain states, this is because of an “antipathetic fallacy”: when presented with an identity claim about a certain feeling, we do not see that feeling represented in the reduced parts of the identity claim, and therefore infer that something is left out.⁵³ Likewise, if we are given a reductive explanation of the shark’s experience of vibrations in the surrounding water in terms of receptors and hair cells, we do not think that this leaves something out, even though we do not feel things the way the shark does.

Counterreply

This argument misses the point of the claim about an explanatory gap. To pick up the distinction introduced at

the end of Section 2, it addresses the issue of (i) whether brain states are *identical* to qualia; but not (ii) whether it is possible to *explain* qualia in reductive physicalist terms. The point of the explanatory gap argument is that it is unclear why material states of the brain feel a certain way to a subject, and perhaps even why they feel any way at all.³⁸

Reply 2

A different way of bridging the explanatory gap, and of addressing (ii), is to attack the assumption that phenomenal states do not allow for any functional analysis.^{54,55} At least in some areas, our everyday understanding of qualia is different. For instance, it is very unlikely that negative emotions such as fear, sadness, or anger can just switch places with more positive ones.⁵⁶ Also, think of auditory qualia. If full spectrum inversion concerning loudness or pitch was possible, then complete silence would appear as extreme noise and vice versa, or very high tones as very low ones, and so on. It is implausible that such changes would have no causal effects. With very low tones, we do not only hear them, we also sense their vibrations through our bodies. Moreover, consider the autobiographical account given by the color-blind perceptual researcher Kurt Nordby, who suffers from achromatopsy, the condition of seeing only in black and white, and shades of grey. He sees things as very blurred and is highly sensitive to light. The more intense the light, the more Nordby has to blink; he moves around extremely carefully, and so on.⁵⁷ Colors convey important contrasts, thus enhancing vision.

New developments and tasks

What is the difference between philosophers and Rottweilers? Rottweilers eventually let go. There are almost infinite ways to continue the philosophical arguments outlined above. While the weight of the preceding considerations is in favor of reductive physicalism, we can expect no knock-down proof. For instance, there are discussions about whether the attempts to bridge the explanatory gap by means of functional analysis of concepts of qualia do not again miss the point: it would still be unclear how an Alzheimer patient experiences emotions or how claustrophobic people experience fear.³⁸ In my view, such considerations tend to conflate the notion of scientific *explanation* with the notion of *empathetic*

understanding. Explanatory knowledge should provide the conditions under which a phenomenon occurs or does not occur. Such knowledge need not also provide those who possess it with an awareness or understanding of how things feel from the point of view of a different sentient creature.

A related question currently under discussion is whether the concept of qualia is clear enough. Those who assume an explanatory gap often claim that qualia are “intrinsic” properties (not relational: not dependent upon other things), and subjective and ineffable (ie, their content cannot be expressed in words, at least not completely). Saying they are intrinsic, however, might beg the question, since it excludes the possibility of functional analysis. So reductionists favor a more moderate notion of qualia, which merely focuses on the phenomenal character (the “what-it’s-likeness”) as the explanandum.^{58,59} Some would even eliminate talk of qualia entirely.⁶⁰ This debate is wholly open.

So, if I had to place my bets now, reductive physicalism would be where I would put my money. It is at least a working hypothesis that motivates further research more than the less ambitious search for correlations only. Accordingly, research has developed along the lines of looking more closely into specific areas for such explanatory reduction. One very positive development is that neuroscientists and philosophers often collaborate to study not only of vision and pain but also a wide spectrum of emotions,⁶¹ auditory sensation, olfaction,⁶² and other topics as well.

Two final warning signs need to be heeded, however, concerning the two basic kinds of observation in this area: brain activity measurements using certain instruments, and subjects’ reports about their qualia. First, there is a worry that studies based on fMRI produce correlations between brain activity measurements and mental state characteristics (such as anxiety, empathy, or distress) that are much higher than to be expected.⁶³

Second, any research into the neuroscience of phenomenal consciousness has to deal with serious problems of first-person reports. Whether there can be a science of consciousness depends on the old question of whether introspection is a legitimate and reliable method. These problems are serious. While being methodological in nature, one might properly describe them not as traps or gaps, but as breathtaking abysses instead. There are extensive debates about them in philosophy and cognitive psychology that neuroscientists need to take onboard.^{42,59,64-69}

Conclusion: the limits of skepticism

What is interesting is that much neuroscience of the mind has been provoked by skeptical philosophical arguments. However, as Immanuel Kant said, skeptics are like nomads, who abhor “permanent cultivation of the soil.” The chief function of skepticism is to sharpen our reasoning, and to avoid both dogmatism and naivety. Naivety here consists of an inference from statements about empirical correlations between brain states and qualia to claims that the former reductively explain the latter. Dogmatism would be to assume that reductive physicalism must be true and defended, come what may. Skepticism is no position to ultimately hold either; it is not ultimately tenable or desirable. I have shown how many skeptical arguments suffer from serious weaknesses. In my view, we should view the advancement of the neuroscience of the mind as an arduous task that perhaps requires, as previous developments in science did, revisions of basic concepts and methodologies. □

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Basic research

¿Conciencia recuperada? Argumentos filosóficos a favor y en contra del fisicalismo reduccionista

Este artículo presenta una visión panorámica de las discusiones recientes en relación con el problema mente-cuerpo, que se encuentran en una área de intersección entre filosofía y neurociencia. Trata de las características fenoménicas de la conciencia o "qualia", que se diferencian de varios otros temas relacionados. Sigue una discusión de los diversos argumentos escépticos, pero influyentes, que cuestionan la posibilidad de explicaciones reduccionistas de qualia en términos fisicalistas: argumentos de conocimiento, argumentos sobre lo concebible, el argumento de la realizabilidad múltiple, y el argumento del hueco explicativo. Ninguno de los argumentos resulta muy convincente. Se deduce que el fisicalismo reduccionista, aunque resulta una posición defendible, no es necesariamente la única opción. Para mantener tal punto de vista libre de dogmatismo e ingenuidad, es necesario que una constante reflexión conceptual y metodológica acompañe las investigaciones en marcha.

Regain de conscience ? Arguments philosophiques pour et contre un physicalisme réducteur

Cet article est une revue des débats récents concernant la dichotomie corps-esprit, qui se trouve à l'intersection de la philosophie et de la neuroscience. Il s'intéresse aux caractéristiques phénoménologiques, de la conscience ou « qualia », mise en exergue par rapport à d'autres sujets. S'ensuit une analyse des différents arguments sceptiques influents qui évoquent la possibilité d'explications réductrices des qualia en des termes physicalistes : arguments de connaissance, arguments de concevabilité, l'argument d'une faisabilité multiple et l'argument d'un fossé explicatif. Aucun de ces arguments n'est très convaincant. Ces arguments ne signifient pas que le physicalisme réducteur est le seul choix, mais il apparaît défendable. Cependant, il est nécessaire de conserver une réflexion méthodologique et conceptuelle constante, en accord avec la recherche actuelle, afin de se garder à la fois du dogmatisme et de la naïveté.

REFERENCES

1. du Bois-Reymond E. Über die Grenzen des Naturerkennens. In: du Bois-Reymond E ed. *Reden von Emil du Bois-Reymond in zwei Bänden*. Vol 1. 2nd ed. Leipzig, Germany: Veit & Co; 1912:441-473.
2. Crane T. The origins of qualia. In: Crane T, Patterson S eds. *History of the Mind-Body Problem*. London, UK: Routledge; 2000:169-194.
3. Lewis CI. *Mind and the World Order*. New York, NY: Charles Scribner & Sons; 1929.
4. Chalmers D. *The Conscious Mind*. Oxford, UK: Oxford University Press; 1996.
5. Sutherland S. *Consciousness*. *Macmillan Dictionary of Psychology*. London, UK: Macmillan; 1989.
6. Searle J. Consciousness. *Annu Rev Neurosci*. 2000;23:557-578.
7. Van Gulick R. Consciousness. *The Stanford Encyclopedia of Philosophy*. 2004. Available at: <http://plato.stanford.edu/entries/consciousness/>.
8. Kemmerling A. *Ideen des Ich: Studien zu Descartes' Philosophie*. Frankfurt, Germany: Suhrkamp; 1996.
9. Sturm T, Wunderlich F. Kant and the scientific study of consciousness. *Hist Hum Sci*. 2010;23:48-71.
10. Farrell B. *Experience*. *Mind*. 1950;49:170-198.
11. Feigl H. The "mental" and the "physical". In Feigl H, Scriven M, Maxwell G, eds. *Minnesota Studies in the Philosophy of Science*. Minneapolis, MN: University of Minnesota Press; 1958:370-497.
12. Sprigge TL. Final causes. *Aristotelian Society Proceedings*. 1971(suppl 45):149-170.
13. Place UT. Is consciousness a brain process? *Br J Psychol*. 1956;47:44-50.
14. Smart JJC. Sensations and brain processes. *Philos Rev*. 1959;68:141-156.
15. Nagel T. What is it like to be a bat? *Philos Rev*. 1974;4:435-450.
16. Jackson F. Epiphenomenal qualia. *Philos Q*. 1982;32:127-136.
17. Jackson F. What Mary didn't know. *J Philos*. 1986;83:291-295.
18. Levine J. Materialism and qualia: the explanatory gap. *Pacific Philos Q*. 54:354-361.
19. Bayne T, Cleeremans A, Wilken P, eds. *The Oxford Companion to Consciousness*. Oxford, UK: Oxford University Press; 2009.
20. Block N, Flanagan O, Güzeldere, G, eds. *The Nature of Consciousness: Philosophical Debates*. Cambridge, MA: MIT Press; 1997.
21. Grey J. *Consciousness: Creeping up on the Hard Problem*. Oxford, UK: Oxford University Press; 2006.
22. Hill CS. *Consciousness*. Cambridge, UK: Cambridge University Press; 2009.
23. Levine J. *Purple Haze*. Cambridge, MA: MIT Press; 2001.
24. Lycan WJ. *Consciousness and Experience*. Cambridge, MA: MIT Press; 1996.
25. McGinn C. *The Problem of Consciousness*. Oxford, UK: Blackwell; 1991.
26. Metzinger T, ed. *Conscious Experience*. Paderborn, Germany: Ferdinand Schöningh; 1995.
27. Metzinger T ed. *Neural Correlates of Consciousness*. Cambridge, MA: MIT Press; 2000.
28. Pauen M, Stephan A, eds. *Phänomenales Bewusstsein*. Paderborn, Germany: Mentis; 2002.
29. Flohr H. An information processing theory of anesthesia. *Neuropsychologia*. 1995;33:1169-1180.
30. Flohr H, Glade U, Motzko D. The role of the NMDA synapse in general anesthesia. *Toxicol Lett*. 1998;100-101:23-29.
31. Crick F, Koch C. Toward a neurobiological theory of consciousness. *Sem Neurosci*. 1990;2:263-275.
32. Tononi G, Balduzi D. Toward a theory of consciousness. In Gazzinga MS, ed. *The Cognitive Neurosciences IV*. Cambridge, MA: MIT Press; 2009:1199-1215.
33. Block N. On a confusion about a function of consciousness. *Behav Brain Sci*. 1995;18:227-247.
34. Prior H, Schwarz A, Güntürkün O, De Waal F. Mirror-induced behavior in the magpie (*Pica pica*): Evidence of self-recognition. *PLoS Biol*. 2008;6:1642-1650.

35. Montero B. The body problem. *Nous*. 1999;33:183-200.
36. Majer U. Lassen sich phänomenologische Gesetze "im Prinzip" auf mikrophysikalische Theorien zurückführen? In: Pauen M, Stephan A eds. *Phänomenales Bewusstsein*. Paderborn, Germany: Mentis; 2002:369-401.
37. Churchland, PS. The hornswoggle problem. *J Conscious Stud*. 1996;3:402-408.
38. Stephan A. Phänomenaler Pessimismus. In: Pauen M, Stephan A, eds. *Phänomenales Bewusstsein*. Paderborn, Germany: Mentis; 2002:342-363.
39. Churchland PM. Reduction, qualia, and the direct introspection of brain states. *J Philos*. 1985;82:8-28.
40. Block N. Qualia. In: Guttenplan S, ed. *A Companion to Philosophy of Mind*. Oxford, UK: Blackwell; 1994:514-520.
41. Kripke S. *Naming and Necessity*. Cambridge, MA: Harvard University Press; 1980.
42. Chalmers D. How can we construct a science of consciousness? In: Gazzinga M, ed. *The Cognitive Neurosciences III*. Cambridge, MA: MIT Press, 2004:1111-1119.
43. Hill CS, McLaughlin BP. There are fewer things in reality than are dreamt of in Chalmers's philosophy. *Philos Phenomenol Res*. 1999; 59:446-454.
44. Perry J. *Knowledge, Possibility, and Consciousness*. Cambridge, MA: MIT Press; 2001.
45. Putnam H. Minds and machines. In: Hook S, ed. *Dimensions of Mind*. Albany, NY: New York University Press; 1960:138-164.
46. Putnam H. Psychological predicates. In: Capitan WH, Merrill DD eds. *Art, Mind and Religion*. Pittsburgh, PA: University of Pittsburgh Press; 1967:37-48.
47. Gigerenzer G, Sturm T. Tools=theories=data? On some circular dynamics in cognitive science. In: Ash MG, Sturm T eds. *Psychology's Territories*. Mahwah, NJ: Erlbaum; 2007:305-342.
48. Cuda T. Against neural chauvinism. *Philos Stud*. 1985;48:111-127.
49. Davidson D. Mental events. In Davidson D. *Essays on Actions and Events*. Oxford, UK: Clarendon Press; 1980:207-225.
50. Pauen M. Is type identity incompatible with multiple realization? *Grazer Philosophische Studien*. 2003;65:37-49.
51. Churchland PM. *Neurophilosophy at Work*. New York, NY: Cambridge University Press; 2007.
52. Dizadji-Bahmani F, Frigg R & Hartmann S. Who's afraid of Nagelian reduction? *Erkenntnis*. 2010;73:393-412.
53. Papineau D. Mind the Gap. *Philos Perspect*. 1998;12:373-388.
54. Cohen MA, Dennett, D. Consciousness cannot be separated from function. *Trends Cogn Sci*. 2011;15:358-364.
55. Hardin CL. Qualia and materialism: Closing the explanatory gap. *Philos Phenomenol Res*. 1987;48:281-298.
56. Pauen M. Painless pain: Property dualism and the causal role of phenomenal consciousness. *Am Philos Q*. 2000;37:51-63.
57. Nordby K. Vision in a complete achromat: a personal account. In: Hess RF, Sharpe LT, Nordby K. eds. *Night Vision*. Cambridge, UK: Cambridge University Press; 1990:3-48.
58. Frankish K. Quining "diet" qualia. *Conscious Cogn*. In press.
59. Kind A. Sticking to one's diet: commentary on "Quining diet qualia" by Keith Frankish. *Conscious Cogn*. In press.
60. Dennett D. Quining qualia. In: Marcel A, Bisiach E eds. *Consciousness in Modern Science*. Oxford, UK: Oxford University Press; 1988:42-77.
61. Thagard P, Aubie B. Emotional consciousness: a neural model of how cognitive appraisal and somatic perception interact to produce qualitative experience. *Conscious Cogn*. 2008;17:811-834.
62. Stevenson RJ. Phenomenal and access consciousness in olfaction. *Conscious Cogn*. 2009;18:1004-1017.
63. Vul E, Harris C, Winkielman P, Pashler H. Puzzlingly high correlations in fMRI studies of emotion, personality, and social cognition. *Perspect Psychol Sci*. 2009;4:274-290.
64. Goldman A. Science, publicity, and consciousness. *Philosophy of Science*. 1997;64:525-545.
65. Dennett D. Who's on first? Heterophenomenology explained. *J Conscious Stud*. 2003;10:19-30.
66. Jack AI, Roepstorff A. Trusting the Subject I (special issue). *J Conscious Stud*. 2003;10.
67. Jack AI, Roepstorff A. Trusting the Subject II (special issue). *J Conscious Stud*. 2004;11.
68. Overgaard M. Introspection in science. *Consciousness Cogn*. 2006;15:629-633.
69. Papineau D. Could there be a science of consciousness? *Philosophical Issues (Supplement to Nous)*. 2003;13:205-220.