The Significance of Autoscopies as a Time Marker for the Occurrence of Near-Death Experiences

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ABSTRACT: The physiological and psychological underpinnings of near-death experiences (NDEs) are not yet understood. In this article, we show that for “critical” NDEs reported after cardiac arrest, two different neurophysiological models have been proposed that, in the literature so far, have not been adequately distinguished from each other. In the real-time model, it is postulated that during critical NDEs, residual activities in the cerebrum were sufficient to generate NDEs in real time. In the reconstruction model, it is assumed that due to severe oxygen deficiency, critical NDEs could not have occurred at the time in question but were reconstructed later during the regeneration phase of the brain. To assess the plausibility of these two models, we analyzed the phenomenology of the view of one’s own body from above (autoscopy) that frequently occurs in the beginning of NDEs. In addition to the available literature, we used original descriptions of autoscopies obtained in an online survey conducted in 2015. We found that the reconstruction model is not supported by empirical findings and that some findings even speak against it. We therefore conclude that future discussions of explanatory models of NDEs should focus primarily on the neurophysiological real-time model and a third alternative according to which autoscopies and NDEs occur in relative independence from the prevailing neurophysiological processes in the brain.

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KEYWORDS: near-death experience, out-of-body experience, autoscapy, temporal anchoring, explanatory model

In this article we provide a revised and extended English version of our previous German article (Nahm & Weibel, 2019). Near-death experiences (NDEs) have long been discussed in the spiritualistic and parapsychological literature. Only in recent decades have they also found their way into the medical and psychological research milieu. In this context, the question of how NDEs can best be explained has generated much controversy. This question is specifically relevant in cases in which people report an NDE that apparently occurred during a prolonged period of time in which extremely reduced or no blood circulation would have been detectable in their body—for example, during the time between cardiac arrest and resuscitation. In this article, we refer to NDEs ostensibly related to such states as “critical NDEs.”

Several researchers have addressed the topic of what happens in the human brain during the minutes following cardiac arrest. According to a generally accepted model, consciousness is lost after a few seconds, and after 30 seconds at most, EEG records no longer indicate cerebral activity (e.g. Pana et al., 2016; Visser et al., 2001; see also Parnia & Fenwick, 2002; van Lommel, 2010). In recent years, several authors reported surges of brain activity around the time of cardiac arrest in humans (e.g., Auyong et al., 2010; Chawla et al., 2009, 2017; Norton et al., 2017) and rats (Borjigin et al., 2013; Zhang et al., 2019). It is unclear, however, whether these surges bear relevance for NDEs and whether they are associated with conscious experience. According to the generally accepted model, coherent self-awareness, perceptions of the environment, as well as the creation of accurate memories are unlikely to be possible during an absence of measurable brain activity. Nevertheless, people whose cardiac arrests occurred in hospitals have repeatedly reported that during this critical period, from an elevated vantage point, they followed the activities of doctors and nurses in the vicinity of the NDErs’ physical bodies. Usually, these reports correspond to the actual events (Holden, 2009).

For example, a frequently discussed report of a critical NDE was first published by a Dutch team of doctors (van Lommel et al., 2001) and was followed up in subsequent publications (Smit, 2008; Smit & Rivas, 2010; see also Rivas et al., 2016). A man who had apparently suffered a heart attack was found in a meadow in the evening and taken to hospital. He was already “ice-cold” and showed post-mortem

lividity—a phenomenon that occurs at the earliest 20–30 minutes after circulatory arrest. He wasn't breathing, and his pupils showed no reaction to light stimuli. He was considered dead. Nevertheless, resuscitation measures were performed, and after about 15 minutes, to the surprise of everyone involved, the first signs of life appeared, and finally the patient's condition was stabilized. He later claimed to have followed the entire procedure from outside his body, relating peculiar details he could hardly have seen or guessed. For example, in the course of the preparatory measures, the man's dentures were removed from his mouth and put onto a crash cart, but ultimately they got lost. After more than a week, the male nurse who had removed the dentures entered the room to administer medicine to the patient. The nurse had not seen the patient except during the time when he seemed comatose. Still, this patient now recognized the nurse and asked him about the dentures.

In a second remarkable case, attending physicians reported that a patient undergoing surgery went into cardiac arrest and could not be resuscitated; he had no heart activity for at least 20 minutes. The patient was declared dead, the heart-lung machine was turned off, and the surgical wound in his chest was provisionally sutured. Sometime later, after the doctors had changed their clothes, signs of life spontaneously returned in this patient, and his condition, too, was finally stabilized. He later stated that he had followed the operation from outside his body and reported surprising details that were difficult to guess or see. For example, he "saw" in this state, during which his physical eyes had been taped shut, how a doctor stuck yellow notes to a monitor (Rivas & Smit, 2013; Rivas et al., 2016). Further examples of similar NDE reports can be found in Rivas et al. (2016) and in Sabom (1982).

From a neurological perspective, such unusual aspects of critical NDEs are challenging to explain. In the NDE literature, authors have offered three different models. Because out-of-body experiences (OBEs) and autoscopies play a crucial role in these three models, we now define how we use these two terms in the present context. We consider OBEs and autoscopies to occur both during and outside the context of NDEs. When they occur in NDEs, they usually represent the initial stages. In OBEs, an experiencer typically has the sensation that their center of consciousness is located spatially removed from their physical body, but they still perceive the physical environment in which their body is situated—though they may or may not actually see their physical body. Although the experiencer's perspective of con-

sciousness is also not located in the physical body in later and more transmaterial stages of NDEs, such as perceiving a Being of Light, interacting with deceased loved ones, or experiencing a life review, for our purpose in this article, we use the term OBE to refer specifically to the aspect of NDEs in which an experiencer perceives the material world in the vicinity of their body. In a specific sub-type of OBEs—autoscopies—an experiencer does see their own physical body from a perspective outside their body, often from above.

In the first explanatory model for critical NDEs, it is postulated that even in these cases of OBEs and autoscopies, there was still sufficient oxygen-driven activity in the cerebrum to render the patients reasonably conscious. As a result, they would have hallucinated their OBE in real time. In the second model, authors have assumed that OBEs are not possible during critical NDEs but that impressions of the hospital environment and of activities of nearby persons would be registered unconsciously. Following the crisis, during the regeneration phase of the brain, these unconscious impressions would be reconstructed into what we call a “pseudo-OBE.” In the third model, authors presumed that OBEs and the verified accounts of occurrences during critical NDEs cannot be explained solely through neurophysiological mechanisms. Rather, the reported ability to perceive would exist independent of the temporarily disabled brain but would still occur in real time. In this paper, these three models are referred to, respectively, as the *neurophysiological real-time model*, the *neurophysiological reconstruction model*, and the *independence model*.

In the following sections, we will examine aspects of the two neurophysiological explanatory models in more detail. To examine their plausibility, we will assess the extent to which existing literature on NDEs and reports of NDEs enable a determination of exactly when, during the course of a crisis, an OBE or NDE occurred—which we refer to as *temporal anchoring*. For this purpose, we focus on only those parts of NDEs that are relevant to temporal anchoring. In particular, we focus on descriptions that include OBEs and autoscopies. These features are the focus of our next section, “Neurophysiological Explanatory Approaches for OBEs and NDEs,” in which we present the two explanatory models in more detail. In the succeeding section, “Autoscopies: Examples From Original Research,” we present various predominantly original descriptions of autoscopies, most of which are taken from an online survey on NDEs in German-speaking countries conducted in 2015 on the initiative of co-author Weibel. In the final section of this article, “Autoscopies as Time Markers for the Occur-

rence of NDEs,” we discuss the merits of the two neurophysiological models and demonstrate which model seems better to fit the available data and reports. Finally, we briefly comment on assets of the independence model as well.

Neurophysiological Explanatory Approaches for OBEs and NDEs

The two neurophysiological models are depicted and compared graphically in Figure 1. These models are explained in detail in the following paragraphs.

In the neurophysiological real-time model for OBEs or NDEs, it is assumed that the respective experience is triggered directly by the physiological brain condition prevailing at the time of the experience. Indeed, numerous experimental studies have shown that OBEs outside the context of NDEs can occur in the context of specific brain activities. They can begin with the onset of a stimulus and end with the termination of this stimulus. For example, dysfunctions of certain parts of the cerebrum, such as the temporoparietal junction, are often regarded as triggers for OBEs, which may be blended with real perceptions of the outside world to form an autoscopia. Olaf Blanke and his associates can be regarded as noted proponents of this interpretation of autoscopies (e.g. Aspell & Blanke, 2009; Blanke, 2012; Blanke et al., 2002, 2004; Blanke & Mohr, 2005). Even when they discussed autoscopies specifically in connection with NDEs, they assume that the experiences occur in real time and that they are triggered by functional impairments of the identified brain region, especially in the right hemisphere (Blanke & Dieguez, 2009). However, in their publications, these authors have not included references to critical NDEs.

By contrast, other proponents of the neurophysiological real-time model, such as anesthesiologist Gerald Woerlee, have mainly commented on critical NDEs. Woerlee first assumed that the cerebrum does not have to be involved in the generation of autoscopies containing veridical contents because residual activities in the brain stem would be sufficient for the generation of self-consciousness and correct perception of the environment (Woerlee, 2004, 2005). Apparently, however, Woerlee later recognized the untenability of this hypothesis and more defensibly stated that the participation of cortical brain regions is also necessary for accurate perceptions of the outside world (Woerlee, 2011; personal communication, September, 2011). He then

Figure 1 *Diagram of the Real-Time Model and the Reconstruction Model of OBEs in NDEs*

shifted to more general speculations according to which even in critical NDEs there must have been so much cerebral activity that, for example, the man who claimed to have observed the removal of his dentures was actually conscious all the time and experienced his autoscropy in real time (Woerlee, 2010).

Likewise, psychologist Susan Blackmore (2017) hypothesized that in critical NDEs, there would still be sufficient brain activity to generate conscious autoscopies in accordance with the metabolic processes taking place in the brain at that time, that is, in real time. The neurophysiological model for NDEs presented by James Lake (2017a) also seems to imply a real-time trigger. Lake referred to observations of a short-term increase in brain activity shortly after cardiac arrest (e.g., Chawla et al., 2009).

For the neurophysiological reconstruction model, according to which the patients were unconscious at the critical time of the occurrences in the hospital and only retrospectively amalgamated their subconscious experiences into a pseudo-OBE or pseudo-autoscropy, there is so far no experimental support. At present, it is purely hypothetical, but its proponents nevertheless have relied on it to explain critical NDEs. Among

these proponents are Benjamin Mitchell-Yellin and John Fischer (2014; see also Fischer & Mitchell-Yellin, 2016). In this model, the functions of the cerebrum in certain reported NDE cases following cardiac arrest or similar critical health conditions are considered so severely impaired that the reported autoscopies could not have occurred in real time. During this period, however, experiencers are said to have possessed an unconscious perceptive faculty, and they subsequently reconstructed their OBEs and autoscopies from these unconsciously registered impressions. This reconstructive process could happen many hours after the crisis, for example during gradual recovery following it. Autoscopies must therefore be regarded as the result of two different processing steps: (a) the unconscious registration of incidents in the operating room, and (b) the subsequent amalgamation of the relevant subconsciously registered impressions into a pseudo-autoscopy. Mitchell-Yellin and Fischer (2014; Fischer & Yellin-Mitchell, 2016) did not consider the neurophysiological arguments for experiencing autoscopies in real time that Blanke and others had advanced.

Further authors writing on neurophysiological explanatory approaches for critical NDEs remained unclear regarding their position regarding the two models. Christopher French (2001), for instance, stressed in a commentary on the critical NDE involving the patient's dentures (van Lommel et al., 2001) that ultimately, nobody can know exactly at what time such an NDE occurred. He asserted that the patient could have had the autoscopy experience during the time before he entered the critical state or during reconstruction in the post-crisis regeneration phase (see also French, 2005, 2009). However, French still allowed for the possibility that OBEs can take place in real time. We found that Keith Augustine's (2015) elaborations on NDEs contained the same ambiguity. It is not clear why these authors stressed that critical NDEs as a whole might not take place in real time but that OBEs would still take place in real time. In a book by Michael Marsh (2010), this ambiguity grew into an explicit contradiction. On the one hand, Marsh asserted that after cardiac arrest severely impaired brain functions would prevent conscious awareness and that all elements of critical NDEs, including autoscopies, are reconstructed in the course of the recovery process of the brain. Nevertheless, Marsh (2010) also discussed experimentally induced autoscopies, which are known to occur in real time, and then claimed that autoscopies occurring in critical NDEs constitute the same experiences as those induced experimentally.

Having provided this brief overview of the basic arguments of neurophysiological explanations for autoscopies in critical NDEs, we next present original accounts of autoscopies from an online survey. They are intended to provide insights into how autoscopies are typically reported by those who experienced them. We provide examples that occurred in different situations and varying health conditions including brain states, because a consideration of these aspects of autoscopies is of crucial importance for neurophysiological models to explain them. In the concluding discussion, we will return to this issue.

Autoscopies: Examples from Original Research

The following examples of autoscopies are taken primarily from an online survey conducted in German-speaking countries. A more detailed description of the results and the methods applied in this survey is published elsewhere (Nahm et al., 2020). The survey included an optional field for free text in which a participant could describe their NDE in their own words. A total of 225 people completed the survey, and 155 (68.9%) of them described or elaborated on their experience by using the free text field. Of these 155 reports, 33 contained descriptions or mentions of an autoscopy. The following quotes are based on the literal German text in which only spelling and typing errors were corrected. They were translated by co-author Nahm. We identify each account by a consecutive ID number and provide the participant's gender and age at the time of the survey.

We first present examples of autoscopies that occurred in states unrelated to dying and while an assumption of optimal oxygen supply in the brain seemed warranted. One autoscopy even took place during physical activity—a relatively rare but nevertheless still occasionally reported circumstance (Alvarado, 2016).

ID 1, male, 61 years old: It happened during a walk with a friend when all of a sudden, I saw myself with my complete perceptive ability from outside (from about 20 meters above) on the road, with my friend. My bodily senses in my physical body were not perceptible to me at that moment and also not controllable. The “seeing” from up there was of the same quality as if I were looking with my physical eyes. I could also think.

Autoscopies and NDE-like experiences have also been reported under the circumstances of meditation or sleep, as in the following examples:

ID 2, male, 42 years old: Out of boredom . . . I listened to a tape about meditation of my parents and followed the "instructions." I noticed rather quickly how my limbs became heavy, and soon I didn't feel them anymore. Sometime later I suddenly "stuck" to the ceiling and looked down at my body, to which I no longer had any personal relation.

ID 3, male, 53 years old: I had gone to bed at about 10 p.m. Had the feeling I hadn't slept for long. Suddenly I was wide awake and, to my amazement, [my] body was lying under me. I looked out through the roof-light, and the streetlamps were on.

Especially interesting is a comprehensive NDE including an autopsychy that was experienced within a very short time before a near-accident. It highlights that NDEs can be experienced also when somebody only believes oneself to be in great danger with no actual proximity to death. This report is given in more detail to illustrate what can be experienced in an NDE within (fractions of?) seconds.

ID 4, female, 47 years old: The NDE was triggered by a life-threatening situation on the highway. But it didn't come to an accident; I remained unharmed. . . . As my physical body still sat at the wheel, frozen in time, almost as if caught in the second, it was separated from the world I was in shortly before by a whitish gauze/fog/silk/cloud. . . . I saw my physical body from above. At the same time I occupied several other positions. . . . I was in an unfathomable vastness that comprised a horizon, but behind it, it continued. It was rather dark, dimmed around me, although everything shone brightly. I had the feeling that I was in the universe . . . or something like that. I saw the tunnel, I stood in front of it, also behind it, and I saw it from above. . . . Deepest love, deepest silence, indescribable feelings of happiness, lightness, contentment, etc. penetrated me, and along with them information, which caused me to completely change my life after the NDE, and other things. I saw the synopsis of my life. A review that was non-judgmental, but showed all! my character traits, my past actions, and revealed to me on which less pleasant personal behavioral patterns I can work after the NDE to reduce them . . . A suck drew me back into my physical body. The situation on the highway had suddenly changed, and the life-threatening situation suddenly dissolved.

The following examples were related by people who had become unconscious for various reasons. It can be assumed that cardiac arrest had not yet occurred. The next case was reported by a diabetic who entered a state of severe hypoglycemia.

ID 5, male, 43 years old: It was a Sunday afternoon in summer 2004. I lost consciousness, apparently sitting on a chair in the kitchen. I floated an estimated 1.5 meters above my physical body and looked

down at myself. I saw myself sitting on the chair. The head was turned slightly to the side and rested on the chest. Saliva dripped out of my mouth. Instead of feeling sad or afraid, I felt happy. . . . I was aware that I was conscious. No imagination, no dream, and I could also rule out hallucinations. Again I looked at my physical body. The saliva already formed a bigger stain on my white T-shirt.

Two other cases concerned suicide attempts with tablets:

ID 6, female, 58 years old: I had swallowed an overdose of tablets and lost consciousness. I then saw myself lying down on the floor from an indescribable height, I remembered the colors of my morning coat with particular distinction.

ID 7, female, 64 years old: I was 18 years old and “died” of an overdose of sleeping pills after a 3-day coma. . . . At first I saw myself hovering over my body in the [hospital], my mother crying at the bedside.

Also after traffic accidents, autoscopies can occur at the beginning of NDEs:

ID 8, male, 54 years old: After a traffic accident when I ran in front of a car as a child, I left my body and watched the events around my injured body from a height of about 15 meters. I watched how my rescue was being initiated, the ambulance vehicle came, and recognized the persons standing by. I could exactly reconstruct the positions of these persons later, and they proved to be correct.

ID 9, female, 60 years old: I had a very serious accident with my friend as a pedestrian. . . . I saw the whole scene when the ambulance came from above and also heard all the words that were exchanged, e.g., the boy—my friend—bleeds like a pig. I saw from above—I was lying on the bed—how I was pushed into the ambulance and how the ambulance drove away with me.

ID 10, female, 65 years old: Seen accident car, own body and summoned persons from above.

The next cases occurred under general anesthesia during surgery.

ID 11, male, 65 years old: I had a heart surgery in 2011. . . . I thought my impressions during the anesthesia / the dream were illusory, because the hair of the operating doctor was not blond like in the initial consultation, but dark. Later I learned that another—dark-haired—doctor had operated on me by proxy.

ID 12, female, 49 years old: Next I looked at my body in the operating room, which was already being operated on. . . . The doctor said he couldn't see anything, there was too much blood. I observed all this both calmly and interestedly from a perspective above a round lamp

with several bulbs in it, from under the ceiling. Strangely, the lamp did not block my view of my body. I could see everything. I heard the doctor ask for silver things that, for me, looked similar to curved shoe-horns. They cut my stomach open and hooked these horns into the open wound to keep it open. I felt no pain. On the contrary. Somehow, I had no real relation to my body.

In the following examples of patients during cardiac arrest, the actual proximity to death and the presumed lack of oxygen in the brain are most pronounced.

ID 13, female, 48 years old: . . . during an operation with cardiac arrest and resuscitation. . . . Uncoupling from “physicalness,” weightlessness, perception of the “own” operating room, as well as the neighboring operating rooms.

ID 14, male, 75 years old: Then I suddenly saw myself lying in bed, from the chest downwards, the nurse and another nurse as well as the doctor. The nurse applied a colorless paste from a red tube, distributed it and passed the tube on to the second nurse. He also applied the paste. He was corrected immediately, with the words: “That must be more, otherwise the man will have burns afterwards.”

ID 15, male, 52 years old: Because of a heart attack I was briefly dead. I was outside of my body, in the same room with the rescue workers. The room was extremely brightly lit, and I could observe the efforts of the paramedics around me from a distance of about 3 meters.

One participant referred to an already published description of her NDE, which also included an autoscopy. She agreed to be cited here:

ID 16, female, 72 years old: The external, medical procedure was described in my medical report. Myocarditis by typhoid bacteria, bradycardia-tachycardia syndrome, sick sinus, ventricular fibrillation, cardiac arrest—but my inner, subjective experience was different. . . . I split. My soul and spirit had left the body, float now and look from above at the room with the bed and the apparatuses, at a wired body and people in the room. I see a horizontal line on the monitor, I hear the alarm whistle. My husband, two doctors, and three nurses are with me. (Brandner, 2001, p. 48)

We conclude this section by introducing so-called heautoscopies, using an example from the literature. In this type of autoscopic experience, the perspective of the visuo-spatial perception changes back and forth between the physical body and an extracorporeal point of view outside of it, or there is a simultaneous awareness of both perspectives (Blanke & Mohr, 2005; Nahm, 2015). A consciousness that is divided in this manner can also occur in NDEs. For example, the pa-

tient mentioned at the beginning, whose dentures were removed prior to resuscitation, described that at the same time as he was following the events in the hospital room from an elevated position outside of his body, he was experiencing pain in his physical body during cardiac massage (Smit, 2008). Other accounts of split consciousness can be found in reports of falling mountaineers. They can experience NDEs within seconds (Heim, 1892), in which their awareness may be divided into (a) a rationally thinking part that experiences the fall from the usual body perspective, and (b) a second part that simultaneously follows this fall from outside and/or experiences the typical NDE elements such as life review and/or light experience.

We illustrate such experiences using an example that is little known in the NDE literature; it is also not included in Albert Heim's (1892) classic publication on experiences of falling mountaineers. (For more details about the life and work of Heim, see Nahm, 2016.) The report was conveyed by Eugen Guido Lammer (1863–1945) who—known as “The Fetterless”—ranked among the most influential, daring, and skilled mountaineers of the late 19th century (Messner & Höfler, 1999). The accident occurred in 1887 when Lammer and his companion, August Lorria, attempted to climb the dangerous west face of the Matterhorn. During his fall, Lammer never lost consciousness, and his brain was presumably optimally supplied with oxygen.

The catastrophe came inconspicuously, not dramatically. . . . A tiny avalanche shot down on me. . . . Already falling, I thrust the pickaxe, but it cut through without effect as if hitting in butter; and the now enlarged avalanche on which I lay rushed against Lorria, who immediately flew out into the dreaded steep gorge. Later, the cartographer Imfeld estimated the fall height at two hundred meters. I experienced the horrible flight with clear senses and can tell you, friends: It is a beautiful death. . . . The one who was pressed through the narrow channel, who was thrown onto the soft body of the companion, then furiously tossed out into the free air again through the pull of the rope: it was a stranger, an indifferent piece of wood, and my Self hovered above this entire incident as a quiet, curious spectator like in a circus. . . . Meanwhile, a flash flood of ideas and thoughts rushed through my brain: many memories of my childhood, my homeland, my mother, the elastically bouncing balls on the billiards. . . . Hundreds of pages would I have to fill with this mass of images and ideas. And at the same time, always the calm objective calculation that we still have so and so much height to cross to certainly lie dead at the bottom. Without scream, without excitement, without grief, completely released from the chain of the ego! Years passed during the fall, centuries. Then the avalanche's waterfall-like roar became quieter, it

hissed out, I opened my eyes, and endless amazement came over me, no joy, no gratitude, no remorse. But now the beautiful passivity was over, the sweet Nirvana; and soon, life harnessed me into its yoke anew: worrying, planning, acting, the well-known evil Three. I sat on top of a high cone of snow lumps and stone blocks—lonely in this terrible cauldron of loneliness. (Lammer, 1929/1887, pp. 113f; translated by co-author Nahm)

The case reports of autoscopies quoted above all follow a uniform pattern that is very familiar from existing literature: The reporters state that they perceived their physical body, including its surroundings, from a position above the scenery of the everyday world. At this location, with a relatively or even unusually clear mind, they retained their logical, analytical thinking as well as familiar modes of perception such as hearing and seeing. Our examples illustrate how typical OBEs that include autoscopies can occur under very different psychological and neurophysiological circumstances but that despite varying circumstances, subjective experiences hardly differ. If an autostcopy takes place while lying down, it is impossible to infer the cause of its occurrence and also the health or brain condition of the reporting person at that time simply from the description of the OBE. Moreover, according to current knowledge, the stereotypical pattern of autoscopies even in utterly diverse health conditions is likely to be independent of the respective socio-cultural background of people experiencing them, at least within samples from Western cultures. Against this background, we now turn again to the question chiefly addressed in this article, namely: At what time during a crisis do OBE and NDE autoscopies probably take place?

Autoscopies as Time Markers for the Occurrence of NDEs

If one follows the described reports, the answer to the question of the temporal anchoring of autoscopies in NDEs is clear: The autoscopies or OBEs have all taken place in real time. Decisive examples include autoscopies that occurred while walking (ID 1) or meditating (ID 2), but also in a state of hypoglycemia (ID 5), after traffic accidents (ID 8, ID 9), or in operating rooms (e.g., ID 11, ID 12, & ID 14). Numerous examples from the literature could be added (e.g., Crookall, 1960; Green, 1968; Rivas et al., 2016; Sabom, 1982). From our case collection, the autostcopy-including NDE that apparently occurred

within (fractions?) of seconds before a near-accident on the motorway (ID 4) is particularly worth mentioning. Similarly, the heautoscopy-inclusive NDE of the falling Guido Lammer must have occurred within seconds. All these examples confirm *prima facie* the various experimental findings according to which autoscopies are experienced in real time (Blanke, 2012). Phenomenologically speaking, there is no reason to assume that the same uniform scheme of typical autoscopies could be generated by two different brain processes at different times in the course of a crisis experience. In other words, there is no reason to suppose that some autoscopies were constructed only afterwards from unconsciously registered sensory impressions. To date, there is no evidence to indicate that certain autoscopies contain events from the immediate past but are indistinguishable from those apparently experienced in real time. Further problems for the neurophysiological reconstruction model and the postulated pseudo-autoscopies arise from other considerations.

- The reconstruction model is based on the assumption that in critical NDEs, the oxygen supply to the brain is impaired to such an extent that both conscious experience in real time, as well as the formation of memories, cannot be possible. Thus, only in the course of regenerating brain functions can self-awareness be restored, and hallucination-like NDEs, including autoscopies, are (re-)constructed. However, according to experimental research results, OBEs are chiefly elicited by disturbed brain functions in real time. Hence, if OBEs and NDEs were occurring during the regeneration phase following cardiac arrests, then the contents of those experiences, including autoscopies, should involve events occurring *at that time*, such as in recovery rooms. However, such autoscopies are seemingly not reported by NDErs. At least, we are not aware of even one published case in the literature on (critical) NDEs; all autoscopia reports known to us relate to the times of actual or anticipated crises. The basic assumption of the reconstruction model thus contradicts the experimentally established findings of OBE research and the resulting predictions about the occurrence and contents of autoscopies.
- Another implication of the reconstruction model is that “unconsciously” registered stimuli can better be transformed into pseudo-autoscopies the clearer and more recently they were registered before the onset of the regeneration phase. Therefore, the model would predict that impressions registered during the apex of crises would less frequently be incorporated into pseudo-autoscopies, whereas those that occur before and during the return of brain functions and awareness would more frequently be incorporated. However, as mentioned, we are not aware

of any NDE autoscapy reports that include, for example, activities that occurred relatively shortly before regaining normal consciousness, such as the transport of the patient from the operating room to the recovery room or events occurring in the recovery room. The only reports that exist contain the more temporally remote events during the crisis.

- Because of this conspicuous lack of supporting cases of critical NDEs, critics of the real-time model appear to have had difficulty finding support for the model and have even misrepresented some cases. For instance, in 1975, Raymond Moody described the case of a man who was hospitalized a few days prior to scheduled spinal disc surgery (pp. 101–107). Three days prior to surgery, the man awoke from a restful night in his hospital bed with severe back pain. Immediately thereafter, he experienced an OBE. It included autoscapy and the patient travelling to the hospital recovery room before returning to his body. The experience was typical in that it seemed to occur in real time and the patient remembered it right after its occurrence. Obviously, this OBE had no relation to a serious health crisis or critical NDE. Still, when discussing critical NDEs, Jens Schlieter (2018) used wording that suggested such a relation. According to Schlieter, the patient was “scheduled for an operation and obviously in a deteriorating condition” and “still conscious but fully absorbed in visions that [dealt] with the expected operation” (p. 24). This wording implies that the patient was about to be operated on, that he was hallucinating on the verge of slipping into unconsciousness, and that he reconstructed his OBE narrative based on experiences that did not occur during the time of his supposed crisis. In reality, however, Moody’s (1975) account depicted a “normal” OBE that occurred upon awakening under conditions of ordinary oxygen supply to the brain. It merely illustrates that OBEs can, of course, include travelling to a location at some distance from the physical body. It is obviously inappropriate to invoke this OBE in support for a model according to which pseudo-OBEs are (re-)constructed after severe health crises.
- It remains unclear in the reconstruction model why heart attack patients, for example, recall their supposedly unconsciously registered sensory impressions at all—and given they indeed do so, why they do not simply remember them or transform them into, for example, dream contents, but transform them instead into a complex, impressive, and apparently veridical, pseudo-OBE. As mentioned above, the patient who had his dentures removed reported being sensitive to pain in his physical body that existed simultaneously with his autoscapy (Smit, 2008). The neurophysiological reconstruction model faces difficulties regarding the question why he didn’t simply recall and remember all impressions registered at that time more or less normally from the embodied perspective.

- If the autoscopies in question were indeed hallucination-like pseudo-OBEs, then they would also be expected to contain typical hallucination-like elements and errors regarding the events occurring in the physical environment during the crises. However, researchers have found that such elements are missing and such errors are extremely rare (Holden, 2009; Rivas et al., 2016; Sartori, 2004). Retrospectively generated pseudo-OBEs should be far more susceptible to errors than real-time autoscopies that appear to be driven by factual real-time sensory impressions.

As shown above, several empirical findings and theoretical considerations render the neurophysiological reconstruction model for autoscopies in particular, as well as OBEs and NDEs in general, objectively implausible. Most importantly, autoscopia has not been reported by patients during the regeneration phase of brain functions after serious health crises, a finding that suggests strongly that the state of the regenerating brain in the post-crisis period is not suited to produce OBEs and, most likely, other experiences as well. In fact, this conclusion is empirically supported by various clinical data according to which patients are unable to have such experiences during the regeneration phase after cardiac arrests (Parnia & Fenwick, 2002; van Lommel, 2010). Rather, autoscopies occurring during NDEs seem to occur in the context of the onset or worsening of a crisis—whether the context is an actual physical crisis or only a subjectively expected danger.

It is thus very likely that intensive and critical NDEs, which often include autoscopies followed seamlessly by other elements, also do not occur during regeneration phases. If autoscopies are anchored in real time, the rest of the NDE that follows it probably occurs at about that time as well, rather than hours later. This notion is substantiated by the frequently reported NDE element of the life review. As with autoscopies and OBEs, life reviews typically comprise the view of people and events from an external perspective. Speaking from the perspective of the neurophysiological real time model, some authors have, indeed, assumed that OBEs and life reviews are elicited by similar neurophysiological processes in the temporoparietal junction of the brain (Katz et al., 2017). If that were the case, then life reviews would typically be experienced around the same time as OBEs. Numerous NDE reports confirm this notion. From the previously described examples of our online-survey, the extensive NDE that seemingly occurred within (fractions of?) seconds before a near-accident could be mentioned here (ID 4); also Lammer's NDE. Both NDEs included autoscopic experi-

ences and a life review that occurred practically at the same time. It therefore appears that the more transmaterial NDE elements are also elicited around the time of the crisis. This conclusion is in agreement with numerous personal reports of NDErs according to which their autoscopies in NDEs as well as other NDE features took place during times of unconsciousness (see also Buer et al., 2018).

In summary, on closer examination and explicit consideration of the phenomenology of autoscopies and NDEs, it is apparent that the neurophysiological reconstruction model is not supported by independent findings. On the contrary, various converging lines of evidence indicate that autoscopies and, thus, also NDE elements that succeed autoscopies, occur at the time that experiencers have described them: during the crisis of real or anticipated danger. From the neurophysiological perspective, the available evidence clearly supports the neurophysiological real-time model that Woerlee (2010) and Blackmore (2017) advocated.

However, on a different level, the neurophysiological real-time model has its own challenges. These include the riddle of how autoscopies in particular, as well as NDEs in general, can occur and be experienced uniformly under very different brain conditions that range from normal functioning and oxygen supply to various affections by drugs and to severe oxygen deficiency after cardiac arrest (see, e.g., Charland-Verville et al., 2014). If one assumes that conscious self-experience is exclusively determined and generated by neurological processes of the brain, drastically different neurological processes should generate drastically different subjective experiences. So far, this discrepancy between model and experience is unresolved and contributes to the conclusion that according to the current state of research, there is no satisfactory neurophysiological explanation for NDEs (Greyson et al., 2009; Nahm, 2012). This argument applies also to the neurophysiological reconstruction model.

On the other hand, the finding that very different brain states can seemingly be associated with uniform experiences constitutes one of the pillars supporting the independence model. According to this model, aspects of experiences and perceptions during OBEs and autoscopies, both within and outside the context of NDEs, cannot be fully attributed to neurophysiological processes (Mays & Mays, 2015; Rivas et al., 2016; van Lommel, 2010). In particular, the assumption that NDEs always result from sufficient cerebral activity for conscious perceptions of the environment, sensitivity to pain, and the ability to create memories, as proposed by Blackmore (2017) and Woerlee (2010), is

contradicted by critical NDEs involving patients who showed symptoms as severe as postmortem lividity. Applied to such critical NDEs, this assumption runs counter to usual mainstream models of the brain functions that must be present for coherent conscious experience to occur (Greyson et al., 2009; Pana et al., 2016; Parnia & Fenwick, 2002; van Lommel, 2010). Moreover, recent studies have shown that, considering the intensity of NDE memories, they cannot be equated to memories of imagined experiences (Moore & Greyson, 2017; Palmieri et al., 2014; Thonnard et al., 2013). These findings cast a critical light on purely neurophysiological explanatory models for NDEs. In addition, numerous OBE cases contain apparently nonphysical veridical perceptions (Holden, 2009) of the environment of the experiencer, sometimes even outside of operation rooms. According to credible third parties who verified the accuracy of the NDErs' perceptions, their perceptions could not have been the result of experiencers' use of their physical senses or their processes of inference or deduction (Rivas et al., 2016). Consequently, Lake (2017b) joined other scholars in acknowledging the possibility of "non-local" consciousness—consciousness not localized in the brain. In a study of NDEs and OBEs in the blind, Kenneth Ring and Sharon Cooper (2008) found that even people who were blind from birth reported NDE events that they seem to have perceived in a vision-like manner—a finding that challenges both neurophysiological models. A further challenge to these models comes from NDEs and OBEs in babies who, due to the not-yet-completed development of their eyes and brains, should not be able to see their environment with acuity and to preserve their observations as conscious long-term memories. Nevertheless, such cases exist. For example, one of co-author Nahm's family members, who is currently 17 years old, had a difficult birth and spent the first days of his life in an incubator. He still remembers an OBE he had at the time, looking at numerous doctors in white dresses that stood at the incubator (see also Sutherland, 2009). According to these aspects of NDEs, the independence model must involve some form of extrasensory perception.

For readers interested in theoretical aspects regarding the independence model, we offer the following considerations prior to presenting our summary and conclusion. Strictly speaking, there are two variants of the independence model: the externalist and the internalist perspectives (for discussions, see, e.g., Braude, 2003; Griffin, 1997). In the externalist variant, veridical perceptions are thought to be mediated in real time via an element such as a "soul" that leaves the body and operates independent from it. In the internalist variant, specific

forms of extrasensory perception (ESP) operating from within the subject's body are assumed, thus entailing only a partial independence. We are currently unaware of an in-depth discussion of how these variants relate to critical NDEs, but it seems that proponents of the internalist view (Braude, 2003) have assumed that there is sufficient brain activity left to mediate clairvoyance in real time. In theory, veridical information could also be gained in the frame of an internalist ESP-inclusive reconstruction model, drawing on retrocognition and perhaps also precognition. Discussing these theoretical ramifications further is beyond the scope of the present article, but we maintain that in general, the externalist and internalist independence models are typically conceived as real-time models and that the reconstruction model does not become more plausible by adding an ESP component such as retrocognition to it (see also Rivas, 2003).

Concluding Remarks

In the previous section, we showed that the neurophysiological reconstruction model for autoscopies and NDEs is not supported by empirical findings and theoretical considerations and must thus be regarded as implausible. In future, the discussion about the most realistic explanatory models for NDEs should therefore focus on the neurophysiological real-time model and the independence model. In general, neurophysiological processes are certainly involved in NDEs as long as there is brain function, and more reliable evidence for the independence model can be provided only by further documentation of individual cases and empirical studies. However, experimental studies are difficult to conduct in the context of NDEs (Holden, 2009; Parnia et al., 2014), as are experimental studies into OBEs occurring in contexts unrelated to death (Nahm, 2013). In this regard, we attempted in our survey to identify "OBE-adepts," NDErs who reported the sometimes-NDE-aftereffect of being able to elicit OBEs willingly and relatively reliably. Although four of our participants indicating this ability always or very often, all of them declined our request to participate in experimental OBE studies. Despite the challenges of NDE and OBE veridical perception research, medical-scientific studies into NDEs have been conducted for only about 40 years, and they already have provided highly interesting results. We expect that the coming decades will yield further exciting data. Until future studies will hopefully have brought more "light into the tunnel," theorizing about NDEs will continue. Which explanatory models are favored by

participants in this discussion will depend on previous personal convictions and emerging evidence concerning the explanatory power of modern neurobiological models of consciousness generation.

In this context, it should be considered that NDEs are by no means the only phenomenon that inspire a questioning of the assumption that human consciousness is exclusively determined and produced by the brain. Rather, NDEs are one of several well-established anomalous experiences and phenomena that suggest an expansion of the mainstream model about the nature of consciousness. These phenomena include unusual healings (for a particularly remarkable case in the context of NDEs, see Sartori, 2008) and encompass a variety of other enigmatic topics regarding the interplay of the mind, body, and environment (see, e.g., Atmanspacher & Fach, 2015; Beauregard, 2007; Bender, 1971; Braude, 2003; Cardena, 2018; Cardena et al., 2015; Driesch, 1975; Hart, 1954; Hart & Collaborators, 1956; Kelly et al., 2007; Matlock, 2019; Mattiesen, 1925, 1936–1939; Moser, 1974; Nahm, 2007, 2011, 2012, 2018; Nahm & Hassler, 2011; Nahm et al., 2017; and Stevenson, 1997). For this reason, NDEs cannot be regarded as an isolated curiosity that occurs in actual or anticipated proximity to death. They always need to be considered in the larger context of other unsolved riddles of human consciousness.

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