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Implications of Near-Death Experiences for a Postmaterialist Psychology

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Classical physics, anchored in materialist reductionism, offered adequate descriptions of everyday mechanics but ultimately proved insufficient for describing the mechanics of extremely high speeds or small sizes, and was supplemented nearly a century ago by quantum physics, which includes consciousness in its formulation. Materialist psychology, modeled on the reductionism of classical physics, likewise offered adequate descriptions of everyday mental functioning but ultimately proved insufficient for describing mentation under extreme conditions, such as the continuation of mental function when the brain is inactive or impaired, such as occurs near death. "Near-death experiences" include phenomena that challenge materialist reductionism, such as enhanced mentation and memory during cerebral impairment, accurate perceptions from a perspective outside the body, and reported visions of deceased persons, including those not previously known to be deceased. Complex consciousness, including cognition, perception, and memory, under conditions such as cardiac arrest and general anesthesia, when it cannot be associated with normal brain function, require a revised psychology anchored not in 19th-century classical physics but rather in 21st-century quantum physics that includes consciousness in its conceptual formulation.

Keywords: materialism, reductionism, near-death experience, mind–body problem, consciousness

Until the early 20th century, classical mechanics was the foundation for all sciences on the assumption that observations of all sciences might someday be reduced to the laws of mechanics. At the heart of the classical worldview was *materialist reductionism*, the idea that any complex phenomenon could be understood by reducing it to its individual components and eventually down to elementary material particles. This worldview implied that all complex psychological phenomena could ultimately be understood in material terms.

This materialist worldview permeated psychology as it did other sciences, even though this reductionism required psychologists to focus exclusively on phenomena that could be described objectively by independent observers and to ignore consciousness. Materialist psychology was epitomized by Watson (1914), who asserted, "Psychology, as the behaviorist views it, is a purely objective, experimental branch of natural science which needs consciousness as little as do the sciences of chemistry and physics" (p. 27). It is ironic that while Watson was aligning behaviorist psychology with classical mechanics, physicists were already moving beyond that model with a quantum physics that could not be formulated without reference to consciousness.

Classical dynamics adequately described the motion of macroscopic objects moving at everyday speeds; it was only the investigation of extraordinary circumstances, involving objects moving with velocities approaching the speed of light or the behavior of microscopic wave-particles, that revealed the limits of the classical model and the need for additional explanatory paradigms. So too with the question of the mind–brain relationship: It is the exploration of extraordinary circumstances of mental function that reveals the limitations of the current model of mind–brain identity and

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the need for a more comprehensive explanatory model.

Near-Death Experiences

One such extraordinary circumstance calling into question the adequacy of the mind–brain identity model is the continued functioning of the mind when the brain appears to be inactive or impaired, such as may occur near death. Dozens of case reports in the medical literature spanning centuries have documented the phenomenon of *terminal lucidity*, the unexplained return of mental clarity and memory shortly before death in patients who had suffered years of chronic schizophrenia or dementia (Nahm & Greyson, 2009). Beyond this paradoxical enhanced mental clarity while brain function presumably deteriorates, considerable research in the past several decades has been published delineating parameters of what have come to be called *near-death experiences* (NDEs). These profound subjective experiences that many people report when they are near death pose challenges to the materialist mind–brain identity model (Greyson, 2003; Parnia, Waller, Yeates, & Fenwick, 2001; Schwartz, Stapp, & Beauregard, 2005; van Lommel, van Wees, Meyers, & Elfferich, 2001).

Such experiences of altered consciousness on the threshold of death have been described sporadically in the Western medical literature since the 19th century (Brierre de Boismont, 1859; Cullen, 1894), were identified as a discrete syndrome toward the end of that century (Heim, 1892), and have been studied more systematically in the past 30 years (Holden, Greyson, & James, 2009). Recent research suggests that NDEs are reported by 12% to 18% of cardiac arrest survivors (Greyson, 2003; Parnia et al., 2001; van Lommel et al., 2001), and that they are more consistent with a normal response to stress than with a pathological disorder (Greyson, 2000, 2001).

These NDEs are vivid experiences involving mystical or transcendental features occurring to people who have been physiologically close to death, as in cardiac arrest or other life-threatening conditions, although mystical and transcendental experiences may of course occur under other circumstances as well. Frequent NDE features include feelings of peace and joy; a sense of being out of one's physical body and watching events from an out-of-body perspective; a cessation of pain; seeing an unusually bright light, sometimes experienced as a "Being of Light" that radiates love and may speak or otherwise communicate with the person; encountering other beings, often deceased people; experiencing a revival of memories or even a full life review; seeing some "other realm," often of great beauty; sensing a barrier or border beyond which the person cannot go; and returning to the physical body, often reluctantly.

A number of reductionistic hypotheses have been proposed to explain NDEs, attributing them to psychopathology, personality traits, altered blood gases, neurotoxic metabolic reactions, or neuroanatomical malfunctions, although such speculations generally lack any empirical support and address only selected aspects of the phenomena (Greyson, Kelly, & Kelly, 2009). The most important objection to the adequacy of all reductionistic psychophysiological theories, however, is that mental clarity, vivid sensory imagery, a clear memory of the experience, and a conviction that the experience seemed more real than ordinary consciousness are the norm for NDEs, even when they occur in conditions of drastically altered cerebral physiology under which the reductionistic model would deem consciousness impossible.

Extreme Physiology of Cardiac Arrest and Anesthesia

Although experiences resembling NDEs may occur in a wide variety of medical circumstances, NDEs are most reliably triggered when patients are clinically near death, such as during cardiac arrest or some other, usually sudden, loss of vital functions. In one study of 1,595 consecutive admissions to a cardiac care unit, NDEs were reported 10 times more often by patients who had survived definite cardiac arrest compared with patients with other serious cardiac incidents (Greyson, 2003). The particular challenge of NDEs to materialist reductionism lies in one central feature that makes this phenomenon uniquely important in any consideration of the mind–brain problem: specifically, the occurrence of vivid and complex mentation, sensation, and memory formation under conditions in which materialist models of the mind deem them impossible. The stark incompatibil-

ity of NDEs with the current reductionistic model of mind–brain relations is particularly evident in connection with experiences that occur under two conditions, namely, general anesthesia and cardiac arrest.

General Anesthesia

In our collection at the University of Virginia, 22% of our NDE cases occurred under anesthesia, and they include the same features as other NDEs, such as out-of-body experiences that involved watching medical personnel working on their body, an unusually bright or vivid light, meeting deceased persons, and, significantly, thoughts, memories, and sensations that were as clear or clearer than usual.

John et al. (2001) recently carried out a massive study intended specifically to identify reliable electroencephalographic (EEG) correlates of loss and recovery of consciousness during general anesthesia. Their results confirmed the standard thinking about anesthesia and EEG, namely, that unconsciousness is associated with a pronounced shift toward lower frequencies in the delta and low theta range, with a more frontal distribution and higher power. More significantly, John et al. showed that gamma-type EEG rhythms lost power and became decoupled across the brain when patients lost consciousness, and that these changes were reversed with return of consciousness. The pattern reflects the complete disabling of the brain under anesthesia.

Additional results supportive of this conclusion derive from other recent functional imaging studies that have looked at blood flow, glucose metabolism, or other indicators of cerebral activity under general anesthesia (Alkire, 1998; Alkire, Haier, & Fallon, 2000; Shulman, Hyder, & Rothman, 2003; White & Alkire, 2003). In these studies, brain areas essential to the global workspace are consistently deactivated individually and decoupled functionally. Auditory and other stimuli are no longer able to ignite the large-scale cooperative network interactions that normally accompany conscious experience.

Cardiac Arrest

The situation is even more dramatic with regard to NDEs occurring during cardiac arrest, many of which in fact occur also in conjunction with major surgical procedures involving general anesthesia. There are numerous reports of NDEs in connection with cardiac arrest, and, like those that occur with general anesthesia, they include the typical features associated with NDEs, most notably vivid or even enhanced sensation and mentation.

However, in cardiac arrest, cerebral functioning shuts down within a few seconds. Whether the heart actually stops beating entirely or goes into ventricular fibrillation, the result is essentially instantaneous circulatory arrest, with blood flow and oxygen uptake in the brain plunging swiftly to near-zero levels. EEG signs of cerebral ischemia, typically with global slowing and loss of fast activity, are detectable within 6–10 s and progress to isoelectricity (flat-line EEGs) within 10–20 s of the onset of arrest. In sum, full arrest leads rapidly to the three major clinical signs of death (absence of cardiac output, absence of respiration, and absence of brainstem reflexes) and provides the best model we have of the dying process (DeVries, Bakker, Visser, Diephuis, & van Huffelin, 1998; Parnia & Fenwick, 2002; van Lommel et al., 2001; Vriens, Bakker, DeVries, Wieneke, & van Huffelin, 1996). Nevertheless, in four published studies alone, more than 100 cases of NDEs occurring under conditions of cardiac arrest have been reported (Greyson, 2003; Parnia et al., 2001; Sabom, 1982; van Lommel et al., 2001).

Those intent on defending materialist reductionism might object that even in the presence of a flat-line EEG there still could be undetected brain activity going on; current scalp-EEG technology detects only activity common to large populations of neurons, mainly in the cerebral cortex. However, the issue is not whether there is brain activity of *any* kind whatsoever, but whether there is brain activity of the specific form agreed on by contemporary neuroscientists as the necessary condition of conscious experience. Activity of this form is eminently detectable by current EEG technology, and it is abolished either by adequate general anesthesia or by cardiac arrest. In cardiac arrest, even neuronal action-potentials, the ultimate physical basis for coordination of neural activity between widely separated brain regions, are rapidly abolished. Moreover, cells in the hippocampus, the region thought to be essential for memory formation, are especially vulnerable to

the effects of anoxia (Vriens et al., 1996). In short, it is not credible to suppose that NDEs occurring under conditions of adequate general anesthesia, let alone cardiac arrest, can be accounted for in terms of some hypothetical residual capacity of the brain to process and store complex information under those conditions.

A second defense of a materialist explanation for NDEs is to suggest that these experiences do not occur when they appear to occur, during the actual episodes of brain insult, but at a different time, perhaps just before or just after the insult, when the brain is more or less functional. However, unconsciousness produced by cardiac arrest characteristically leaves patients amnesic and confused for events immediately preceding and following these episodes (Aminoff, Scheinman, Griffin, & Herre, 1988; Parnia & Fenwick, 2002; van Lommel et al., 2001). In addition, the confusional experiences occurring as a person is losing or regaining consciousness do not have the life-transforming impact so characteristic of NDEs. Second, a substantial number of NDEs contain apparent time "anchors" in the form of verifiable reports of events occurring during the period of insult itself. For example, a cardiac-arrest victim described by van Lommel et al. (2001) had been discovered lying in a meadow 30 min or more prior to his arrival at the emergency room, comatose and cyanotic, and yet days later, having recovered, he was able to describe accurately various circumstances occurring in conjunction with the ensuing resuscitation procedures in the hospital.

NDE Features Problematic for Materialist Reductionism

Most near-death experiencers are convinced that during the NDE they temporarily separated from their physical bodies. In our collection, for example, 81% of experiencers reported feeling separated from the body during the NDE. The idea that mind and brain are not identical is not inherently unscientific. Although it contradicts the assumption of materialistic reductionism that the mind can be reduced to physical entities, the direction that physics has taken in the last century justifies ample caution when it comes to making assumptions about the scope and the fundamental character of the natural world. Although most psychologists and neuroscientists accept the reductionistic model that brain produces mind, or indeed is the mind, several features of NDEs call into question whether materialist reductionism will ever provide a full explanation of them.

Enhanced Mentation During Cerebral Impairment

Perhaps the most important of these features, because it is so commonly reported in NDEs, is the occurrence of normal or even enhanced mental activity at times when, according to the mind–brain identity model, such activity should be diminishing, if not impossible. Individuals reporting NDEs often describe their mental processes during the NDE as remarkably clear and lucid and their sensory experiences as unusually vivid, equaling or even surpassing those of their normal waking state. Reports of NDEs from widely divergent cultures confirm that people have consistently reported, from different parts of the world and across different periods of history, having had complicated cognitive and perceptual experiences at times when brain functioning was severely impaired.

A recent analysis of several hundred NDE cases showed that 80% of experiencers described their thinking during the NDE as "clearer than usual" (45%) or "as clear as usual" (35%). In addition, 74% described their thinking as "faster than usual" (37%) or "at the usual speed" (37%); 65% described their thinking as "more logical than usual" (29%) or "as logical as usual" (36%); and 55% described their control over their thoughts as "more control than usual" (19%) or "as much control as usual" (36%; Kelly, Greyson, & Kelly, 2007, p. 386). An analysis of NDEs with contemporaneous medical records showed that, in fact, people reported enhanced mental functioning significantly more often when they were actually physiologically close to death than when they were not (Owens, Cook, & Stevenson, 1990).

Another example of enhanced mental functioning during an NDE is a rapid revival of memories that sometimes extends over the person's entire life. An analysis of several hundred NDE cases showed that in 24% of them there was a report of some degree of revival of memories during the NDE. Moreover, in contrast to the isolated and often just single brief memories evoked during cortical stimulation, memories revived during an NDE are frequently described

as being "many" or even as an almost instantaneous "panoramic" review of the person's entire life: 57% of those reporting memories said that they had experienced many memories of a review of their entire life, whereas only 43% reported one or a few memories (Kelly et al., 2007, p. 386). In addition, an analysis of 68 published life review cases found that in 71% the experience had involved memories of many events of the person's whole life (Stevenson & Cook, 1995, p. 455).

Accurate Perception From an Out-of-Body Perspective

Another important feature of NDEs that materialist reductionism cannot adequately account for is the experience of being out of the body and perceiving events that one could not ordinarily have perceived. A recent analysis of several hundred cases showed that 48% of near-death experiencers reported seeing their physical bodies from a different visual perspective. Many of them also reported witnessing events going on in the vicinity of their body, such as the attempts of medical personnel to resuscitate them at the scene of an accident or in an emergency room (Kelly et al., 2007). A materialist reductionism could attribute the belief that one has witnessed events going on around one's body to a retrospective imaginative reconstruction attributable to a persisting ability to hear, even when unconscious, or to the memory of objects or events that one might have glimpsed just before losing consciousness or while regaining consciousness, or to expectations about what was likely to have occurred (Blackmore, 1993; Saavedra-Aguilar & Gómez-Jeria, 1989; Woerlee, 2004).

Such explanations are inadequate, however, for several reasons. First, memory of events occurring just before or after loss of consciousness is usually confused or completely absent (Aminoff et al., 1988; Parnia & Fenwick, 2002; van Lommel et al., 2001). Second, claims that adequately anesthetized patients retain any significant capacity to be aware of or respond to their environment in more than rudimentary ways—let alone to hear and understand—have in general not been substantiated. The phenomenology of such awakenings in anesthesia is altogether different from that of NDEs, and often extremely unpleasant, frightening, and even painful (Osterman, Hopper, Heran, Keane, & van der Kolk, 2001; Spitellie, Holmes, & Domino, 2002). The experiences are typically brief and fragmentary, and primarily auditory or tactile, and not visual; for example, the patient may report hearing noises or snippets of speech, or briefly feeling sensations associated with intubation or with specific surgical procedures.

There have been occasional reports of patients who appeared to display some degree of memory for events that occurred during surgery (Cheek, 1964, 1966), but there were numerous methodological problems with studies purporting to show this (Trustman, Dubovsky, & Titley, 1977), and more recent and better controlled studies have not substantiated such claims (Ghoneim & Block, 1992, 1997). There is no convincing evidence for adequately anesthetized patients having any explicit, or conscious, memory of events during the surgery (apart from patients who have reported such memories in connection with an NDE). It is not plausible that memories of complex sensory experiences occurring during general anesthesia could have been acquired by the impaired brain itself during the period of unconsciousness. Furthermore, any such explanatory claims are even less credible when, as commonly happens, the specific sensory channels involved in the reported experience have been blocked as part of the surgical routine—for example, when visual experiences are reported by patients whose eyes were taped shut during the relevant period of time.

Sabom (1982) carried out a study specifically to examine whether claims of out-of-body perceptions could be attributed to retrospective reconstruction. He interviewed patients who reported NDEs in which they seemed to be watching what was going on around their body, most of them cardiac patients who were undergoing cardiopulmonary resuscitation at the time of their NDE. He also interviewed "seasoned cardiac patients" who had not had an NDE during their cardiac-related crises, and asked them to describe a cardiac resuscitation procedure as if they were watching from a third-person perspective. He found that 80% of the comparison patients made at least one major error in their descriptions, whereas none of the NDE patients made any. Moreover, 19% of the NDE patients related accurate details of specific idiosyncratic or unexpected events during their resuscitation

(pp. 87–115). Sartori (2008) recently replicated Sabom's findings in a 5-year study of hospitalized intensive care patients, in which patients who reported leaving their bodies during cardiac arrests described their resuscitations accurately, whereas every cardiac arrest survivor who had not reported leaving the body described incorrect equipment and procedures when asked to describe their resuscitation.

An even more difficult challenge to materialistic models of NDEs comes from cases in which experiencers report that, while out of the body, they became aware of events occurring at a distance or that in some other way would have been beyond the reach of their ordinary senses even if they had been fully and normally conscious. Clark (1984) and Owens (1995) each published a case of this type, and we have reported on 15 cases, including seven cases previously published by others and eight from our own collection (Cook, Greyson, & Stevenson, 1998; Kelly, Greyson, & Stevenson, 2000), again including accurate perceptions of unexpected or unlikely details. In addition, Ring and Cooper (1997, 1999) reported 31 cases of blind individuals, nearly half of them blind from birth, who experienced during their NDEs quasi-visual and sometimes veridical perceptions of objects and events.

One criticism of these reports of perceptions of events at a distance from the body is that they often depend on the experiencer's testimony alone. However, some cases have been corroborated by independent witnesses (Clark, 1984; Hart, 1954; Ring & Lawrence, 1993). van Lommel et al. (2001, p. 2041), for example, reported a case in which a cardiac arrest victim was brought into the hospital comatose and cyanotic and remained in a coma and on artificial respiration in the intensive care unit for more than a week. When he regained consciousness, he immediately recognized one of the nurses as the person who had removed his dentures during the resuscitation procedures, and he described "correctly and in detail" the emergency room and the procedure, including the cart in which the nurse had put his dentures. The nurse corroborated his account. Cook et al. (1998, pp. 399–400) reported a case in which the patient described leaving his body and watching the cardiac surgeon "flapping his arms as if trying to fly." The surgeon verified this detail by explaining that, in order to keep his scrubbed hands from possibly becoming contaminated before beginning surgery, he had developed the idiosyncratic habit of flattening his hands against his chest, while rapidly giving instructions by pointing with his elbows.

In a recent review of 93 reports of potentially verifiable out-of-body perceptions during NDEs, Holden (2009) found that 43% had been corroborated to the investigator by an independent informant, an additional 43% had been reported by the experiencer to have been corroborated by an independent informant who was no longer available to be interviewed by the investigator, and only 14% relied solely on the experiencer's report. Of these out-of-body perceptions, 92% were completely accurate, 6% contained some error, and only 1% was completely erroneous. Even among those cases corroborated to the investigator by an independent informant, 88% were completely accurate, 10% contained some error, and 3% were completely erroneous. The cumulative weight of these cases is inconsistent with the conception that purported out-of-body perceptions are nothing more than hallucinations.

Visions of Deceased Acquaintances

Many people who approach death and recover report that, during the time they seemed to be dying, they met deceased relatives and friends. In a recent analysis of several hundred NDEs, 42% of experiencers reported meeting one or more recognizable deceased acquaintances during the NDE. Such experiences have been widely viewed as being hallucinations, caused by drugs or other physiological conditions or by the person's expectations or wishes to be reunited with deceased loved ones at the time of death. However, a closer examination of these experiences indicates that such explanations are not adequate (Kelly, 2001).

People close to death are more likely to perceive deceased persons than do people who are not close to death: The latter, when they have waking hallucinations, are more likely to report seeing living persons (Osis & Haraldsson, 1977). Near-death experiencers whose medical records show that they really were close to death also were more likely to perceive deceased persons than experiencers who were ill but not close to death, even though many of the latter thought they were dying (Kelly, 2001).

Moreover, numerous people near death also perceive figures other than known deceased persons during the NDE, most of these being unrecognized. If expectation alone were driving the process, people would presumably recognize the hallucinatory figures, either as actual deceased or living people or as known religious figures, more often than was in fact the case. People more often perceive deceased people with whom they were emotionally close, but in one third of the cases, the deceased person was either someone with whom the experiencer had a distant or even poor relationship or someone whom the experiencer had never met, such as a relative who died long before the experiencer's birth (Kelly, 2001). van Lommel (2004, p. 122) reported the case of a man who had an NDE during cardiac arrest in which he saw his deceased grandmother and an unknown man. Later shown a picture of his biological father, whom he had never known and who had died years ago, he immediately recognized him as the man he had seen in his NDE.

There is one particular kind of vision of the deceased that calls into question even more directly their dismissal as subjective hallucinations: cases in which the dying person apparently sees, and often expresses surprise at seeing, a person whom he or she thought was living, but who had in fact recently died. Reports of such cases were published in the 19th century and have continued to be reported in recent years (Greyson, in press). Because in these cases the experiencers had no knowledge of the death of the recently deceased person, the vision cannot plausibly be attributed to the experiencer's expectations.

Conclusion

In sum, the challenge of NDEs to materialist reductionism lies in asking how complex consciousness, including mentation, sensory perception, and memory, can occur under conditions in which current physiological models of mind deem it impossible. This conflict between a materialist model of brain–mind identity and the occurrence of NDEs under conditions of general anesthesia or cardiac arrest is profound and inescapable. Only when we expand models of mind to accommodate extraordinary experiences such as NDEs will we progress in our understanding of consciousness and its relation to brain. The predominant contemporary models of consciousness are based on principles of classical physics that were shown to be incomplete in the early decades of the 20th century. However, the development of postclassical physics over the past century offers empirical support for a new scientific conceptualization of the interface between mind and brain (Schwartz et al., 2005).

References

Alkire, M. T. (1998). Quantitative EEG correlations with brain glucose metabolic rate during anesthesia in volunteers. *Anesthesiology, 89,* 323–333.

Alkire, M. T., Haier, R. J., & Fallon, J. H. (2000). Toward a unified theory of narcosis. *Consciousness and Cognition, 9,* 370–386.

Aminoff, M. J., Scheinman, M. M., Griffin, J. C., & Herre, J. M. (1988). Electrocerebral accompaniments of syncope associated with malignant ventricular arrhythmias. *Annals of Internal Medicine, 108,* 791–796.

Blackmore, S. (1993). *Dying to live.* Buffalo, NY: Prometheus.

Brierre de Boismont, A. (1859). *On hallucinations* (R. T. Hulme, trans.). London: Henry Renshaw.

Cheek, D. B. (1964). Surgical memory and reaction to careless conversation. *American Journal of Clinical Hypnosis, 6,* 237–239.

Cheek, D. B. (1966). The meaning of continued hearing sense under general chemo-anesthesia. *American Journal of Clinical Hypnosis, 8,* 275–280.

Clark, K. (1984). Clinical interventions with near-death experiencers. In B. Greyson & C. P. Flynn (Eds.), *The near-death experience* (pp. 242–255). Springfield, IL: Charles C. Thomas.

Cook, E. W., Greyson, B., & Stevenson, I. (1998). Do any near-death experiences provide evidence for the survival of human personality after death? *Journal of Scientific Exploration, 12,* 377–406.

Cullen, W. L. (1894). What drowning feels like. *British Medical Journal, 2,* 941–944.

DeVries, J. W., Bakker, P. F. A., Visser, G. H., Diephuis, J. C., & van Huffelin, A. C. (1998). Changes in cerebral oxygen uptake and cerebral electrical activity during defibrillation threshold testing. *Anesthesia & Analgesia, 87,* 16–20.

Ghoneim, M. M., & Block, R. I. (1992). Learning and consciousness during general anesthesia. *Anesthesiology, 76,* 279–305.

Ghoneim, M. M., & Block, R. I. (1997). Learning and memory during general anesthesia. *Anesthesiology, 87,* 378–410.

Greyson, B. (2000). Dissociation in people who have near-death experiences. *Lancet, 355,* 460–463.

Greyson, B. (2001). Posttraumatic stress symptoms following near-death experiences. *American Journal of Orthopsychiatry, 71,* 368–373.

Greyson, B. (2003). Incidence and correlates of near-death experiences in a cardiac care unit. *General Hospital Psychiatry, 25,* 269–276.

Greyson, B. (in press). Seeing deceased persons not known to have died: "Peak in Darien" experiences. *Anthropology and Humanism.*

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* (pp. 213–234). Santa Barbara, CA: Praeger/ABC-CLIO.

Hart, H. (1954). ESP projection. *Journal of the American Society for Psychical Research, 48,* 121–146.

Heim, A. (1892). Notizen über den Tod absturz [*Remarks on fatal falls*]. *Jahrbuch des Schweitzerischen Alpenclub [Yearbook of the Swiss Alpine Club], 27,* 327–337.

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* (pp. 185–211). Santa Barbara, CA: Praeger/ABC-CLIO.

Holden, J. M., Greyson, B., & James, D. (Eds.). (2009). *The handbook of near-death experiences.* Santa Barbara, CA: Praeger/ABC-CLIO.

John, E. R., Prichep, L. S., Kox, W., Valdés-Sosa, P., Bosch-Bayard, J., Aubert, E., . . . Gugino, L. D. (2001). Invariant reversible QEEG effects of anesthetics. *Consciousness and Cognition, 10,* 165–183.

Kelly, E. W. (2001). Near-death experiences with reports of meeting deceased people. *Death Studies, 25,* 229–249.

Kelly, E. W., Greyson, B., & Kelly, E. F. (2007). Unusual experiences near death and related phenomena. In E. F. Kelly, E. W. Kelly, A. Crabtree, A. Gauld, M. Grosso, & B. Greyson, *Irreducible mind* (pp. 367–421). Lanham, MD: Rowman & Littlefield.

Kelly, E. W., Greyson, B., & Stevenson, I. (2000). Can experiences near death furnish evidence of life after death? *Omega, 40,* 513–519.

Nahm, N., & Greyson, B. (2009). Terminal lucidity in mental disorders. *Journal of Nervous and Mental Disease, 197,* 942–944.

Osis, K., & Haraldsson, E. (1977). *At the hour of death*. New York: Avon.

Osterman, J. E., Hopper, J., Heran, W. J., Keane, T. M., & van der Kolk, B. A. (2001). Awareness under anesthesia and the development of posttraumatic stress disorder. *General Hospital Psychiatry, 23,* 198–204.

Owens, J. E. (1995). Paranormal reports from a study of near-death experience and a case of an unusual near-death vision. In L. Coly & J. D. S. McMahon (Eds.), *Parapsychology and thanatology* (pp. 149–167). New York: Parapsychology Foundation.

Owens, J. E., Cook, E. W., & Stevenson, I. (1990). Features of "near-death experience" in relation to whether or not patients were near death. *Lancet, 336,* 1175–1177.

Parnia, S., & Fenwick, P. (2002). Near death experiences in cardiac arrest. *Resuscitation, 52,* 5–11.

Parnia, S., Waller, D. G., Yeates, R., & Fenwick, P. (2001). A qualitative and quantitative study of the incidence, features and aetiology of near death experiences in cardiac arrest survivors. *Resuscitation, 48,* 149–156.

Ring, K., & Cooper, S. (1997). Near-death and out-of-body experiences in the blind: A study of apparent eyeless vision. *Journal of Near-Death Studies, 16,* 101–147.

Ring, K., & Cooper, S. (1999). *Mindsight: Near-death and out-of-body experiences in the blind.* Palo Alto, CA: William James Center/Institute of Transpersonal Psychology.

Ring, K., & Lawrence, M. (1993). Further evidence for veridical perception during near-death experiences. *Journal of Near-Death Studies, 11,* 223–229.

Saavedra-Aguilar, J. C., & Gómez-Jeria, J. S. (1989). A neurobiological model for near-death experiences. *Journal of Near-Death Studies, 7,* 205–222.

Sabom, M. B. (1982). *Recollections of death.* New York: Harper & Row.

Sartori, P. (2008). *The near-death experiences of hospitalized intensive care patients: A five year clinical study.* Lewiston, England: Edward Mellen Press.

Schwartz, J. M., Stapp, H. P., & Beauregard, M. (2005). Quantum physics in neuroscience and psychology. *Philosophical Transactions of the Royal Society of London Series B: Biological Sciences, 360,* 1309–1327.

Shulman, R. G., Hyder, F., & Rothman, D. L. (2003). Cerebral metabolism and consciousness. *Comptes Rendus Biologies, 326,* 253–273.

Spitellie, P. H., Holmes, M. A., & Domino, K. B. (2002). Awareness under anesthesia. *Anesthesiology Clinics of North America, 20,* 555–570.

Stevenson, I., & Cook, E. W. (1995). Involuntary memories during severe physical illness or injury. *Journal of Nervous and Mental Disease, 183,* 452–458.

Trustman, R., Dubovsky, S., & Titley, R. (1977). Auditory perception during general anesthesia. *International Journal of Clinical and Experimental Hypnosis, 25,* 88–105.

van Lommel, P. (2004). About the continuity of our consciousness. *Advances in Experimental Medicine and Biology, 550,* 115–132.

van Lommel, P., van Wees, R., Meyers, V., & Elfferich, I. (2001). Near-death experience in survivors of cardiac arrest. *Lancet, 358,* 2039–2045.

Vriens, E. M., Bakker, P. F. A., DeVries, J. W., Wieneke, G. H., & van Huffelin, A. C. (1996). The impact of repeated short episodes of circulatory arrest on cerebral function. *Electroencephalography and Clinical Neurophysiology, 98,* 236–242.

Watson, J. B. (1914). *Behavior.* New York: Holt.

White, N. S., & Alkire, M. T. (2003). Impaired thalamocortical connectivity in humans during general-anesthetic-induced unconsciousness. *NeuroImage, 19,* 402–411.

Woerlee, G. M. (2004). Cardiac arrest and near-death experiences. *Journal of Near-Death Studies, 22,* 235–249.

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