

A Theory of Mind and Brain that Solves the ‘Hard Problem’ of Consciousness

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Abstract—We propose that the “mind” is an energetic, spatially extended, nonmaterial entity that is united with the brain and body. The mind is a separate entity having the character of a structured energy field, which can interact with physical processes including brain neurons. The nonmaterial mind is also the seat of conscious experience. The mind interacts directly with cortical neurons, probably via electrical interaction, resulting in both subjective phenomenal experience and causal influence on neurological processes. All cognitive faculties reside in the mind but ordinarily need the brain’s neural activity for conscious awareness. When brain structures are damaged, mental faculties dependent on them are partially or totally impaired. The main evidence for this view are phenomena from near-death experience and various neurological phenomena, in particular phantom limbs. This theory solves the “hard problem” of how phenomenal experience can arise from physical brain activity: conscious experience depends on a second entity with physical attributes—the conscious mind—which interacts with the brain to produce phenomenal experience. Experiences of qualia, such as redness, are an effect in the mind resulting from electrical activity in specific regions of the brain. The unity of consciousness results from the unity of the mind’s “field of consciousness”: phenomenal states are unified in the mind as subject. Causal closure of the physical is maintained but the domain of “the physical” must necessarily be expanded. Mind is a fundamental entity, a new dimension of reality.

Keywords: hard problem of consciousness—explanatory gap—interactionism—dualism—near-death experience—phantom limb—mind-body problem

Introduction

The prevalent view in neuroscience is that the brain produces consciousness. We are conscious because the electrical activity in our brain's neurons works in a complex way and consciousness somehow “emerges” from that complex neural activity. The difficulty with this view is that it doesn't really explain our interior, subjective *experience* of consciousness, as pointed out by David Chalmers (1996), which is really the “hard problem” of consciousness.

Chalmers argued that conscious experience can't be explained solely from physical phenomena and offered five arguments to support this (Chalmers, 1996, especially pp. 93–106):

1. The brain’s neurological activity alone does not explain the *qualities* of our internal experience – why a red object appears *red* to us. A person brought up in a totally black-and-white environment may know everything there is to know about how the brain produces color experience but still would not know what it is *like* to see color (the *qualia* or *knowledge argument*).

2. It is logically conceivable that a physically identical duplicate of a person can exist which behaves identically but which lacks conscious experience. This possibility implies that conscious experience is not logically dependent (“supervenient”) on the physical (the *philosophical zombie argument*).
3. It is conceivable that in a world physically identical to ours, conscious experience is *different*, for example, that color experience is inverted – where we see red, people in the identical world see blue, and vice versa (the *inverted spectrum argument*).
4. The facts of physical causation in the world (in physical objects, biological systems, etc.) alone do not suggest that there should be any consciousness. The only way I know about consciousness is because I experience it (the *epistemic asymmetry argument*).
5. The phenomenal “feel” of conscious experience cannot be explained as a functional property of a physical system through functional analysis – only the *effects* of conscious experience play functional roles (the *absence of analysis argument*).

Chalmers advocated the view that everything, including conscious experience, is a consequence of basic properties and laws. Because conscious experience can’t be reduced to physical processes, it necessarily involves some new fundamental properties and laws beyond the existing physical laws. The new laws will specify how the phenomenal properties of consciousness depend on physical laws. Chalmers held that consciousness can be explained by basic natural laws, not through transcendent elements or mystery. But the current natural laws need to be expanded (Chalmers, 1996, Chapter 4).

Chalmers rejected all forms of interactionist dualism, which hold that a non-physical consciousness could be causally effective in influencing the brain. Even if a mechanism for causal interaction could be found, the mechanism for interaction itself would not explain conscious experience any more than neurological mechanisms do (Chalmers, 1996, pp. 156–158).¹

The fundamental problem of a theory of consciousness then is bridging the “explanatory gap” between the physical level and conscious experience. Tim Bayne and Chalmers (2003) further suggested that a theory of consciousness must be compatible with the idea that a subject’s conscious states are necessarily unified, that is, the conjunction of all of a subject’s phenomenal states at any time is itself a phenomenal state. The unity of consciousness implies that there is a *subject* in whom the phenomenal states are unified.

In this paper, we present an interactionist dualist theory of consciousness whose basic premise is that the “mind” is a nonmaterial, energetic entity that is spatially coextensive and intimately integrated with the brain and body.

On the one hand, the mind is an objective, autonomous entity that interacts with the brain’s neurons. The brain’s neural electrical activity, interacting with the mind, mediates all cognitive faculties. On the other hand, the mind is a “field of consciousness”,² which is the seat of consciousness of the person. In other words, the mind *is* the subject in which phenomenal experience occurs. Ordinarily, the electrical interaction between the brain and the mind is required for phenomenal experience and consciousness.

The evidence for the objective reality of the mind as a field of consciousness which interacts energetically with the brain comes primarily from the near-death experience (NDE) and various neurological phenomena, in particular phantom limbs. The phenomena reported in NDE suggest that the mind is a nonmaterial entity that can separate from the physical body, can have subtle interactions

¹ Chalmers (2010, pp. 126–130), relaxed his stance against interactionism somewhat, in that a new basic force associated with a mental field could causally influence brain states and vice versa, but this would involve significant revisions to physical theory.

² A “field” in this sense is a region of space with specific properties.

with physical processes in the separated state, and then reunites with the physical body. Similarly, phantom limb phenomena that we have investigated suggest that the phantom limb is an objective, energetic field which can interact in a subtle way with another person’s brain, producing unusual visual sensations in the other person. The aftereffects of NDE include unusual electrical phenomena which suggest that the interactions of the mind entity are energetic and electrical in nature.

This theory solves the hard problem of how phenomenal experience can arise from physical brain activity: phenomenal experience and consciousness depend on a *second entity*, namely the mind, which is the seat of phenomenal experience, the *subject* in which phenomenal experience occurs. All interactions of the mind with physical processes, especially neural electrical activity above a minimum duration, result in *that person’s* subjective phenomenal experience.

With the addition of this second entity to the picture, the explanatory gap is bridged. Brain electrical activity is causally linked through physical interaction with the field of the mind and directly produces subjective phenomenal experience. The particular qualitative character of the phenomenal experience, for example, of redness, is totally dependent on the mind and its interaction with specific brain electrical activity, for example, in a particular part of the visual cortex.

The unity of consciousness results from the unity of the mind’s field of consciousness, in which phenomenal states are experienced as a unity. Because the mind interacts causally with physical processes, causal closure of the physical is maintained. However, the domain of what constitutes “the physical” must necessarily be expanded to include the nonmaterial mind. Mind is a fundamental entity, a new dimension of reality.

The Mind as an Autonomous, Energetic Field of Consciousness

In an earlier paper, we introduced the idea of the *self-conscious mind* or simply “mind” (Mays & Mays, 2008a, pp. 22–31).³ The human being consists of (1) an energetic, spatially extended, nonmaterial mind that is united with (2) a material brain and body.

The mind is nonmaterial (does not consist of material atoms, etc.) but rather is a structured, energetic region of space that can interact with physical processes, in particular with neurons, and thus has physical attributes. The mind is united and co-extensive with the brain and body and interacts directly with the brain, probably via electrical interactions with cortical and other dendritic structures.

The mind is also the seat of phenomenal experience, that is, a “field of consciousness”. All cognitive faculties (perception, thinking, feelings, volition, memory and self-awareness) reside in the nonmaterial mind entity, not in the brain.

However, the mind ordinarily is completely dependent on brain structures and neural activity for consciousness. Mental events become conscious only when there is sufficient electrical brain activity.⁴ If the electrical activity is not sufficient in strength or duration, the percept or other mental event remains subliminal.⁵

On the other hand, the mind can initiate electrical brain activity and thereby serves as the *agent*

³ Our concept of the “self-conscious mind” is different from that of Karl Popper and John Eccles (1977) who also used the term in a dualist interactionist theory of mind. We discuss the differences between the two theories in a later section.

⁴ Sensations become conscious only after a sufficient duration of electrical brain activity. In a series of experiments, Benjamin Libet showed that electrical activity in the brain must continue about a half second before subjects become aware of liminal tactile stimuli (Libet, 1973; Libet *et al.* 1975; Libet *et al.* 1991).

⁵ Lower than threshold liminal stimuli do not rise to conscious awareness but if subjects are required to give a response (forced-choice), the responses are increasingly accurate the closer the stimulus duration is to the liminal threshold (e.g., Libet, 2004, pp. 102–106).

that initiates volitional activity,⁶ exerts “mental force”,⁷ and alters brain neural patterns plastically.⁸

The mind is the unified phenomenal field resulting in the sense of the unity of consciousness. Disparate aspects and features of the perceptual field are represented in electrical activity in different parts of the brain. The electrical activity comes to consciousness within the mind and is integrated through purely mental processes into a unified phenomenal experience.

When brain structures are damaged, mental faculties dependent on them are partially or totally impaired. Damage to neurons or temporary impairment from drugs or other substances interfere with the normal interface between the neurons and the corresponding structures of the mind. Sensory, motor, affective and thought processes may thereby be altered or impaired.

The qualitative character of phenomenal experience, for example, of redness, is dependent on the mind’s interaction with specific brain electrical activity in a particular part of the visual cortex. The mind depends on brain neural activity in specific cortical locations for particular cognitive functions. The brain has a complex physical structure that is reflected in both distinctive cognitive functional areas and distinctive cell structures. Since the mind needs to selectively interact in close proximity with specific neural structures, the mind must have an equally complex internal structure that corresponds closely with the brain’s physical structure. In fact, it is likely that the internal structure of the mind’s field directly maps to the neural structure throughout the body.

Evidence from Near-death Experiences

A near-death experience is a profound subjective experience with transcendental and mystical elements usually occurring in people who come close to death or are in intense physical or emotional danger (Moody, 1975; Greyson, 2000). The elements of NDE include feelings of peace, an intensified sense of reality, the sensation of being separated from the physical body (out-of-body experience or OBE), traveling through a dark tunnel, meeting deceased relatives, experiencing a bright light, having a panoramic life review, and returning to the physical body.

The reported aftereffects of NDE include the loss of the fear of death, reduced anxiety levels, increases in spirituality, concern for others and appreciation for life, and decreases in materialism and competitiveness. The physical and physiological aftereffects frequently include increased sensitivity to light, loud sounds, touch, electricity and household chemicals; increased allergies; unusual electrical effects such as interference with electronic equipment, appliances and watches; and synesthesia, the case of one sense or mental state present with another, such as colors or tones with numbers and letters (Ring & Valarino, 1998, pp. 123–144; Atwater, 2007, pp. 85–112).

The NDE provides several lines of evidence that support the idea that the mind is an autonomous energetic entity or field of consciousness (Mays & Mays, 2008a, pp. 16–22):

⁶ People generally sense that they have agency, that “their” volitional activity results in their physical movement, speech acts, focus of attention, thoughts, etc.

⁷ Jeffrey Schwartz and Sharon Begley (2002) reported that obsessive-compulsive disorder (OCD) is associated with a brain “circuit” that is overactive and “locked” into a repetitive neural pattern (pp. 62–74). He developed a cognitive behavioral therapy based on intense mental attention and refocusing which successfully treats OCD patients without medication. Patients’ PET scans show significant reduction in the locked neural pattern (pp. 77–94). Schwartz asserted that the therapy’s directed mental effort generates a “mental force” which causes the neuroplastic changes (p. 95).

⁸ Neuroplastic changes in neural structures can occur rapidly when fine motor movements are practiced mentally. In one experiment (Pascual-Leone *et al.* 1995) significantly enlarged cortical areas for the finger muscles were noted for subjects who only visualized a piano exercise but had no actual muscle movement, changes that were nearly as large as subjects who had physical practice. After five sessions of only mental practice, subjects were as proficient in actual playing as subjects who had physically practiced for three sessions. These findings suggest that the mind serves an agent that can sustain purely endogenous mental activity that can result in neural reorganization and physical performance improvement.

- *Evidence that the mind is an objective autonomous entity:* In NDE, the apparent locus of an experiencer’s self-conscious awareness shifts from being within the body to outside the body. Near-death experiencers (NDErs) frequently find themselves hovering several feet over their physical bodies, watching the efforts to revive them. During the out-of-body component of NDE, the locus of consciousness has a particular position in space and a particular visual perspective. NDErs have rich, intensely real cognitive experiences, with heightened, lucid awareness, logical thought processes, and vivid perceptions. In a number of cases, these experiences occur during a period of complete loss of cortical and brain stem activity. This implies that the mind is an objective entity with a spatial location and orientation, and is the seat of a person’s consciousness. The mind can operate independently of the physical body, which implies that the mind entity is autonomous when it is united with brain and body.
- *Evidence that cognitive abilities reside in the mind, not in the brain:* While outside the body, the NDEr retains the faculties of perception, thought, volition, memory, feelings and self-awareness, in other words, all of the faculties of ordinary consciousness. In particular, during NDE, existing memories are recalled and new memories – of the experience – are formed. This implies that all cognitive abilities, including memory, reside in the mind, not in the brain.
- *The mind has two modes of perception – direct and through the brain:* Perceptions in NDErs of the physical surroundings are nearly always veridical, despite the NDEr’s inability to perceive them physically, and are frequently later verified (Holden, 2009, pp. 193–199). This implies that the mind entity can interact in some way with physical processes, for example, light and sound waves, while independent of the brain, and that it has at least two modes of perception – *direct* perception of physical reality and perception *mediated* through brain processes.
- *During NDE, the mind entity is freed from the physical body:* In the out-of-body state, NDErs feel no physical bodily pain, even when painful medical procedures are performed on the body. They have the feeling that they have been freed from the body, and they typically report feeling elated at that sense of freedom. They view their physical body with detachment and disinterest. They feel weightless and tireless, and completely at peace. Visual perception, including color, has much greater acuity than in the body. Existing physical defects or disabilities such as blindness, deafness, lameness, or missing limbs are absent in most NDE cases. NDErs with poor vision can see clearly. NDErs who are blind or visually impaired, including those blind from birth, can see during their NDE OBEs, and, in a few cases, visually based knowledge that could not have been obtained by ordinary means can be corroborated independently. These NDE features are consistent with a mind entity that has been freed of the limitations of the physical body. At all other times, the mind is united with the brain and body.
- *The mind is a nonmaterial, structured energetic field that interacts with physical processes:* The out-of-body mind appears to pass readily through solid objects and is invisible to ordinary sight, but it also appears to interact in subtle ways with physical processes: physical objects, light, sound, and other persons’ bodies. Over half of NDErs reported they had some sort of nonmaterial body during NDE. The “body” had a quality variously described as translucent, “cloud-like,” and an “energy pattern” and as shaped either like the physical body or like a sphere or ovoid. The NDEr “body” appeared luminous in some way to the NDEr, giving off some kind of light of its own. Although the “body” cannot be seen by ordinary people, it apparently can be sensed by animals.⁹ In at least some NDErs, the “body” appeared to have an intricate, luminous structure.¹⁰

⁹ Jerry Casebolt recounted his NDE at age seven, where he hovered above and just out of reach of a dog on a playground, with the dog repeatedly wagging its tail, jumping up and barking at him. They looked into each other’s eyes; Jerry was moving up, down and to the sides; they moved together like a dance (Corcoran, 1996, p. 81; Casebolt, personal communication, 3 August 2008).

The NDEr can see other individuals who are also out-of-the-body during the NDE. These fellow NDErs also appear to have a bodily form. These aspects of NDE imply that the mind entity is an energetic, nonmaterial field that has an intricate internal structure, and interacts with physical processes.

- *The mind's internal structure interfaces with the brain in similar ways among different people:* Some NDE accounts include a report of the NDEr “merging” with an in-body person in order to see and hear through their eyes and ears (Mays & Mays, 2008a, p. 34), which implies that the mind's internal structure can interface with the brain in a similar way from one person to another and therefore the mind's internal structure is similar from person to person.

In summary, the evidence from NDE suggests that all cognitive faculties, including memory, reside in an autonomous mind, a nonmaterial field of consciousness that is ordinarily united intimately with the brain and body. Only during extraordinary events such as NDE does it separate from the physical body and operate for a time independent of it. When united with the body, the mind must conform to the physical limitations – including disabilities – of the body. In the present view, the brain mediates cognitive faculties with the mind, which enables a person to be conscious while in the body. Although the mind is nonmaterial, the mediation must work through some sort of physical interaction with the brain.

Evidence from Phantom Limbs

A phantom limb is the vivid subjective experience that a limb that is congenitally absent or has been amputated is still present (Ramachandran & Hirstein, 1998). In an earlier paper (Mays & Mays, 2008a, pp. 39–40), we reasoned that the mind is a spatially extended field that is coextensive with the physical body, probably interacting with the arms and legs by way of the peripheral afferent and efferent nerves. In the absence of a physical limb, a part of the field of the mind would still project beyond the stump as a kind of “mind limb” extending beyond the physical body. Some of the subjective sensations associated with the phantom could thus be due to the interaction of its “mind limb” with the physical body and with external physical processes.

We suggested that the properties of the phantom limb would reflect the properties of the mind entity as a whole and thus could provide supporting evidence for the existence of the mind entity. Indeed, we have found evidence that this is the case. In 2007-2010, we conducted exploratory experiments with subject M.G., a 58-year-old college-educated woman with congenital unilateral adactylia (missing five fingers of the left hand) (Mays & Mays, 2008b).¹¹

In many respects, M.G. experiences her phantom fingers the same way as other phantom limb subjects. However, she also reports physical sensations in her finger buds, palm and arm (tingling, warmth, pressure) when her phantom fingers are “touched” by an object or by her right hand. When other people are “touched” on the head by M.G.'s phantoms, they report feeling warmth and pressure, and seeing inner visual images (e.g. a dark circle with a white ring of light) which are reminiscent of visual sensations evoked by electrical brain stimulation (e.g. Penfield & Rasmussen, 1950). M.G. reports she sometimes can see her phantom fingers as a faint whitish or bluish light against a dark background (Mays & Mays, unpublished report, 2009). Her report is consistent with another phantom limb subject, A.Z., who reported “In darkness, I have noted a faint glowing of my phantom body

¹⁰ Raymond Moody described an NDEr who studied his hands during his NDE OBE. His hands were “composed of light with tiny structures in them. He could see the delicate whorls of his fingerprints and tubes of light up his arms.” (Moody & Perry, 1988, p. 10).

¹¹ Additional details of this research may be read at our site <http://selfconsciousmind.com/>, in particular at <http://selfconsciousmind.com/phantomlimbresearch>.

parts” (Brugger *et al.* 2000, p. 6168). Finally, M.G. reports that “massage” of her phantom fingers, by the massage therapist passing her hands over the finger area, evokes tickling sensations and the therapist can also sense the presence of the phantoms. This report is consistent with a number of reports from Therapeutic Touch practitioners who have treated patients for phantom limb pain.¹²

Phantom limbs thus provide several additional lines of evidence that support the idea that the mind is an autonomous energetic entity or field of consciousness:

- *The mind is an objective entity separate from the body and a field of consciousness:* The phantom limb appears to be a field of sensation extending beyond the physical body in the space where the physical limb was present, such that when the phantom limb is “touched”, the subject can feel sensations. When the phantom limb “touches” another person, that person experiences sensations. Some amputees can feel “touch” during Therapeutic Touch treatment and the therapist can generally “feel” the presence of the phantom limb (also with subject M.G., during massage). These phenomena support the idea that the phantom limb is an objective spatial extension of the field of the mind, a “mind limb”, which interacts in some way with physical processes and produces conscious sensations in the subject. The phenomena further imply that the mind is an objective entity coextensive with the body, which acts as a field of consciousness throughout.
- *The nonmaterial mind is an energetic field that interacts with physical processes:* Phantom limb “touch” on another person’s head in the region of the brain can elicit visual and other sensations similar to electrical brain stimulation. At least two phantom limb subjects report being able to “see” their phantom limbs as a faint glow against a dark background or in the dark. These phenomena imply that the “mind limb”, and therefore the mind, is a region of space that can interact with physical processes and thus has physical attributes.
- *The field of the mind has an internal structure that relates to the peripheral nerves:* There is an unusual relationship between phantom limb sensations and neural activity in the stump. Phantom limb sensations can be modulated by stump manipulations, temporarily abolished by local stump anesthesia, and altered by changes in stump blood flow. Altering the sodium channel conductance in stump neurons can increase or block phantom limb pain (Nikolajsen & Jensen, 2001). All of these phenomena directly connect the stump neurons and specific phantom limb sensations, depending on the type of neural interaction. In the context of the present view, this implies that stump neurons interact in some way with *different parts* of the field of the “mind limb”. These phenomena suggest that the mind limb and therefore the mind has an internal structure that interfaces with the peripheral nerves as well as the cortex.

In summary, the evidence from phantom limbs suggests that the mind is an objective entity with a shape similar to the physical body. With a missing limb, the corresponding “mind limb” is still present as a field of phenomenal sensation that appears to have an internal structure that relates to specific peripheral nerves. Interactions with the mind limb region can evoke sensations in the phantom limb subject and can in some cases be “seen” by the subject. The mind limb region can be felt by others and can apparently interact with another person’s brain to produce effects that are

¹² There are at least a dozen case reports of the successful application of Therapeutic Touch healing in phantom limb pain treatment. Some of the reports are quite dramatic in the degree and speed of relief that was achieved. These case reports share a common phenomenology, including (1) the therapist can feel the phantom limb as “present” in the expected location, sometimes having a distinctive “energy”, (2) the patient can feel the presence of the therapist’s hand in the phantom limb area that the therapist is working in, despite the fact that the patient cannot see what the therapist is doing, since the patient is looking away or the patient’s eyes are closed or bandaged, and (3) the patient experiences immediate and dramatic reduction in the subjective pain (e.g., Leskowitz, 2000 and 2001). For more details of these cases, see the page <http://selfconsciousmind.com/phantomlimbresearch/PhantomLimbPainTherapeuticTouch.html>.

similar to electrical brain stimulation. As with evidence from NDE, the mind presents as an objective, energetic field which can interact subtly with physical processes.

Specific Evidence of Interaction of the Nonmaterial Mind

How can the nonmaterial mind interact with the physical processes of the brain and body? The NDE “body” has no obvious apparent interaction with physical processes: it readily passes through solid objects, cannot be seen or heard, etc. However, NDE literature includes a number of reports of NDErs’ having subtle interactions with physical processes. Furthermore, a phantom limb appears to be a field of sensation, also with subtle interactions with physical processes.

In NDE, the NDEr’s “body” can be “seen” by animals and fellow NDErs. There is apparent interaction with physical processes such as light and sound, because the NDEr reports veridical visual and auditory perceptions. There also is apparent interaction with material objects, because the NDEr can sometimes feel slight resistance when passing through objects such as walls, can bob on the ceiling and feel the support of the hospital roof, and can “touch” and feel a material object (Mays & Mays, 2008a, pp. 32–34). There is one account of an NDE involving apparent interaction of the NDEr’s “body” with fog on a cold night. The NDEr jumped up and down and the “jumping fog” was seen by another man.¹³

The NDEr “body” can interact with another person’s body: an NDEr’s hand went through the doctor’s arm, which felt “gelatinous” with an electric current;¹⁴ and an NDEr could tickle the nose of another patient and she would sneeze.¹⁵ There are at least three reported cases where an NDEr “merged” with another person to see and feel what they were seeing, feeling and thinking.¹⁶ These cases imply that interaction with and influence over neural activity in the brain is possible; in particular, “merging” implies that the mind readily joins with and interacts with the brain, even another person’s brain.

Regarding phantom limbs, we described several interactions in the previous section that we observed with subject M.G. The interactions of M.G.’s phantom fingers “touching” physical objects evokes distinct physiological sensations in the finger buds, left palm and left arm, and presents distinctive physiological reactions. In experiments with M.G. “touching” other subjects in the region of the brain, the “touch” evokes subtle but definite physiological sensations, especially unusual inner

¹³ P. M. H. Atwater (2011, pp. 241–242; personal communication, 7 March 2008) reported an NDE in which a man was driving outside Portland, Oregon in late October around midnight. It was foggy; he swerved on black ice on a hairpin curve and crashed into a tree, severing his arm. In his OBE, he saw that he would die if he didn’t get help. He sought help from a house a distance away. Outside the second story window, he jumped up and down and shouted repeatedly to “call the police, there’s been an accident!” The man inside later told the police that the fog outside his window was jumping and seemed to have the shape somewhat like that of a person. The second man heard “in both ears” that there had been an accident, went outside with a flashlight and found the wrecked car.

¹⁴ When a cardiac arrest NDEr passed her hand through Raymond Moody’s arm, she felt it had a “very rarefied gelatin” consistency, with an electric current running through it (Moody & Perry, 1988, pp. 8–9).

¹⁵ Jerry Casebolt, in an NDE as a seven-year-old, playfully tickled another patient’s nose, touching her just once and she sneezed. He repeated this two more times (Corcoran, 1996, p. 83; Casebolt, personal communication, 3 August 2008).

¹⁶ (1) During an NDE, a 5-year-old boy who was suffering from meningitis briefly “went into” his sister’s head and saw the world through her eyes (Morse & Perry, 1990, p. 177). (2) A 48-year-old man was despondent and attempted suicide by hanging. During his NDE OBE he desperately sought help from his wife. She could not hear his cries, so he “went into” her body and could see and hear with her eyes and ears. When he made contact with her, he heard her exclaim, “Oh, my God!” Apparently she knew what was needed, because she grabbed a knife, ran out to where her husband was hanging, and cut him down (Greyson & Bush, 1992, p. 105). (3) During his NDE, George Rodonaia had been declared dead and experienced an extensive OBE. He was “inside his wife’s head” as she was picking out his grave and heard all of her thoughts. She was making a mental list of eligible men to date, with their characteristics as possible future husbands. Rodonaia later repeated all these details to her, considerably upsetting her. This account was later confirmed by his wife, Nino (Atwater, 1994, pp. 81–83; Atwater, personal communication, 7 March 2008).

visual images. M.G. reports that she sometimes can “see” her phantom fingers as a faint light against a dark background, consistent with the report of another limb deficient subject, A.Z. Finally, M.G. also reports that “massage” of her phantom fingers evokes tickling sensations and the massage therapist can feel the presence of the phantom fingers, consistent with reports from Therapeutic Touch practitioners in treating phantom limb pain.

In summary, evidence from both NDE and phantom limb phenomena suggest that interaction occurs with both the out-of-body mind entity and the phantom “mind limb”. Subtle interactions occur between the nonmaterial field and physical processes (material objects, light, fog and sound), and between the nonmaterial field and another person’s body. The interactions evoke phenomenal sensations in the NDEr or phantom limb subject and in the other person. In addition, evidence also suggests that the nonmaterial field can appear luminous at times, both to the subject, to fellow NDErs and to animals. In particular, the interactions with in-body persons (the case of feeling inside a person’s arm, the case of tickling a person’s nose, the cases of “merging” with another person’s brain, and the cases of phantom limb “touching” another person’s brain) suggest that interaction of the field of the mind with neural processes readily occurs.

Alternate Explanations

Explaining NDE phenomena

The most commonly cited explanation of NDE is the dying brain hypothesis: all of the phenomena of NDE can be explained as hallucinations, imaginings and mental constructions of the dying brain, by one or more physiological causes (Blackmore, 1993, p. 4). The fact that the NDEr had vivid conscious states with veridical perceptions while unconscious can be explained by physiological phenomena during unconsciousness, such as anesthesia awareness and subliminal perceptions, and information obtained after resuscitation. None of these explanations holds up to scrutiny.

Near-death experiences are not caused by abnormal brain function

Skeptics assert that NDE phenomena are merely the brain states of a dying brain, which can explain all of its main elements: feelings of peace, feeling separated from the physical body, passing through a tunnel, seeing a bright light, having a life review, etc. A number of physiological factors are generally cited in these explanations of NDE (Greyson *et al.* 2009, pp. 217–234). However, none of these factors, alone or in combination, is adequate to explain NDE, because (1) the reported experiences bear only slight resemblance to NDE, (2) many NDEs occur under conditions without the suggested physiological factor, and/or (3) in cases where the physiological factor is present, NDEs are not reported in even a large percent of cases. The main physiological factors cited by skeptics are:

- *Altered blood gas levels:* Cerebral hypoxia or anoxia (too little or no oxygen), as well as hypercarbia (elevated carbon dioxide) do sometimes involve NDE features (tunnel vision, bright lights, sense of floating, brief fragmented visual images). However, their primary features include symptoms not found in NDE – jerking movements, compromised memory, tingling sensations, confusion upon waking, etc. Moreover, NDEs occur in conditions without hypoxia or anoxia (non-life-threatening illnesses, falls, etc.) and in patients where measured blood levels do not reflect lowered oxygen or elevated carbon dioxide levels. Finally, NDEs occur in only 10-20% of cardiac arrest cases where anoxic conditions are very likely to occur.
- *Neurochemical factors:* Release of endorphins or similar chemicals in the brain at the time of stress may produce cessation of pain and feelings of peace, both common in NDE. However, injection of endorphins tends to produce long-lasting effects, whereas these effects in NDE begin and end abruptly, with the experience. An endogenous ketamine-like anesthetic agent may produce effects similar to low doses of ketamine (sense of out of body, a tunnel to a light,

believing one has died, etc.) However, unlike the vast majority of NDEs, ketamine experiences are usually frightening, having bizarre imagery and are felt to be illusory. Other important features of NDE (meeting deceased relatives, life review) are absent from reported ketamine experiences.

- *Temporal lobe seizure or other abnormal electrical activity in specific brain regions:* Abnormal electrical activity or dysfunction in the temporal lobes are claimed to produce all or most NDE phenomena (out-of-body sensations, panoramic memories, etc.). While electrical brain stimulation studies by Wilder Penfield are commonly cited as evidence, electrical brain stimulation is not the same as seizure or dysfunctional temporal lobe electrical activity and the experiences cited are dissimilar to those reported in NDEs (fragments of music, isolated scenes from memory, fear, bizarre imagery, etc.) Transcranial magnetic stimulation has also been cited as inducing all of the major components of NDE (out-of-body experiences, being pulled toward a light, hearing strange music, etc.). However, the experiences reported were unlike typical NDE features or were too vague to compare, and other researchers were unable to replicate the results. Finally, temporal lobe seizures themselves do not result in experiences that resemble NDE features.
- *Induced out-of-body experiences (OBEs):* Out-of-body experiences have been claimed to result from seizure activity or electrical stimulation in the region of the temporo-parietal junction (TPJ) (Blanke *et al.* 2002 and 2004). The interpretation of the results of these studies is controversial (Greyson *et al.* 2009, pp. 221–223). The generalization of cases of moderate to severe neurological pathology to all persons experiencing OBE is conjectural. Further, the cases of OBE associated with TPJ seizure and electrical stimulation are not typical of spontaneous OBEs, especially those associated with NDE: TPJ-induced OBEs are more fragmentary, distorted and illusory, involving incomplete or non-veridical elements, in contrast with spontaneous OBEs.
- *Rapid eye movement intrusion:* Rapid eye movement (REM) intrusion, the intrusion into waking consciousness of some characteristics of the REM sleep state, shares some characteristics with NDE such as a sense of extraordinary light, feeling immobilized yet alert to the surroundings, and a sense of being dead. Under other conditions, Kevin Nelson and colleagues claimed, REM intrusion can cause additional aspects of NDE, including autoscopy, light, visual experience, pleasant feelings and transcendent qualities (Nelson *et al.* 2006). However, several methodological weaknesses of their study have been cited. More importantly, the characteristics of REM intrusion and NDE do not match: only 40% of NDE respondents reported *any* REM intrusion symptoms; fear and hallucinations are common in sleep paralysis and REM intrusion but not in NDE; key NDE elements such as veridical perception and lasting aftereffects are absent in REM intrusion; and NDE occurs during anesthesia and with other drugs that inhibit REM (Long & Holden, 2007).

Thus, physiological explanations are inadequate to explain NDE. No single physiological factor is present in all cases of NDE and the reported physiological experiences bear only slight resemblance to NDE. The NDE appears to be a unique phenomenon in its own right.

Continuity of consciousness and apparent veridical perceptions in NDE

NDE occurs with reasonable frequency during cardiac arrest, sometimes with an out-of-body component that includes veridical perceptions. Within 10 seconds after cardiac arrest, blood flow to the brain, electrical brain activity as measured by electroencephalogram (EEG), and brain stem function all rapidly cease, the patient loses consciousness and the patient is generally considered clinically dead. Nevertheless, during the arrest, some patients upon resuscitation report vivid, conscious, out-of-body perceptions of themselves and their physical environs (Mays & Mays, 2008a,

pp. 9–18).

The timing of the veridical perceptions can sometimes unequivocally establish the state of the patient’s brain electrical activity, assuming the general progression of physiological changes that have been measured in other patients during cardiac arrest. In some cases, the patient reported vivid consciousness and accurately described out-of-body perceptions of the *onset* of resuscitation efforts (or other similar events) when brain function almost certainly had ceased, from a visual perspective out of the patient’s physical line of sight.

The physiological explanations of such cases include positing subliminal perceptions during unconsciousness, the construction of birds-eye imaginings of what transpired and post-resuscitation acquisition of knowledge from doctors, nurses or others. These explanations do not hold up to scrutiny of the actual facts of the cases. Two prospective studies have been done (Sabom, 1982, pp. 81–115; Sartori, 2006) in which cardiac arrest patients with NDE were asked to describe their recollection of the resuscitation procedure, and these accounts were compared with those from a control group of similar patients without NDE. In both studies, the NDE patients’ recollections were very accurate whereas the controls’ recollections were very inaccurate, containing misconceptions, errors and guesses. If the proposed physiological explanations had occurred, this stark difference would not be observed between the two groups.

Another skeptical assertion is that even strongly suggestive cases of apparently nonphysical veridical perception (AVP) cannot be distinguished from visual imagery constructed from guesswork and/or residual hearing and sight, because the cases happened too long ago to be verified now (Blackmore, 1993, p. 182). However, Janice Holden (2009, pp. 193–199) reported an analysis of AVP cases during the OBE phase of the NDE that have been reported in the NDE research literature, where the veridical elements were reported to be corroborated. Of 93 cases, 86 cases (92%) were completely accurate, 6 cases (7%) had some error and 1 case (1%) was completely erroneous. More importantly, of the 86 cases that were completely accurate, 13 cases were verified by the experiencer only, 38 were verified by others per the report of the experiencer and 35 were verified by objective sources. One might be tempted to dismiss reports of verification by the experiencer only and verification by others per the report of the experiencer, as the result of confabulation. However, this is unreasonable because of the number of reported cases and the high percentage of overall cases that were completely accurate. The reports can’t all be confabulations. Furthermore, it is completely unreasonable to dismiss as confabulation the large percentage of cases (40%) that were verified by objective sources.

Thus, physiological explanations also fail to hold up in the NDE phenomena of the continuity of consciousness with AVP during periods of no electrical brain activity. Since physiological explanations alone are inadequate to explain the cause of NDE and key phenomena associated with NDE, other explanations such as the present theory are valid possibilities.

Explaining phantom limb phenomena

The two current theories of phantom limbs are the neuromatrix theory (Melzack, 2001) and the neural remapping theory (Ramachandran & Hirstein, 1998). The neuromatrix theory states that neural patterns in a network involving the cortex, thalamus and limbic system generate conscious awareness and the sense of the body and self. The activity in the body-self neuromatrix forms neurosignatures for different body parts which persist even after limb amputation, causing phantom sensations and phantom pain. The remapping theory states that the somatosensory map of the physical body is reorganized when there is an amputation, such that the adjacent neural regions in the map “invade” and take over the neural region associated with the missing body part. The subject then feels phantom sensations and phantom pain when the adjacent areas are inadvertently physically stimulated. Thus, for an arm amputation, the region of the face and lips and the region of the stump become remapped to the missing hand. Rubbing the face then produces sensations of the missing fingers.

Both of these theories hold that phantom limb sensations are a product of abnormal neural organization in the brain and thus fail to explain the objective qualities of the phantom limb field that we have observed. In particular, these theories do not explain (1) the observed interaction of the phantom limb region with physical objects evoking distinctive physiological reactions in the stump, (2) the observed interactions of “touching” another subject in the region of the brain, evoking unusual inner visual images in the other subject, (3) the reports of phantom limb subjects being able to “see” their phantom limbs, and (4) the reports that phantom limb patients can accurately sense where Therapeutic Touch practitioners are “touching” the missing limb without using physical sight.

The observed phenomena suggest that the phantom limb region is an objective entity extending beyond the physical stump and that subjective phantom sensations are a result of interactions in the phantom limb region rather than solely neural activity in the brain. While our observations of these phantom limb phenomena are still preliminary and further research is needed, these phenomena support the present theory.

Philosophical views of consciousness

David Chalmers (2010, pp. 103–139) summarized the different philosophical approaches to consciousness, divided into six classes or types. Types A, B and C are different forms of reductive materialism (the differences are not relevant to this discussion), which holds that consciousness is a purely physical process. Chalmers showed, in arguments similar to those given in the Introduction section above, that the materialist view cannot explain phenomenal experience and therefore must be false.

Chalmers’ type E is a form of dualism better known as epiphenomenalism which holds that physical states cause subjective phenomenal states but the converse, that phenomenal states can causally alter or influence physical states, is not true. The mind is merely a by-product of physical processes. Because people generally have a sense of agency in their actions, this view is generally rejected as counterintuitive and unacceptable.

Chalmers’ type F is a form of monism, sometimes called panpsychism or panprotopsyism, which holds that phenomenal properties, or perhaps more fundamental “protophenomenal” properties, are intrinsic in and underlie physical reality itself. Phenomenal experience arises from physical brain states because the physical brain has intrinsic phenomenal (or protophenomenal) properties. This view has difficulty explaining how phenomenal experiences arising from numerous individual microphysical systems combine together to form a single subject of experience. This is known as the combination problem. Like epiphenomenalism, the type-F view is generally rejected as counterintuitive and strange, for example holding that there something it is like to be an electron.

Because the type-A, B, C and F views posit a direct dependence on the physical brain, none of these views can explain the NDE phenomena of continuity of vivid consciousness and veridical perception while the brain has no electrical activity. Because type-E epiphenomenalism posits no physical causal effects for phenomenal states, there should be no detectable effects of the field of the mind. However, these effects are observed in instances of NDE and phantom limb interactions.

That leaves Chalmers’ final type D or interactionist dualism which holds that physical states cause phenomenal states and phenomenal states cause physical states. Phenomenal experience can be explained because causal interactions from physical states can directly influence a mental field. The objection that mental states influencing brain states would violate causal closure of the physical can be answered, Chalmers conceded, by some new basic force associated with a mental field that can causally influence brain states and vice versa. Such a force associated with a mental field would be a reasonable extension—although a significant revision—of existing physical theory.

Responses to criticisms of interactionist dualism

The present theory is a form of type-D interactionist dualism which posits the mind and the body

and a mechanism for the interaction between them. The main objections to dualism, and responses relating to this theory, are:

- *How can mind-brain interaction occur?* There is no conceivable mechanism whereby a totally non-physical mind could affect the material body. If the mind and body are totally different types of things, how can there be a causal nexus between them, how can they intermingle and interact with each other (e.g. Dennett, 1991, pp. 33–35)? *Response:* The mind is not totally non-physical. It is nonmaterial, but has the character of a structured energy field that interacts with physical processes. The evidence supporting this view, presented earlier, includes phenomena from NDE and from phantom limb interactions.
- *How does brain injury also impair the non-physical mind?* When the brain is damaged in some way, mental faculties are always compromised or impaired to some degree. If the mind is a completely separate substance from the brain, how does brain injury also always impair the mind (Churchland, 1988, pp. 18–21)? *Response:* The mind is an autonomous entity but is completely united with the brain. It has the character of a structured energy field that interacts directly, physically with brain neurons. Consciousness and cognitive abilities ordinarily are not possible without the underlying neural activity. Even endogenous mental activity must be reflected in brain electrical activity in order to become conscious. Impairment is due to interference with the interface between the neurons and the corresponding structures of the mind.
- *How can the mechanism for interaction between the brain and mind explain phenomenal experience?* Even if a mechanism for causal interaction could be found, the mechanism for interaction itself would not explain phenomenal experience any more than neurological mechanisms do (Chalmers, 1996, pp. 156–158). *Response:* The mind is itself the locus of phenomenal experience. All interactions of the brain with the mind entail phenomenal experience. The causal interaction explains the phenomenal experience.
- *How does this view avoid the Cartesian theater in the brain?* An interactionist dualist theory posits that the brain informs the mind of perceptions and the mind directs the brain in appropriate action. The mind is thus like a “homunculus” located in a special center in the brain. There is no interior homunculus observing the results of neural activity and giving commands in a “Cartesian theater in the brain”, as such theories imply (Dennett, 1991, p. 107). *Response:* The mind’s structures unite directly with all neural structures, having no intermediate stages of “interpretation” and “command”. All neural activity interacts directly with the mind, resulting in phenomenal experience.
- *How is this view not a category-mistake? How is this not just a “ghost in the machine”?* A theory that places “mind” and “body” together in relation to one another as terms of the same logical category makes a category-mistake, since they are not of the same logical category. There is no hidden entity, the “mind”, inside a mechanical “body” (Ryle, 1949, pp. 11–24). *Response:* Both the mind and the material body are objective, spatially extended entities, one a nonmaterial field and the other a material object, which unite together to form a cohesive unity. There is no category-mistake of relating entities belonging to different logical categories: both mind and body are objective aspects of reality with physical attributes that relate to each other through physical interaction. There is no “ghost in the machine” because the mind is closely united with the body through a physical interaction relationship.
- *Doesn’t this view violate causal closure of the physical?* Causal interactions between a non-physical entity and a material body would violate the “causal closure of the physical world”. The interaction of a non-physical entity would introduce an influence on a physical system which would violate the principle that all physical effects can be ultimately reduced to physical causes. *Response:* The mind is a field (region of space) that interacts with physical processes, and thus has physical attributes, implying that at some level, the field of the mind acts as a physically

causal entity. As a consequence, the domain of what constitutes “the physical” must necessarily be expanded to include minds. Causal closure of the physical world is maintained.

Non-local consciousness

Pim van Lommel (2010, pp. 257–279) proposed a theory of non-local consciousness which is a form of “extended” type-F panprotopsyism in which consciousness has a primary presence in the universe and manifests as wave functions in non-local space. Consciousness can exert influence because non-local space, as well as matter, possesses phenomenal properties. Indeed, non-local consciousness is more fundamental than space and time and is the origin and basis of everything, including the material world.

Van Lommel uses the analogy of the television set which receives and transforms electromagnetic signals into a moving picture and sound. The brain is analogous to the TV set with non-local consciousness analogous to the electromagnetic signals. With the loss of brain function in cardiac arrest, the neural electromagnetic activity ceases and the interface between consciousness and the physical body is disrupted. This creates the conditions for experiencing directly the enhanced, non-local consciousness outside the body that is characteristic of NDE. According to van Lommel, this view can account for all of the elements of NDE and implies that the non-local consciousness persists even after death; it is endless. Van Lommel emphasizes the NDE elements that have a non-local character and the sense of interconnectedness, for example, access to detailed memories of one’s past and sometimes visions of future events, visions of and communication with deceased relatives and friends and with transcendent beings, the sense of unconditional love and acceptance, and contact with universal knowledge and wisdom.

The interface between the brain and non-local consciousness is difficult to define. The endless non-local consciousness manifests as indestructible and not directly observable wave functions which are always present in and around the body but cannot be localized in any particular place, not even in the brain; they are everywhere. The brain and body merely function as a relay station. The electromagnetic fields in the brain are the effect and consequence of non-local consciousness rather than the cause. Phenomenal experience and physical brain activity are different manifestations of the same underlying non-local reality and cannot be reduced to one another. Van Lommel suggests possible quantum processes that could link non-local consciousness to the physical brain.

Thus, van Lommel holds that the fundamental property of consciousness is *non-locality* and the motivation for this view appears primarily to be the non-local aspects of NDE. His theory is highly speculative with few details of how non-local consciousness could work with the brain. In particular, van Lommel has no explanation for the persistence of apparent localized consciousness during NDE. Furthermore, his theory does not fit with the phenomena of definite physical interaction reported in NDE or cases of “merging” in NDE. How do non-local wave functions interact with physical processes when the NDEr is out of the body? If each brain is tuned to just one person’s non-local wave functions, how can the NDEr readily “tune in” to another person’s brain, in the case of NDE merging?

In the present view, the fundamental aspect of the mind is the *localized individuality or beingness* of the person. This aspect of the mind manifests throughout the NDE in the persistence of self-conscious awareness with a particular location and visual perspective. Even in the most transcendent experiences in NDE, for example a sense of merging with the oneness of existence, self-awareness and the formation of individual memories are present. Deceased and transcendent beings which the NDEr encounters also display localized, individual natures. In our view, the mind’s individuality is fundamental and the transcendent or non-local aspects are secondary properties of the mind. Moreover, NDE phenomena include definite interactions with physical processes. Thus, the mind is localized and has both physical attributes and non-local attributes.

Summary

Physiological explanations alone are inadequate to explain the cause of NDE and key phenomena associated with NDE. The NDE appears to be a unique phenomenon in its own right. Similarly, current theories of phantom limbs can’t explain the phenomena of interaction that we and others have observed. The present view of the mind as an energetic nonmaterial entity, however, can explain these phenomena.

Chalmers’ analysis of philosophical views of consciousness admits that a new basic force associated with a mental field—a reasonable extension, although significant revision, of existing physical theory—could causally influence brain states and vice versa. The present theory posits such a basic force acting within a mental field and answers all the objections historically raised against dualism.

Van Lommel’s theory of non-local consciousness does not adequately explain the phenomenon of localized consciousness persisting throughout NDE. The present theory that the mind is fundamentally localized and has both physical and non-local attributes better explains all NDE phenomena.

Solution to the ‘Hard Problem’ of Consciousness

The present theory solves the “hard problem” of how phenomenal experience can arise from physical brain activity: phenomenal experience and consciousness depend on a *second entity* in addition to the brain, namely the mind, which is the seat of phenomenal experience for the person.

The clearest evidence of the dependence of phenomenal experience on the mind is NDE. During the out-of-body component of NDE, the locus of consciousness separates from the physical body and has a particular position in space and a particular visual perspective. In this independent state, the NDEr has rich, intensely real cognitive experiences, with heightened, lucid awareness, logical thought processes, and vivid perceptions. While outside the body, the mind appears as a coherent entity which retains all of the faculties of ordinary consciousness. When the mind entity returns to and reunites with the body, the locus of consciousness switches back to an in-body perspective. Wherever the mind entity is located, the person’s phenomenal experience and particular visual perspective occurs.¹⁷

This implies that the mind is an objective entity with a spatial location and orientation, and is the seat of a person’s consciousness. The mind entity is autonomous but when the mind is united with the brain, the two entities operate as one. Brain electrical activity is causally linked through reciprocal physical interaction with the field of the mind and directly produces subjective phenomenal experience. The mind’s structures are united directly with neural structures, with no intermediate stages of “interpreting” and “directing” the neural activity.

All interactions of the field of the mind with physical processes result in the person’s subjective phenomenal experience. These physical interactions include ordinary neural electrical activity, electrical brain stimulation, direct physical interactions during NDE OBE and interactions involving phantom limbs.

Experiences of qualia are an effect in the mind resulting from electrical activity in specific cortical locations. The electrical activity at a particular cortical location is associated with

¹⁷ Joseph McMoneagle (1997, p. 30; personal communication, 4 June 2010) reported that during his NDE from convulsions, he was out of his body observing his friend trying to revive him. Finding no pulse, his friend struck him in the center of the chest periodically (not as in CPR, which was not widely practiced at the time, in 1970). Each time his friend struck him, McMoneagle would feel a *click* and find himself looking up at his friend through his physical eyes. Then he would immediately feel another distinct *click* and would again be out of his body looking down at him from above. This yo-yo process (*click*—pain, *click*—no pain, *click*—pain, etc.) went on for more than ten minutes.

phenomenal experience of a particular quale, which implies that the particular electrical activity affects the field of the mind in that location and produces the specific associated quale. The specific *qualities* of a person's internal experience – why a red object appears *red* – are an effect in the mind.

A theory of consciousness must be compatible with the idea that a person's conscious states are necessarily unified. In the present theory, the unity of consciousness results necessarily from the unity of the mind's field of consciousness, in which phenomenal states are experienced as a unity.

While the mind entity is nonmaterial, it has physical attributes that can causally influence and can be causally influenced by physical neural processes. Because the mind interacts causally with physical processes, causal closure of the physical is maintained. However, the domain of what constitutes “the physical” must necessarily be expanded to include the nonmaterial mind.

A Possible Mechanism for Interaction

The present theory proposes that the field of the mind interacts energetically with brain neurons. Thus, mind-brain interaction must ultimately resolve to physical neural processes. There are several tentative data from NDE and phantom limb phenomena that suggest possible mechanisms for the field of the mind. There is also sufficient information about neural structures to suggest how a mind mechanism might work with neural structures to achieve mind-to-brain and brain-to-mind causal interactions.

In NDE, the field of the mind interacts with electromagnetic (light) waves to produce phenomenal perception. It interacts weakly with molecules – air vibrations, solid surfaces and solid objects – to produce sensations of phenomenal sound, “bobbing” on the ceiling and slight resistance passing through an object. The field of the mind also probably interacts weakly with air molecules to emit light, probably in the ultraviolet (UV) frequencies.¹⁸ It interacts readily with neurons to evoke phenomenal sensations in others and to allow “merging” in NDE. Finally, the field of the mind must have a structure closely matching the finely differentiated neural structure of the brain and nervous system.

One physical mechanism for a field of the mind that could account for these properties is a finely differentiated structure of minute oscillating electric or magnetic dipoles. This structure was first proposed by Kenneth Arnette (1995, 1999).¹⁹ We suggest that such a structure could explain all of the observed interactions described above. In particular, sufficiently energetic oscillating dipoles could excite nitrogen molecules which would then emit in the UV range,²⁰ with an energy requirement on the order of three electron volts (eV).

Neural minicolumns and columns

The basic unit of the neocortex is the minicolumn, a narrow vertical chain of neurons arranged in six layers.²¹ Typically, minicolumns are bound together by dense short-range horizontal connections in cortical columns (Mountcastle, 1998, pp. 165–203).²² Cortical columns have a specific function depending on their location within the cortex, for example, somatosensory receptivity for a specific

¹⁸ The reports of luminosity in the NDEr “body” and in phantom limbs suggest that the light is physical electromagnetic radiation. The case of a dog seeing and tracking an NDEr suggests that the light emitted might be in the UV range since dogs have greater visual acuity than humans in the blue and purple frequencies and presumably also in the UV range.

¹⁹ Arnette proposed a *theory of essence* in which the essence (mind) is an energetic body. Arnette proposed that mind-brain interaction occurs through a binding of electromagnetic fields, analogous to electric dipole-dipole interaction, which allows a reciprocal causal influence between the essence (mind) and the brain.

²⁰ One particularly strong emission line in nitrogen occurs at 3995Å, in the near-UV range.

²¹ The cortical layers are numbered 1 to 6. Layers 2 and 3 are usually treated together as layer 2/3.

²² The minicolumn typically contains 80–100 neurons. There are usually 50–100 minicolumns in a cortical column. The cortical column is about 0.3 mm to 0.5 mm in diameter.

part of the body, specific feature resolution in the visual field, or contraction of a specific muscle fiber group.

About 70–80% of the neurons within the minicolumn are pyramidal cells. Pyramidal cells are characterized by (1) a large pyramid-shaped cell body or soma, (2) a single, long apical dendrite rising vertically from the soma, which branches out at the top of the shaft in a dendritic tuft, (3) numerous basal dendrites which extend horizontally and below the soma, and (4) a single axon descending from the soma. The apical dendrites are all oriented perpendicular to the surface of the neocortex. The long pyramidal cells at layer 5 in a minicolumn cluster together in the center of the minicolumn, surrounded by shorter pyramidal cells in layer 2/3. The apical and basal dendrites are covered with numerous tiny membranous protrusions called spines.

Neocortical minicolumns and columns are linked together both in a “feed-forward” manner, where neural input is propagated upward in the hierarchy of functional areas, and in a “feedback” or reciprocal manner, where neural activity is propagated back downward in the hierarchy. Neural signals flow through different cortical areas in the hierarchy, starting with basic neural signals appearing “downstream” and ascending to “higher” cortical areas “upstream”, where the basic signals are progressively further analyzed and refined, for example into specific perceptual features (lines, shapes, colors, movement, spatial location, etc.).

Possible neural mechanism for mind-brain interactions

The facts of the cell structure and physiology of the brain, namely, (1) that the neural activity associated with consciousness is concentrated almost entirely in the gray matter, in the outer 2.5 mm of the neocortex, (2) that the apical dendrites have a unique linear structure oriented perpendicular to the cortical surface, and (3) that apical dendrites terminate in intertwined dendritic tufts in layer 1, strongly suggest that the interface with the field of the mind must be at the cortical surface, including in the sulci folds. Furthermore, mind-brain interactions of an oscillatory electrical or magnetic character might be very effective within the apical dendritic shafts. Such interactions might be amplified or modulated through interactions within the layer 1 dendritic tufts. The dendritic spines may also play a role in the mind-brain interaction.²³

David LaBerge (2001; LaBerge & Kasevich, 2007) has proposed that elevated neural activity in pyramidal apical dendrites is the basis for consciousness. LaBerge cited evidence that apical dendrites support oscillatory resonance. Synapses on the apical dendrite produce pulses that are propagated in both directions along the dendritic shaft. Action potentials from the soma produce significant back propagation of the signal in the apical dendrite shaft. LaBerge proposed that the subjective experience of prolonged attention is embodied in the waves of successive surges of current in the apical dendrites. Prolonged attention amplifies the electrical activity in the selected brain regions and correspondingly increases the intensity of the subjective experiences.

The present theory agrees with LaBerge in suggesting that oscillatory or back propagating electrical waves along the apical dendritic shaft, probably induced by ion transfer (e.g. Larkum *et al.* 2003), are significant for consciousness. They are a likely candidate for the reciprocal interfaces to the mind. The apical dendritic tufts in layer 1 are probably also part of this interface, since they spatially spread out effects of the apical dendritic shaft to a broader area.

Brain-to-mind interface

Within the minicolumn, the basic microcircuit consists of excitatory interactions between the neurons in layer 2/3, layer 4, layer 5 and layer 6 (see Douglas & Martin, 2004, Figures 1 and 2, pp.

²³ Pyramidal dendritic spines exhibit motility (rapid changes in shape) that is extinguished in the presence of inhalation anesthetics such as isoflurane (Kaech *et al.* 1999). The effect of such anesthetics in suppressing consciousness may be in blocking the function of the dendritic spines in the interface with the mind.

423–424), which suggests the different possible interfaces with the mind.

See Figure 1: the bracketed numbers refer to items in the figure. Sensory inputs [1] project to layer 4 spiny stellate cells [2] in a feed-forward fashion. The layer 4 cells excite layer 2/3 pyramidal cells [3] which in turn excite adjacent layer 2/3 cells [4] to enhance the signal and “spread” the input to a larger cortical area. Subjective phenomenal experience ensues [5]. This process implies that the *oscillations in layer 2/3 apical dendrites in general constitute the brain-to-mind interface*. Layer 2/3 cells project to layer 4 cells in neighboring cortical columns [6]. In this process, the input is spread to other cortical columns of layer 2/3 pyramidal cells for further sensory analysis and refinement [7].

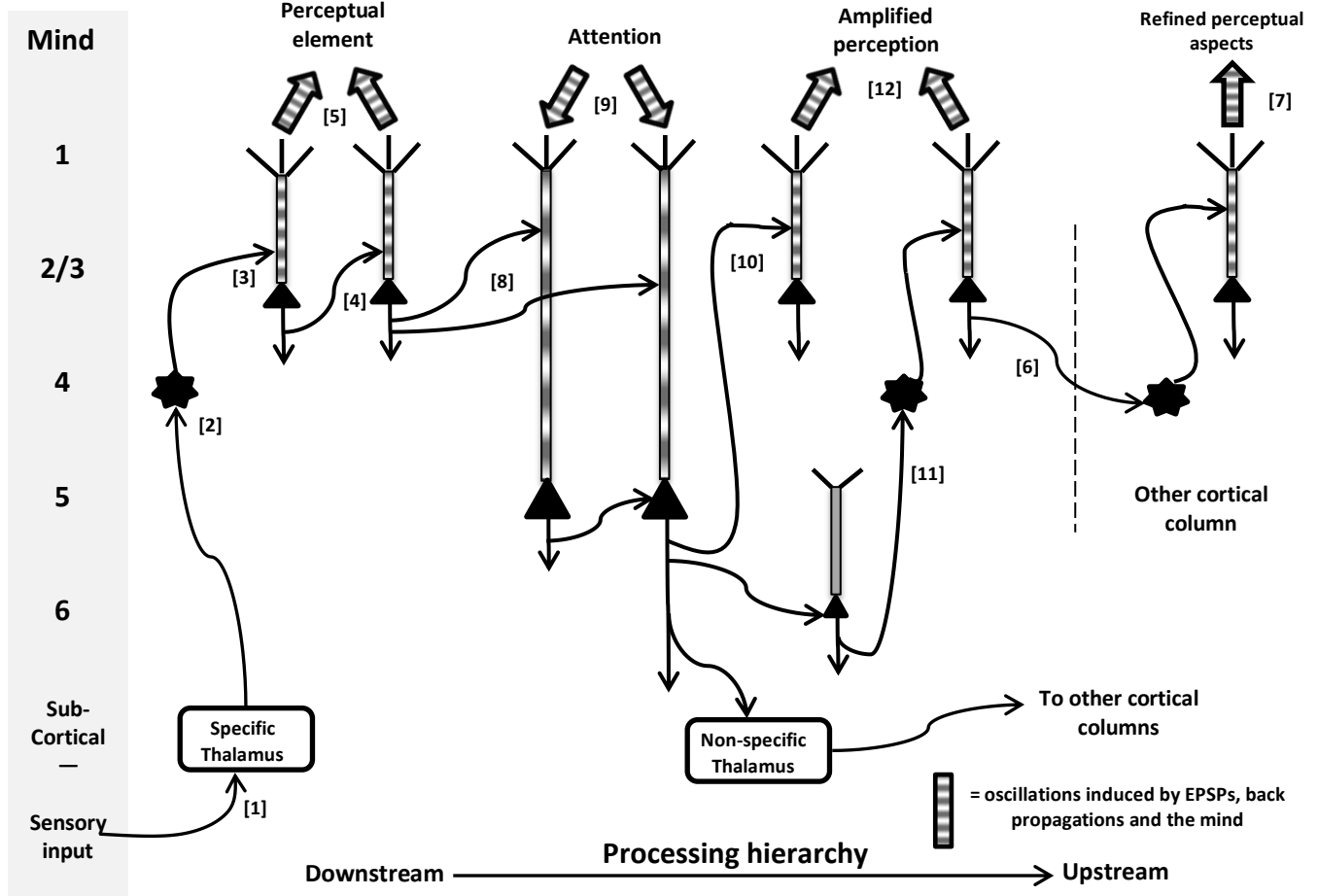


Fig. 1. Brain-to-mind processing in perception. On the left are listed the different regions of the process: the mind, the different layers of the neocortex and the subcortical region. Pyramidal cells are represented by a dark triangle (the soma), a long vertical shaft (the apical dendrite, splitting into layer 1 dendritic tufts). The cell’s axon projects from the base of the soma. Spiny stellate cells in layer 4 are depicted by a seven-pointed star. The position of the soma defines which cortical layer the cell is in. Inhibitory neurons are not shown. See the text for explanation of the neural processes.

Mind-to-brain interface

Layer 5 pyramidal cells are excited by layer 2/3 pyramidal cells [8]. We suggest that these inputs enable the focus of attention [9]. The mind can selectively amplify these layer 5 oscillations which then initiate excitations from layer 5 directly to layer 2/3 cells [10] or indirectly to layer 6 cells and then layer 4 cells [11], to increase the electrical intensity in the perceptual brain-to-mind interface of layer 2/3. The perceptual element is thus amplified in phenomenal experience [12]. A person’s volition thus operates through layer 5 cells to focus attention, which implies that *oscillations in layer*

5 apical dendrites in general constitute the mind-to-brain interface. Reciprocal excitatory axons project from layer 5 downstream as feedback to earlier cortical columns in the hierarchy (not shown in Figure 1). We propose that these reciprocal connections also amplify perceptual content through attentional focus.

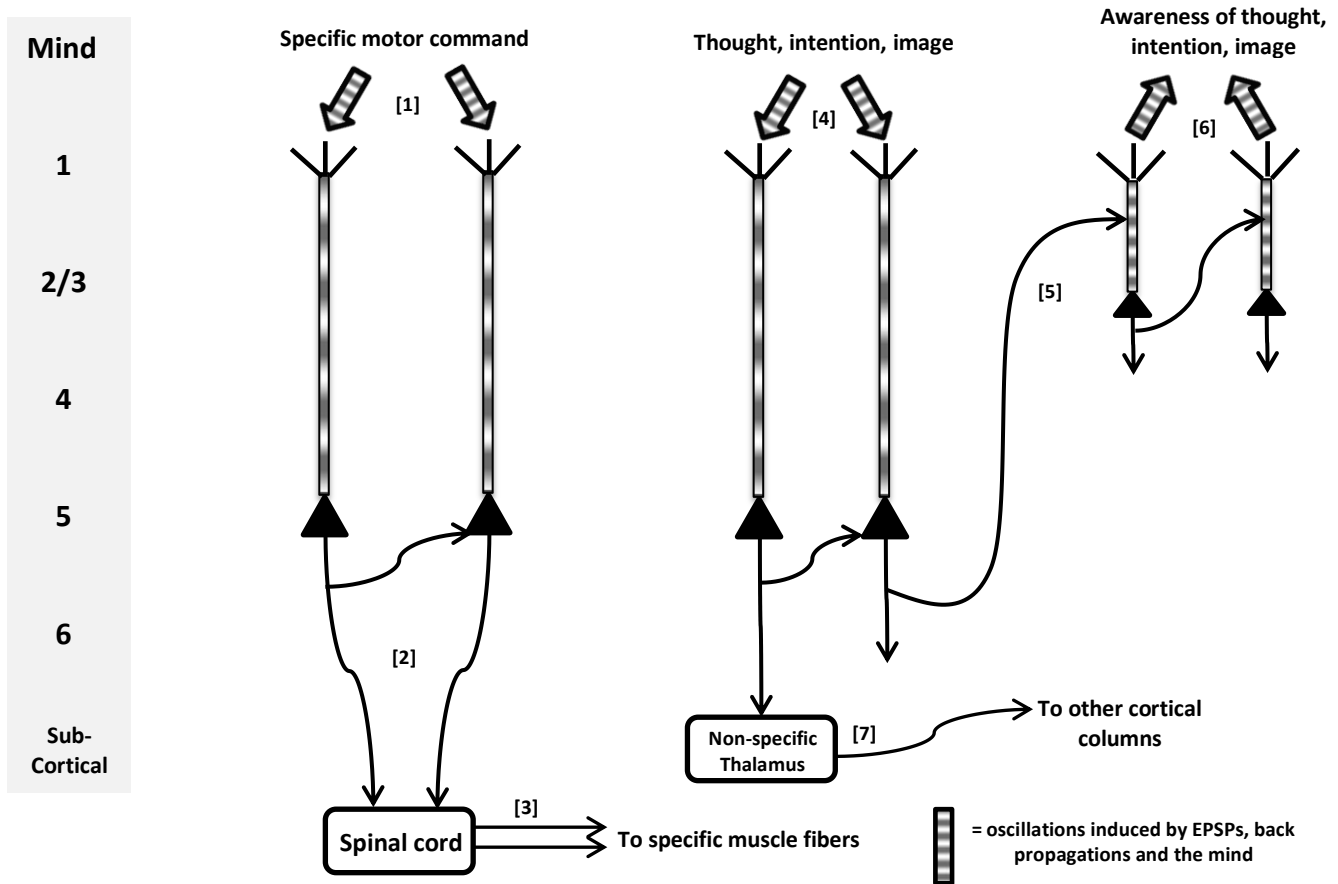


Fig. 2. Mind-to-brain processing for volition. Representations are similar to Figure 1. See the text for explanation of the neural processes.

Volition

See Figure 2: the bracketed numbers refer to items in the figure. Layer 5 pyramidal cells project to other structures in the brain, the best example being in the primary motor area whose layer 5 cells project directly to the spinal column and subsequently to muscle fibers. Intention and volition in the mind cause specific muscle movement, which again implies that *oscillations in layer 5 apical dendrites in general constitute the mind-to-brain interface*. The mind can directly initiate action potentials in layer 5 neurons [1]. One or several layer 5 cells are fired [2] and the impulse is carried down the spine [3] to specific muscle fibers. Other endogenous mental states (thoughts, images, decisions, etc.) are similarly reflected in neural activity via layer 5 cells. A subjective thought, intention or image initiates action potentials in layer 5 cells [4]. These potentials activate associated layer 2/3 cells [5] which enable the person to become aware of the thought or intention [6]. Other layer 5 potentials are passed through certain thalamic structures to distant parts of the cortex [7], for example to evoke an intended image in the visual cortex. Even endogenous mental events require

neural electrical activity to become conscious.²⁴ A person's volition thus operates through layer 5 cells to initiate motor movement and to evoke endogenous mental states, as well as to focus attention.

Energy requirements

In both the brain-to-mind and mind-to-brain interface, energy is consumed in generating oscillations or similar electrical influences in the apical dendrites, but without always triggering action potentials. The mind-brain oscillatory interface is an additional neural process over and above the neural processes that trigger action potentials. Thus, more energy is needed for consciousness beyond the energy needed for action potentials. Evidence supporting this view is that the focus of attention requires more blood flow, hence more energy, than would be expected by the increase in action potentials that are observed (Koch, 2004, p. 179).²⁵ We would expect that most of the energy for the mind-brain interface comes from the physical neural processes per se and that the mind structures contribute only a subtle physical effect in the process. A relatively small energy contribution, for example on the order of three eV, should be sufficient to trigger apical dendritic oscillations and to be triggered by the oscillations.

Functional differentiation

There are differences in the electrical properties of layer 2/3 and layer 5 apical dendrites, due to their different shaft lengths, for example differences in impedance and resonance. Indeed, these differences are also present to a lesser degree in layer 2 versus layer 3 dendrites. It is likely that the mind interface to the brain can distinguish between these differences with a corresponding differentiation of functional capability.

Memory processes

Episodic memory is facilitated by the hippocampal cortex. As experiences occur, the sensory, motor and mental neural components activate the hippocampus pyramidal cells and induce memory formation in the mind. Memories are later consolidated in the mind through further hippocampal activity. In episodic memory recall, hippocampal pyramidal cells interface with the mind and reactivate the same sensory and mental neural components, but at a lower intensity.²⁶

Summary

The proposed model of mind-brain interface is based on the layer 2/3 and layer 5 pyramidal cell apical dendrites. The apical dendrites carry electrical oscillations or waves, probably induced by ion transfer, that occur at sufficient intensity for the interface with the mind, without necessarily evoking action potentials. The oscillations are most likely induced by EPSPs (excitatory postsynaptic potentials – pulses from axons to the dendritic shaft), by pulses back propagating into the dendritic shaft from the neuron's action potentials, and by some form of induction from the mind, for example by electric dipole-dipole interaction. The oscillations provide an interface to the corresponding fine structures of the field of the mind. The oscillations in layer 2/3 apical dendrites serve as the brain-to-mind interface for sensory and other mental experiences. The oscillations in layer 5 apical dendrites

²⁴ In a series of experiments, Benjamin Libet found that a minimum duration (“time-on”) of neural activity of about a half second is required to elicit liminal sensory experience (Libet et al. 1991). If the neural activity is less than that duration, the sensation is detected subliminally but with no awareness. Libet (1993, p. 385) proposed that all mental events, including endogenous events, begin subconsciously and have a similar time-on requirement. Libet (2004, p. 106) concluded that awareness is a phenomenon independent of content and that such minimum durations are a unique requirement for awareness.

²⁵ Focus of attention was found to increase action potentials in primary visual (V1) neurons only mildly, whereas measures of hemodynamic signals in V1 observed “large and robust attentional effects.”

²⁶ This description is consistent with imaging studies of recall of visual and auditory sensations, for example Wheeler *et al.* (2000). Regions of sensory cortex are reactivated during retrieval of sensory-specific information.

are induced by the mind in the mind-to-brain interface and serve either to focus attention or to induce neural firing of the corresponding pyramidal cells for motor or other volitional action.

Comparison with Eccles’ theory of psychons

John Eccles’ interactionist theory of the self-conscious mind (Eccles, 1994, especially pp. 87–112) is similar in several respects to the present theory. However, for Eccles the mind is a separate “world”²⁷ from the physical, in which all subjective experiences from outer and inner senses manifest. The mind is a composite of elemental or unitary mental events called *psychons*; the whole mental world is granular in structure, consisting of psychon mental units. Each psychon is reciprocally linked one-to-one to a corresponding *dendron*, which is a cluster of 70–100 layer 5 apical dendrites in the neocortex. The interaction between the psychon and its dendron gives a specific, characteristic unitary experience. The entirety of the neocortex consists of dendrons and serves as the “liaison brain” which interfaces with the mind. In Eccles’ theory, the psychons are not a perceptual path to mental experiences; rather, they *are* the mental experiences in all their diversity and uniqueness. The physical brain has no mental properties or qualia.

In the interface between the psychon and its dendron, the psychon associates with the dendron’s collection of approximately 100,000 dendritic spine synapses. With an intention to move or to focus one’s attention, the psychon acts on this grid of synapses and alters the rate of synaptic potentials (“exocytosis”) by influencing the quantum probability field, and thereby alters the probability of firing an action potential. Such an influence can occur at the quantum level without a violation of energy conservation. With perception, in which the liaison brain evokes subjective perceptual experience, the mechanism is less clearly defined. With attention, there is increased exocytosis which provides the corresponding psychon the opportunity for increased selection of synaptic exocytosis. This increased selection gives the direct experience of the perceptual element.

The present theory agrees with Eccles’ view on several points: (1) that the mind is nonmaterial, (2) that the mind’s interaction with the brain directly constitutes phenomenal experience, and (3) that the mind has a structure which interfaces with specific anatomical elements of the cortex. There are also significant differences:

- *The nature of the mind:* Based on the evidence, the present theory holds that the mind is an energetic field with physical attributes, an objective entity that is spatially extended, with a particular location in space. In contrast, Eccles’ theory views the mind as a different “world” with an undefined spatial relationship to physical reality.
- *The nature of interaction between the mind and the brain:* Again, based on the evidence, the present theory holds that the mind’s energetic field interacts directly and bidirectionally with cortical neurons in a macroscopic way, probably using subtle electrical or magnetic forces. In contrast, Eccles’ theory holds that mind-brain interaction occurs by the psychon’s influence on the quantum probability field of the dendron’s synaptic grid.
- *The structure of the mind:* The present view holds that the mind is a unified field with very finely structured points of interaction with the neocortex. The unity of conscious experience occurs because of the unitary nature of the mind. In contrast, Eccles holds that the mind is a composite of unitary mental events, the psychons, each with a one-to-one point of interaction with clusters of apical dendrites. Eccles’ theory does not explain how the diverse mental units are brought

²⁷ The mind is “World 2” in which the self or psyche experiences the world through outer senses (light, color, etc.) and inner senses (thoughts, feelings, memories, etc.), and through which it exerts its will in the physical “World 1” (Popper & Eccles, 1977, pp. 358–360).

together into a unity of conscious experience except through a possible psychon-to-psychon interaction.

Just What is the Mind—and What is the Brain?

In NDE and phantom limb phenomena, the mind presents as a field, that is, a region of space with specific properties. The essential property of the mind is consciousness, more precisely the phenomenal experience of a particular individual. The mind has energetic attributes in that it appears to interact with physical processes, especially with neurons, and appears to exhibit electrical effects and luminosity. Whenever the field of the mind interacts with physical processes – in normal interactions with the brain, in NDE interactions and in phantom limb interactions – there is phenomenal experience.

The field of the mind is not like any currently known physical field. It appears to have a complex internal structure that directly maps to the neural structure throughout the brain and body. There appears to be a close, intricate connection between the mind's structure and the neocortical neurons, at the level of the cortical column and minicolumn. Because the brain's functional capability is organized spatially over the surface of the neocortex, there is also a tight, intricate spatial integration with the mind.

In ordinary consciousness, the mind is tightly united with the brain such that any impairment of the brain also impairs consciousness. However, there is no semantic content in the brain – the brain's function is simply neural electrical activity devoid of any “meaning” except in conjunction with the mind. On the other hand, the mind can't consciously think a thought, imagine an image or will to contract a muscle fiber without the intimate connection with the brain to bring the mental event to consciousness.

The mind does not appear to have the properties of a substance, in particular because it appears to be unitary and indivisible, although it has extension and location in space. Rather than a subtle substance, the mind appears to be more the seat of consciousness and the essential selfhood of the person.

Can the Nonmaterial Mind be Studied Scientifically?

The nature of the mind and how it functions with the brain are ultimately empirical questions. Objective, nonmaterial entities can be studied scientifically through their effects on other entities. We propose that further scientific investigation will be worthwhile in the following areas:

- *Phantom limb phenomena:* The phantom limb provides direct access to a “mind limb”, its inherent internal structure and how that structure interacts with the body and brain, in particular with the neurons in the stump. The phenomenal experience of phantom limb sensations and phantom limb pain are directly reportable, as are interactions of the phantom limb field with other subjects. Direct physical interaction of the limb field in measurement devices may also be possible. Research in this area also has the potential to develop effective treatment modalities for phantom limb pain, which has hitherto proved intractable.
- *NDE phenomena:* More thorough surveys of NDE accounts should provide additional cases and data about interactions with physical processes and “merging” of the NDEr with in-body persons. These data should provide additional information about the nature of the mind “body” in its out-of-body state. More detailed evidence of veridical NDE perceptions will strengthen the case for the nonmaterial mind.
- *NDE physiological aftereffects:* When the mind has reunited with the brain and body following

NDE, there generally are striking physiological aftereffects (heightened sensitivities, electrical effects, etc.), which probably result from the incomplete reintegration of the mind with the physical body. A direct study of unusual physiological aftereffects, especially just following NDE, should provide further insight about the mind in relation to the body.

- *Other neurological phenomena:* In principle, all neurological phenomena should be explainable in terms of the mind entity interacting with the brain. There are particular phenomena that might provide interesting insights and confirmation of this theory, for example, phenomena which might better be explained by the principle of “coming to awareness” – that all mental activity remains subliminal and comes to awareness only when sufficient electrical activity has occurred – such as the cutaneous rabbit, blindsight and split brain phenomena. Additionally, the interface of the mind with neurons might be unraveled through a detailed study of the microcircuits of specific cortical regions, such as the visual and motor cortex and the hippocampus.

Mind is a Fundamental Entity, a New Dimension of Reality

All interactions in the mind have two sides: they entail both phenomenal experience and a physical causal role. Physical causal closure is maintained because the mind is a nonmaterial entity with physical attributes, whose structures can act causally on neural processes. When phenomena are discovered which imply new physical entities or forces, the domain of what constitutes physical reality has historically been expanded. The case of the mind as a new aspect of reality is no different. The mind entails new fundamental properties and is a fundamental aspect of reality, namely the source of consciousness.

The essential property of the mind is the phenomenal experience of a particular individual. The mind is the seat of the essential selfhood of the person; it *is* the person. Conscious experience arises necessarily within the mind’s field of phenomenal experience, through the direct interaction of the mind with the person’s brain.

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References

- Arnette, J. K. (1995). The theory of essence. II. An electromagnetic-quantum mechanical model of interactionism. *Journal of Near-Death Studies*, **14**, 77–99.
- Arnette, J. K. (1999). The theory of essence. III: Neuroanatomical and neurophysiological aspects of interactionism. *Journal of Near-Death Studies*, **18**, 73–101.
- Atwater, P. M. H. (1994). *Beyond the light: The mysteries and revelations of near-death experiences*. New York: Avon Books.
- Atwater, P. M. H. (2007). *The Big Book of Near-Death Experiences: The ultimate guide to when we die*. Charlottesville, VA: Hampton Roads Publishing.
- Atwater, P. M. H. (2011). *Near-Death Experiences, the rest of the story: What they teach us about living, dying, and our true purpose*. Charlottesville, VA: Hampton Roads Publishing.
- Bayne, T. & Chalmers, D. J. (2003). What is the unity of consciousness? In A. Cleeremans (Ed.), *The Unity of Consciousness: Binding, integration and dissociation* (pp. 23–58). Oxford, England: Oxford University Press.
- Blackmore, S. (1993). *Dying to live: Near-death experiences*. Buffalo, NY: Prometheus Books.
- Blanke, O., Ortigue, S., Landis, T. & Seeck, M. (2002). Stimulating illusory own-body perceptions: The part of the brain that can induce out-of-body experiences has been located. *Nature*, **419**, 269–270.
- Blanke, O., Landis, T., Spinelli, L. & Seeck, M. (2004). Out-of-body experience and autoscopia of neurological origin. *Brain*, **127**, 243–258.
- Brugger, P., Kollias, S. S., Müri, R. M., Creliez, G., Hepp-Reymond, M.-C. & Regard, M. (2000). Beyond re-membering: Phantom sensations of congenitally absent limbs. *Proceedings of the National Academy of Sciences of the United States of America*, **97**, 6167–6172.
- Chalmers, D. J. (1996). *The Conscious Mind: In search of a fundamental theory*. New York: Oxford University Press.

- Chalmers, D. J. (2010). *The Character of Consciousness*. New York: Oxford University Press.
- Churchland, P. M. (1988). *Matter and Consciousness: A contemporary introduction to the philosophy of mind*. Cambridge, MA: MIT Press.
- Corcoran, D. K. (Ed.) (1996). *When ego dies: A compilation of near-death and mystical conversion experiences*. Houston, TX: Emerald Ink.
- Dennett, D. C. (1991). *Consciousness Explained*. Boston: Little Brown & Co.
- Douglas, R. J. & Martin, K. A. C. (2004). Neuronal circuits of the neocortex. *Annual Review of Neuroscience*, 27, 419–451.
- Eccles, J. C. (1994). *How the self controls its brain*. Berlin, Germany: Springer-Verlag.
- Greyson, B. (2000). Near-death experiences. In E. Cardeña, S. J. Lynn & S. Krippner (Eds.), *Varieties of anomalous experience: examining the scientific evidence* (pp. 315–352). Washington, DC: American Psychological Association.
- Greyson, B. & Bush, N. E. (1992). Distressing near-death experiences. *Psychiatry*, 55, 95–110.
- Greyson, B., Kelly, E. W. & Kelly, E. F. (2009). Explanatory models for near-death experiences. In J. M. Holden, B. Greyson & D. James (Eds.), *The Handbook of Near-Death Experiences: Thirty years of investigation* (pp. 213–234). Santa Barbara, CA: Praeger Publishers.
- Holden, J. M. (2009). Veridical perception in near-death experiences. In J. M. Holden, B. Greyson & D. James (Eds.), *The Handbook of Near-Death Experiences: Thirty years of investigation* (pp. 185–211). Santa Barbara, CA: Praeger Publishers.
- Kaech, S., Brinkhaus, H. & Matus, A. (1999). Volatile anesthetics block actin-based motility in dendritic spines. *Proceedings of the National Academy of Sciences of the United States of America*, 96, 10433–10437.
- Koch, C. (2004). *The quest for consciousness: A neurobiological approach*. Englewood, CO: Roberts & Company.
- LaBerge, D. (2001). Attention, consciousness, and electrical wave activity within the cortical column. *International Journal of Psychophysiology*, 43, 5–24.
- LaBerge, D. & Kasevich, R. (2007). The apical dendrite theory of consciousness. *Neural Networks*, 20, 1004–1020.
- Larkum, M. E., Watanabe, S., Nakamura, T. & Lasser-Ross, N. (2003). Synaptically activated Ca²⁺ waves in layer 2/3 and layer 5 rat neocortical pyramidal neurons. *Journal of Physiology*, 549 (2), 471–488.
- Leskowitz, Eric (2000). Phantom limb pain treated with Therapeutic Touch: a case report. *Archives of Physical Medicine and Rehabilitation*, 81, 522–524.
- Leskowitz, Eric (2001). Phantom limb pain: subtle energy perspectives. *Subtle Energies and Energy Medicine*, 8 (2), 125–152.
- Libet, B. (1973). Electrical stimulation of cortex in human subjects, and conscious sensory aspects. In A. Iggo (Ed.), *Handbook of sensory physiology, volume II: Somatosensory system* (pp. 743–790). Berlin: Springer-Verlag.
- Libet, B. (1993). Epilogue: Some Implications of “time-on” theory. In *Neurophysiology of consciousness: Selected papers and new essays* (pp. 385–392). Boston, MA: Birkhäuser.
- Libet, B. (2004). *Mind time: the temporal factor in consciousness*. Cambridge, MA: Harvard University Press.
- Libet, B., Alberts, W. W., Wright, E. W., Lewis, M. & Feinstein, B. (1975). Cortical representation of evoked potentials relative to conscious sensory responses, and of somatosensory qualities – in man. In H. H. Kornhuber (Ed.), *The somatosensory system* (pp. 291–308). Acton, MA: Publishing Sciences Group.
- Libet, B., Pearl, D. K., Morledge, D. E., Gleason, C. A., Hosobuchi, Y. & Barbaro, N. M. (1991). Control of the transition from sensory detection to sensory awareness in man by the duration of a thalamic stimulus: The cerebral “time-on” factor. *Brain*, 114, 1731–1757.
- Long, J. & Holden, J. M. (2007). Does the Arousal System Contribute to Near-Death and Out-of-Body Experiences? A summary and response. *Journal of Near-Death Studies*, 25 (3), 135–169.
- Mays, R. G. & Mays, S. B. (2008a). The phenomenology of the self-conscious mind. *Journal of Near-Death Studies*, 27 (1), 5-45. Reprint at <http://selfconsciousmind.com/papers.html#paper1>
- Mays, R. G. & Mays, S. B. (2008b). Phantom limb “touch” suggests that a “mind-limb” extends beyond the physical body. Poster presentation at *Toward a Science of Consciousness Conference*, April 8-12, 2008, Tucson, AZ. Reprint at <http://selfconsciousmind.com/papers.html#poster>
- McMoneagle, J. W. (1997). *Mind Trek: Exploring consciousness, time, and space through remote viewing*. Charlottesville, VA: Hampton Roads Publishing.
- Melzack, R. (2001). Pain and the neuromatrix in the brain. *Journal of Dental Education*, 65(12), 1378–1382.
- Moody, Jr., R. A. (1975). *Life after life: the investigation of a phenomenon – survival of bodily death*. New York: Bantam Books.
- Moody, Jr., R. A. & Perry, P. (1988). *The light beyond*. New York: Bantam Books.
- Mountcastle, V. B. (1998). *Perceptual neuroscience: The cerebral cortex*. Cambridge, MA: Harvard University Press.
- Nelson, K. R., Mattingly, M., Lee, S. A. & Schmitt, F. A. (2006). Does the arousal system contribute to near death experience? *Neurology*, 66, 1003–1009.

- Nikolajsen, L. & Jensen, T. S. (2001). Phantom limb pain. *British Journal of Anaesthesia*, 87 (1), 107–116.
- Pascual-Leone, A., Dang, N., Cohen, L. G., Brasil-Neto, J. P., Cammarota, A. & Hallett, M. (1995). Modulation of muscle responses evoked by transcranial magnetic stimulation during the acquisition of new fine motor skills. *Journal of Neurophysiology*, 74, 1037–1045.
- Penfield, W. & Rasmussen, T. (1950). *The Cerebral Cortex of Man: A clinical study of the localization of function*. New York: Hafner Publishing Co. (1968).
- Popper, K. R. & Eccles, J. C. (1977). *The self and its brain: an argument for interactionism*. London: Routledge.
- Ramachandran, V. S. & Hirstein, W. (1998). The perception of phantom limbs: The D. O. Hebb lecture. *Brain*, 121, 1603–1630.
- Ring, K. & Valarino, E. E. (1998/2000). *Lessons from the Light: What we can learn from the near-death experience*. Needham, MA: Moment Point Press, 1998/2000.
- Ryle, G. (1949). *The Concept of Mind*. New York: Hutchinson's University Library.
- Sabom, M. B. (1982). *Recollections of death: A medical investigation*. New York, NY: Harper and Row.
- Sartori, P. (2006) A long-term prospective study to investigate the incidence and phenomenology of near-death experiences in a Welsh intensive therapy unit. *Network Review: Journal of the Scientific and Medical Network*, 90, 23-25.
- Schwartz, J. M. & Begley, S. (2002). *The mind and the brain: neuroplasticity and the power of mental force*. New York: HarperCollins.
- van Lommel, P. (2010). *Consciousness beyond life: The science of the near-death experience*. New York: Harper-Collins.
- Wheeler, M. E., Petersen, S. E. & Buckner, R. L. (2000). Memory's echo: Vivid remembering reactivates sensory-specific cortex. *Proceedings of the National Academy of Sciences of the United States of America*, 97 (20), 11125–11129.