

Framework and Mechanism for Mind-Brain Interaction Based on Evidence From Near-Death Experiences and Neurology

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ABSTRACT: We propose a new substance dualist framework to explain consciousness, drawing on near-death experience (NDE) and neurological evidence. Evidence from veridical NDE perceptions indicates that consciousness can separate from the physical body as an individuated, self-aware entity or mind. We propose that the mind is a *separate entity* from the physical body, belonging to a distinct ontological category. Accordingly, the human being is conceptualized as the union of the mind entity—or soul—and the physical body. As the locus of consciousness, the mind entity possesses all the attributes of consciousness: perception, thinking, emotion, memory, volition, and self-awareness. We provide NDE evidence that the mind entity interacts in general with physical processes and specifically with neural activity in the brain. The mechanism for mind-brain interaction involves initially triggering and then detecting neural action potentials. The induced neural activity in specific regions brings the mind's mental content to awareness. The mind-brain interface occurs in cortical dendritic spines, where the mind triggers calcium ion release from the spine apparatus via spine F-actin filaments. Inhaled anesthetics dissolve these filaments, blocking this process, leading to loss of consciousness. The mind entity's actions to induce cortical activity can explain numerous cognitive neurological processes, including perception and language comprehension.

KEYWORDS: consciousness, substance dualism, mind entity, mind-brain interface, inhaled anesthetics, dendritic spines

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Our purpose in writing this paper is to offer a substance dualist framework to explain consciousness, drawing on near-death experience (NDE) and neurological evidence by integrating both substance dualist philosophy and empirical science. We propose a mechanism of mind-brain interaction and the functional relationships of the mind entity to the brain. We address other modes of neuronal function such as inhibitory interneurons, cerebellar neurons, and the influence of hallucinogenic psychedelics. We explore the shifts of a substance dualist framework from the present neuroscientific paradigm and address the common philosophical objections to interactionist dualism.

To prepare readers for the following extensive text, we offer an outline of major headings in Table 1.

Substance Dualism

In philosophy of mind, the position of *substance dualism* is a minority view. Substance dualism is the thesis that the human person is composed of an immaterial soul and a physical body. Philosophers Brandon Rickabaugh and J. P. Moreland (2024) gave a more formal definition of substance dualism's essential aspects:

Mere substance dualism. The human person (i) is comprised of a soul (a fundamental, immaterial/spiritual substance) and a physical body, (ii) capable of existing without a body, but not without his/her soul, and (iii) the mental life of which is possessed and unified by his/her soul. (p. 14)

They expressed the belief that substance dualism, although still a minority view today, is gaining acceptance and is poised to make a strong return in the 21st century (p. 5).

Substance dualism is also very relevant to the basic question of the origin of consciousness and to near-death studies. The fundamental nature of the soul or, in our terminology, the mind entity, affords the soul *ontological status* as a distinct type of thing in the universe.

However, Rickabaugh and Moreland (2024) recognized that *causal explanations* of consciousness lie outside the purview of substance dualism as a philosophical ontological theory:

[Substance dualism] is not intended to provide a *causal explanation* for the occurrence of conscious states; [substance dualism] is an ontological theory as to what sort of thing must an entity be to capture adequately several features, not of mental states, but of the thing that *has* them. (p. 303)

Table 1 Main Headings of This Article

[Introduction]	
Substance Dualism	
Two Substance Dualist Theories Based on Near-Death Experience Phenomena	
The Mind Entity Framework	
Validity of the Empirical Study of Near-Death Experiences	
“Mind Entity” as a Distinct Ontological Category	
Basic Neurological Principles for Embodied Consciousness	
Principles of the Mind Entity Framework for Embodied Consciousness	
Some Philosophical Implications of the Mind Entity Framework	
The Mechanisms of Mind-Brain Interaction	
Near-Death Experience Phenomenology of Interaction With Physical Processes	
Mechanism for the Mind Entity to Detect Neural Activity	
Mechanism for the Mind Entity to Induce Neural Activity	
Validating Evidence of the Mind-to-Spine Interface	
Functional Relationships of the Mind Entity to the Brain	
Delayed Awareness and Subliminality – Benjamin Libet	
Coming to Awareness (“Ignition”) – Stanislas Dehaene et al.	
Long-Distance Synchrony – Francisco Varela	
Steps of Cognition in Perception – Marta Kutas & Kara Federmeier	
Further Elaboration of the Process of Coming to Awareness (“Mirroring”)	
A New Neuroscientific Framework of Consciousness	
Other Modes of Neuronal Function	
Shifts in the Neuroscientific Paradigm	
Philosophical Objections to Interactionist Dualism	
Impossibility of Interactionist Dualism Due to Inability of Mind to Interact With Brain	
Causal Pairing Problem	
Causal Closure of the Physical	
Validation of Substance Dualism	

They summarized the sort of thing an entity must be to adequately capture the features of a thing that has mental states. These essential features are:

1. The appropriate entity for exemplifying mental properties.
2. The appropriate entity for holistically unifying mental properties.
3. The appropriate entity for being an enduring mental continuant.
4. The appropriate entity for being the employer and referent of “I.”
5. The appropriate entity for having an irreducible “First-Person Point of View.”
6. The appropriate entity for being possibly disembodied as a unified center of consciousness.
7. The appropriate entity for ontologically grounding claims like “Necessarily, thoughts have thinkers.”
8. The appropriate entity for exercising active power and teleologically guiding a deliberative process toward an end. (p. 303)

They concluded that “souls are essentially constituted by properties and property-instances, and not [physical] stuff” (p. 303).

Although philosophical inquiry is not intended to provide a *causal explanation* for the occurrence of conscious states, Rickabaugh and Moreland (2024) called for a substance dualist research project to consider the *empirical research* on near-death experiences, stating:

Many reported near-death experiences (NDEs) studies make it clear that people immediately experience themselves as completely disembodied selves or I’s. Although they experience being invisible, they have a spatial location and “point of view” from somewhere in the room. . . . When their bodies are described, they seem fuzzy (sort of spread throughout an extended location yet more like a cloud without distinct, precise boundaries), they often seem to have bodies of light, etc. (p. 333)

In our view, the empirical evidence from near-death experiencer (NDER) reports *can be the basis* for a substance dualist ontological framework that can provide convincing causal explanations for how conscious states can occur.

In David Rousseau’s (2011) insightful essay, he developed a similar ontological framework using a *dualistic systems perspective*. Rousseau proposed a Naturalistic Substance Dualism based on the consideration of the “psychonetic faculties,” that is, the soul’s inherent capacities to interact with the physical body and other souls while retaining its distinctness and separateness.

In this paper, we review previous interactionist substance dualist NDE research and outline a new substance dualist framework for un-

derstanding consciousness. The framework is based on NDE and neurological evidence, integrating both substance dualist philosophy and empirical science.

Two Substance Dualist Theories Based on Near-Death Experience Phenomena

NDE research based on a substance dualist framework has been underway for more than 30 years.

In May 2005, when we began our research on NDEs, we were unaware of J. Kenneth Arnette's previous publications in which he presented an interactionist dualist model based on NDE evidence (1992, 1995, 1999). In the spring of 2008, after our initial paper had been completed (Mays & Mays, 2008), we became aware of Arnette's three papers. Therefore, we acknowledge the scientific priority of Arnette's work. We are not aware of any other NDE researchers working from an interactionist dualist perspective.

Both Arnette's *theory of essence* and our *mind entity framework* are forms of interactionist substance dualism based primarily on NDE evidence. The two models share several features: Both propose the existence of an autonomous, nonmaterial mind or essence that interacts with the physical body and brain and continues to exist independently of the body during NDEs and after physical death; propose a mechanism for embodied mind-brain interaction based on electrical brain interactions that give rise to consciousness, perceptions, thoughts, memory, motor actions, and unconscious mental effects; and propose a mechanism for the mind-essence to causally trigger neural activity and to causally interact with the brain's neural electrical fields to trigger awareness of sensory percepts. The specifics of these similarities are explained further in the following sections. The differences between the two frameworks are primarily in the details of the causal connections between the mind and the brain.

Substance Dualist Theory: Kenneth Arnette – Theory of Essence

Theory of Essence. Arnette (1992, 1995, 1999) suggested that the classic mind-body problem can be explored *empirically* by examining NDEs. He proposed that human beings are made up of a body and an essence—the latter survives after death and exists beyond physical

laws, such as gravity. This essence contains human personality and consciousness, and, upon death, it separates from the body and this universe (or *spacetime*) and travels via a wormhole or tunnel to transcendent locales.

Arnette used *content analysis* of NDE narratives and studies by Raymond Moody (1975), Kenneth Ring (1980), and Michael Sabom (1982) to identify common features of essence-body interaction. In several cases, NDErs described accurate observations during out-of-body experiences, later verified by medical records. Arnette observed four main types of interaction: between the essence and (a) the NDEr's body, (b) other physical bodies, (c) the NDEr's brain, and (d) other essences.

- Interactions of the NDEr's essence with its body: NDErs often felt pulled or pushed back into their bodies when revived, suggesting a force at play.
- Interactions of the NDEr's essence with other physical bodies: NDErs tried to touch people but passed through them, indicating the essence can occupy the same space as a physical body without interacting with it.
- Interactions of the NDEr's essence with the NDEr's brain: Cognitive abilities were reportedly clearer during NDEs, implying the essence may function more efficiently when separate from the brain.
- Interactions of the NDEr's essence with other out-of-body essences: NDErs described telepathic communication with both living and discarnate essences, receiving thoughts before words were spoken.

Three Types of Interaction. Arnette's model included three types of interaction. Regarding *essence/body interaction*, he theorized that the attractive force between essence and body is electromagnetic, as the nervous system produces an electromagnetic field (EMF), specifically a *spatially extended electromagnetic field*. He compared this connection to the attraction between *electric* or *magnetic dipoles*, whereby the essence is specifically "tuned" to its own physical body as a *composite* of innumerable electric dipoles.

When interacting with *other* physical bodies, the superposition of the essence and the other person's composite body-plus-essence would cancel and would have little or no interaction with the NDEr's essence. Thus, the NDEr's essence can pass through other bodies with little or no effect.

In summary, Arnette's empirical analysis of NDE cases supports the idea of an essence that interacts with the body through electromagnetic forces, offering a potential framework for understanding mind-body interaction.

Regarding *essence/brain interaction*, Arnette observed that during out-of-body experiences, individuals reported *clearer*, more efficient thinking compared to when consciousness is connected to the brain. He attributed this phenomenon to interactions between one's "essence" and the brain, suggesting that in the body, these interactions *dampen* cognitive function.

According to Arnette's dipole model, the essence's thought processes generate a fluctuating electromagnetic field on a microscopic level near cortical neurons, and both the essence and neurons act as mutually interacting dipoles within this field. Specifically, in his model, a dipole rotating in two dimensions in a fluid medium interacts electromagnetically with the medium around it. At one moment in time, the dipole and surrounding fluids are electromagnetically at equilibrium.

When the dipole rotates, the lingering organization around the dipole (in the fluid) takes time to respond to the new orientation of the dipole, and during this time, there is a "drag" on the rotation of the dipole, thus slowing the dipole's motion. This process could be called "dielectric friction" or *dipolar rotational relaxation* (Arnette, 1981). The result is that the dipole (essence) moves more slowly—due to the surrounding fluid medium (brain)—than if it were in a vacuum (discarnate state). And this experience is exactly what NDErs in general report.

This connection enables the essence to access sensory information via the brain's electric field and to influence bodily functions by interacting with the brain's electric field. However, the brain's field can interfere with the essence's cognition, leading to less vivid or dampened consciousness in the in-body state.

Finally, regarding *essence/essence interaction*, Arnette hypothesized this type of interaction to be telepathic communication with both living and discarnate essences. Arnette compared telepathic exchanges to *fluorescence energy transfer*, that is a *direct exchange of energetic states* without observable energy transfer. In these cases, information is conveyed between essences at a distance, with no identified medium or mechanism for the transfer.

A Definition of Mind. Arnette suggested that the mind can be explained by a set of scientific principles as found in classical physics (electromagnetism and general relativity) and new physics (multiverse theory and string theory). He described the conscious mind as the part of us humans that thinks, is aware, and makes decisions. The mind connects our inner experiences with our body, enabling us to sense

information from the world and to act physically based on that information or on self-reflection. Thus, the mind, as depicted in **Figure 1**, acts as a bridge between the bodily structure and the deeper essence.

Arnette's diagrammatic representation of the mind (**Figure 1**) shows the mind *in ordinary in-body consciousness*, based upon his rotational relaxation model of essence/brain interaction, as described above. The essence and body are shown as two triangles. Their intersecting circles depict electric fields, and the area where they overlap is the conscious mind, formed through their interaction. This depiction implies that the conscious mind arises from *both* physical and essential aspects, connecting the two. Parts of each field that do not overlap represent the unconscious mind. Although the conscious mind might access these areas, their contents typically stay hidden from direct awareness.

Arnette emphasized that for the body and essence to interact, they must share some common, physical property—in this model, fluctuating electromagnetic dipole fields. The mind exists only through the interplay of both fields. The body acts as a transformer or interface, converting sensory inputs into patterns the essence can access. This union enables the essence to experience and act within the physical world, relying on the body's biological systems for accurate information and response.

The Mechanism of Neural Firing. Arnette (1999) proposed that the essence and brain share the same three-dimensional space, connecting through their oscillating electromagnetic dipole fields. He suggested that thoughts and mental images are shaped by the essence's electric field, which interacts directly with the brain. When the essence's EMF fluctuates, it can trigger neural firing by pushing a neuron's voltage over its threshold. An idea in the mind can trigger neural action potentials. In a complementary way, the essence senses neural activity as changes in the brain's electromagnetic dipole field, enabling it to perceive sensory signals—such as sights, sounds, colors, scents—via these EMF fluctuations.

The ongoing interaction between the essence and brain forms a dynamic equilibrium, with each constantly influencing the other through this interface. Although the specifics of Arnette's mind-brain interface remain unclear, he speculated that brain neural activity at any level can be modeled as EMF dipoles.

Substance Dualist Theory: Robert & Suzanne Mays – The Self-Conscious Mind

The Phenomenology of the Self-Conscious Mind. Our scientific research is based on the phenomenological examination of the detailed subjective experiences of numerous NDErs, in which we try to *live into* their experiences, looking for commonalities and patterns, while withholding judgment until the collective evidence becomes overwhelming, and, even then, remaining open to theoretical revisions when new evidence appears. Our attitude is much like that of Nathalie Depraz, Francisco Varela, and Pierre Vermersch:

[W]e have to have an open exploration, without positions staked out ahead of time and without establishing concepts definitely defined at the outset. . . . [A]n open questioning whose answers are not given ahead of time but instead surge forth from the research itself, is opposed to a system presented from the outset via a grid of definitions, . . . or indeed, any static exposition of the research results of a theory. (Depraz et al., 2003, p. 17)

Line of Reasoning. In our paper on the phenomenology of the self-conscious mind (Mays & Mays, 2008), we presented the following line of reasoning:

- In an NDE, the apparent locus of the NDEr's self-conscious awareness shifts from being within the body to outside the body. The NDEr's veridical perceptions during the out-of-body component strongly suggest the existence of a self-conscious mind as a "field of consciousness," a region of space where a person's consciousness exists. In the out-of-body state, the mind appears to be nonmaterial—that is, not consisting of material particles or atoms—and completely independent of the physical body.
- The fact that self-conscious awareness appears to operate with full mental faculties outside of the body, at times when the body and brain have ceased to function by any measurable means, contradicts the prevalent view of neuroscience that consciousness can occur only when there is physical brain activity. Yet an NDE appears to be a continuous, seamless experience of the *same self* who retains a continuity of memory from before the start of the NDE to after the return to the body, like any other significant life experience.
- If self-conscious awareness can separate from the body and operate *independently* of it for a time, then self-conscious awareness probably operates as an autonomous entity *as well in the body*, al-

though it is intimately, concurrently united and co-extensive with the brain and body, with cognitive faculties operating through the mediation of the brain. Mental activity always begins in the mind but is then “reflected” in neural activity.

- The NDEr’s autonomous mind is the person’s consciousness itself—it *is* the person himself/herself/oneself—the person’s *mind entity*.
- When embodied, the nonmaterial self-conscious mind is a three-dimensional field that is *coextensive* with the brain and body, *merging* with the brain and nervous system and operating through neural activity (Mays & Mays, 2008, pp. 35–36).
- The self-conscious mind is, thus, ordinarily intimately united or integrated with the physical body and must, therefore, interact in some way with the brain and body. At some level, this interaction has a physical effect within the neurons. Because people ordinarily are unaware of the operation of their brains, the self-conscious mind initially operates subconsciously and automatically within the brain. Conscious awareness then arises out of the brain’s neural activity.
- Thus, the NDEr’s out-of-body experiences delineate what aspects of consciousness are in fact independent of the brain. Conversely, various “neural correlates of consciousness” can provide indications of how the autonomous conscious mind entity operates when united with the brain.
- These two perspectives of consciousness, namely existing for a time outside the body and, in the usual case, united with it, together strongly denote the existence and agency of a *self-conscious mind*.

NDE Phenomenology. Our theory of the self-conscious mind is based on the empirical evidence of NDErs’ experiences. In particular, the phenomenology of the NDE out-of-body phase (Mays & Mays, 2008, pp. 18–22) delineates which aspects of consciousness are, in fact, independent of the brain. We describe these features as follows, somewhat enhanced from our original paper:

- At the start of an NDE, some experiencers simply perceive their consciousness suddenly to be located outside their body with no memory of how it separated; other NDErs experience their consciousness separating from their body. In the latter case, various NDErs describe this process differently: For example, some perceived their consciousness leaving through their head, chest, or toes, or by lifting holistically from the body. In leaving the body, some NDErs hear hissing, buzzing sounds or feel tingling and may observe a thin thread leading back to the body.

- The apparent locus of consciousness shifts from within the physical body to outside and appears to have an independent existence. NDErs can perceive their immediate surroundings frequently from above their physical body near the ceiling. Their physical body appears as an “empty shell.” There is a continuity of their sense of self and of memory from the in-body state through the out-of-body state and the return to the body. NDErs feel themselves to be the same persons throughout the experience.
- The NDEr feels no bodily pain, has a sense of freedom from the body, and generally feels weightless, tireless, and completely at peace.
- The NDEr generally reports having some sort of nonmaterial body variously described as translucent, “cloud-like,” and an “energy pattern,” and as shaped either like the physical body or like a sphere or ovoid (see **Figure 2**).

So I now look at this [immaterial] body I feel to be mine, which is bizarre, it appears to be me as substance-less, and yet it still has a shape; sort of amoeba-like. It looks like a TV screen when there is no programme on, but there are black and white lights that are vibrant, and flickering. The whole body is like this. It only then occurs to me that this strange body I now have has no weight; I'm a weightless floating thing. Although I have no [physical] arms, no [physical] legs it feels like I [do] have [limbs,] in fact. (Putnoki, 2014, p. 81)

- The ordinary mental and cognitive faculties of perception, thought, volition, memory, and feelings are present, although sometimes in modified form. When separated from the body, the NDEr has a heightened sense of reality, enhanced clarity of thought, perception, and memory recall, with lucid mental processes. The NDEr's volition operates without any constraint or limitation of the physical body. The individual can direct movement simply by thinking or desiring it and then move very quickly or seemingly instantaneously.
- The individual has accurate visual perception, including color, but the perception has much greater acuity than in the body (Holden, 1988). Vision during the NDE for some experiencers requires physical illumination, but others experience very bright illumination. The NDEr also has a kind of “zooming” or “wraparound” vision involving simultaneous 360-degree spherical vision around an object, through it, and within it. The wraparound vision appears to operate effortlessly. The visual acuity and 360-degree vision may be explained partly by the ability of NDErs to focus their attention without the limitations of the physical eyes or the constraint of a particular perspective dictated by the position and limitations of the physical body (Jourdan, 2011).

- Existing sensorimotor or structural defects or disabilities, such as blindness, deafness, lameness, or missing limbs, are absent in most NDErs. NDErs who are middle-aged or older may feel or “see” themselves as much younger, often “in the prime” of their adulthood.
- A surprising number of people who had their NDEs during infancy or early childhood report that they experienced themselves as “adults” during their NDE. They describe their experience from an adult perspective, with the NDEr at the time having fully developed perception and thought, while retaining memory of the experience. The NDEr’s adult perspective ceases upon returning to their juvenile body.
- Visual perception also appears to work for objects not visible to ordinary physical sight. NDErs can sometimes see their own nonmaterial “bodies,” such as their limbs and clothing, and even describe details of the limbs’ structure. In so-called “multiple simultaneous” NDEs, the NDEr can see other individuals who are also out of their bodies. These fellow NDErs are also “seen” to have a bodily form (Mays & Mays, 2021, Section 4C).
- NDErs can sometimes hear physical sounds such as physical speech, the beeping of monitoring machines, or the hum of fluorescent lights. Individuals can also “hear” people speak, either from physical sound or by thought transfer or telepathy.
- The NDEr’s “body” appears to be completely nonmaterial. Living people cannot hear the NDEr “speak” and cannot see the NDEr, but animals sometimes appear to sense an NDEr’s presence. Some NDErs report that they can sense the texture of surfaces of objects by touch, or that they perceive a slight resistance in passing through solid objects, but in general there is no apparent interaction between the NDEr’s “body” and physical objects.
- Again, not all NDErs recall the process of their consciousness returning to their body. When they do, the process can be gradual, such as walking back or falling back through a tunnel and, again, reentering the body in one of various ways; or rapid, a quick snapping back into the body. The self-conscious perspective then typically returns to being fully within the physical body, though, rarely, an NDEr may report “not feeling fully back” with a sense of ongoing partial disembodiment.
- Upon returning to the body, the NDEr’s physical characteristics return—weight, fatigue, physical pain, and physical disabilities. The NDEr’s memory of NDE events is generally very vivid and long-lasting.

The Cause of NDEs as Separation of Consciousness From the Body. We propose that the “cause” of NDEs is not the NDEr’s physical circumstances—because not everyone who survived seemingly identi-

cal physical circumstances reports the memory of an NDE—but is the separation of the NDEr’s consciousness from their physical body (Mays & Mays, 2021). This assertion is supported by evidence from NDEr’s results on the NDE Scale (Greyson, 1983; Mays & Mays, 2024).

The Common Proximate Cause of All NDEs. The NDE Scale (Greyson, 1983) assesses the number and intensity of the elements in an NDE to give a measure of the “depth” of the experience. The Scale contains 16 items, each assigned a value of 0, 1, or 2 depending, respectively, on the absence, mild intensity, or strong intensity of the element addressed in the item. A total score thus ranges from 0 to 32. An NDE is defined as a score of 7 or greater. The average score for an NDE is about 16.

An independent statistical analysis of the NDE Scale showed that NDEs are a structured experience (Lange et al., 2004). The Scale measures *one consistent ‘core’ experience* that is the same for people of all ages and across many cultures (Greyson, 2021).

Vanessa Charland-Verville et al. (2014) conducted a study comparing NDEs associated with life-threatening events that result in coma to “NDE-like” experiences occurring in non-life-threatening situations. The NDE scores of the two groups showed no significant difference in intensity or content between the two experiences. In our view, this result shows that neither the apparent proximity to death nor the specific physiological or psychological factors leading to an NDE determine either its quality or “depth” (Mays & Mays, 2015).

The commonality of NDE scores in a wide range of conditions suggests that a *common state of consciousness* occurs in all NDEs. The common state of consciousness suggests that there is a *common underlying proximate or immediate cause* to all NDEs. Various antecedent conditions can lead to or trigger the common precipitating cause—the common mechanism—resulting in an NDE.

The proximate cause might be physiological, such as a common brain circuit in a particular brain region, or non-physiological, for instance, the *separation of consciousness as an autonomous entity from the physical body*. We argued that the latter hypothesis has greater explanatory power (Mays & Mays, 2021): that the separation of the mind entity from the physical body *is* the proximate cause of all NDEs.

Confirmation From NDE Scale Data of the Separation of Consciousness as the Cause of NDEs. In a study of NDE reports from the IANDS Experience Registry (IANDS, 2023), we applied the

mind entity framework to the analysis of 565 NDE Scale results of NDErs with a total score of 7 or higher (Mays & Mays, 2024).

The mind entity framework holds that a human being is a nonmaterial mind united with the physical body. In an NDE, the mind, or seat of consciousness, separates from the body and operates independently of it until the mind returns to and reunites with the body.

Evidence from veridical NDEr perceptions supports the idea that during the NDE some part of the human being—the mind or spirit—has actually separated from the physical body and has perceived events in the physical realm from a vantage point outside the body, in many cases while the brain was fully anesthetized or was completely inactive. The perceptions occur in real-time and are completely accurate. In these cases, no physical explanations hold up to scrutiny (Mays & Mays, 2024, pp. 196–203).

To validate that the separation of consciousness is the essential feature that defines an NDE, we reviewed the 16 features of the NDE Scale and selected those features that directly or indirectly imply the separation of consciousness from the physical body. This analysis divided the scale features into nine “separation-related” features plus seven “incidental” features. The “incidental” features are those that are likely to occur in *other* paranormal experiences as well as NDEs (pp. 203–207).

Table 2 enumerates the nine separation-related features in our dataset, ordered by prevalence. The cumulative prevalence is provided as each new feature is incorporated. These nine features alone accounted for 99.3% of the entire NDE dataset.

An analysis of the pairwise prevalence of the nine separation features showed that each separation feature occurs with other separation NDE features. Features such as N3 Life review or N11 Life preview, which do not *directly* imply consciousness separation, invariably accompany features that do.

In contrast, the seven “incidental” features can occur *alone*, under circumstances of paranormal experiences *with no separation-related features*—for example, in circumstances such as dreams, mind-altering drugs, or meditation. Thus, the incidental features do not help to differentiate NDEs from other paranormal experiences (p. 205). The incidental features from the NDE Scale were:

- N1. Did time seem to speed up or slow down?
- N2. Were your thoughts speeded up?
- N4. Did you suddenly seem to understand everything?

- N5. Did you have a feeling of peace or pleasantness?
- N6. Did you have a feeling of joy?
- N7. Did you feel a sense of harmony or unity with the universe?
- N9. Were your senses more vivid than usual?

If the mind entity framework is correct, NDErs experience consciousness leaving their physical body, meeting deceased relatives, undergoing a life review, or being told they must return. According to this framework, the NDEr's account is an accurate portrayal of what happened in the NDE. NDEs are real—not imagined, random, or chaotic—experiences.

The NDE Scale results confirm the mind entity framework because the nine separation features describe a *coherent course of events* beginning with an explicit or implicit separation of the NDEr's consciousness from the physical body:

- As we would expect, N12 (Separation from the body) is the most prevalent feature because that aspect of the experience is the fundamental feature of the framework.
- The other *prevalent* NDE features describe aspects of being in a transmaterial or unearthly realm, seeing or being surrounded by a brilliant light, encountering a mystical being or unearthly presence, and coming to a border or point of no return. These “essential” features describe experiencing different aspects of the transmaterial realm after separating from the body.

Table 2 *Prevalence of Separation-Related NDE Scale Items*

Scale Item	Scale question	Individual prevalence	Cumulative prevalence
N12	Separated from your body?	81.4%	81.4%
N14	Encountered a mystical being or presence?	74.3%	94.9%
N13	Entered some other, unearthly world?	74.0%	97.2%
N8	Surrounded by a brilliant light?	68.5%	98.4%
N16	Reached a border or point of no return?	59.1%	98.8%
N15	Encountered deceased or religious spirits?	50.3%	98.8%
N10	Aware of things going on elsewhere (ESP)?	34.7%	98.8%
N3	See scenes from your past?	26.9%	99.1%
N11	See scenes from the future?	25.8%	99.3%

Note. N = 565.

- The four remaining features define the less prevalent aspects of the out-of-body NDE experience—meeting deceased loved ones or spiritual/religious figures, out-of-body perceptions in the physical realm, visions of one’s past—the life review, and prophetic visions of future events. These features also fit the expected transmaterial aspects of the framework.

Thus, the nine separation-related features form a *coherent set of mutually prevalent elements*. The coherence of the separation-related features suggests that *NDEs are universal*. The unifying factor for all NDEs is the separation of the NDEr’s consciousness from one’s physical body. NDE Scale data confirm the validity of the mind entity framework through the prevalence, coherence, and universality of the framework-related features (pp. 209–210).

The Mind Entity Framework

Validity of the Empirical Study of Near-Death Experiences

In this section, we argue that NDEs can be studied empirically because NDE narratives document a consistent “core” experience that provides valid data for scientific study.

Consistency of the NDE ‘Core’ Experience

NDEs are more than isolated stories or anecdotes. They have consistent, well-defined characteristic features with remarkable uniformity of the NDE elements that are the same for people of all ages and across many cultures.

Based on a Gallup poll and two research studies, between 4% and 8% of people have had an NDE. Given the uniformity of NDEs across many societies, a conservative estimate would be 5% of the world population have had an NDE. If that is the case, the elements and details of NDEs have occurred to nearly 400 million people worldwide—more than the entire population of the United States. So, hundreds of millions of people worldwide have had an NDE and have lost their fear of death (Mays & Mays, 2021, p. 4).

Usefulness of the Elements in NDE Narratives as Empirical Evidence

The elements in NDEs are remarkably consistent. For example, about 35% of NDErs are told they must return to the body (Martial et al.,

2020). Usually they hear the same words, to the effect “It’s not your time; you must go back; you have more to do on Earth.” Just as when many millions of tourists visit Paris and report seeing the same unusual structure—the Eiffel Tower—which we then regard as objectively real, so when many tens of millions of NDErs journey to another realm and hear the same unusual admonishment, “It’s not your time; you must return,” their experience can be regarded as *objectively real*, not imagined.

Thus, the elements of an NDE may appear to be merely subjective experiences when taken *individually*. However, when an element is considered *collectively* across many millions of NDEs, the element can be regarded as the experience of a common, objective reality witnessed and shared by many NDErs. With this strong evidence from NDEr accounts, researchers are justified in accepting NDEs as providing valid data for scientific study, using the *same rigorous empirical observations* as in any other field of science.

The High Quality of Evidence From NDEs

The quality of the evidence we use is based on the following factors:

- *NDErs are credible eyewitnesses to their experiences.* The experiences are frequently *corroborated* by the NDEr or another person. For example, an NDEr reports observing an unusual event in another location while out-of-body, which he later corroborates with a doctor. NDErs report their experiences as hyperreal, rather than as vague perceptions. Their memories of the event are “*more vivid and detailed [than] are memories of other real events from the same time period*” (Moore & Greyson, 2017). The memories of their NDE *do not change over time* and are dependable. They are not embellished even over long periods (Greyson, 2007).
- *Millions of NDErs report the same experience with the same characteristics.* NDErs who observe and later corroborate an unusual event join perhaps 60 million other eyewitnesses worldwide who reported the same objective phenomenon—verified veridical perceptions from a position outside the physical body.
- *Similar first-person testimony from multiple NDErs provides strong objective evidence.* The weight of this evidence depends on the number of NDErs reporting the same idiosyncratic experience (e.g., hearing “It’s not your time.”).
- *Independent corroboration from other credible witnesses of the phenomenon* provides further objective evidence to the NDEr’s testimony.

- *Multiple lines of evidence from NDEs and other death-related experiences build a consistent, coherent picture of the overall phenomenon* (Mays & Mays, 2021).

“Mind Entity” as a Distinct Ontological Category

Based on the NDE phenomenology described earlier, we propose that the *mind entity* is a nonmaterial, spatially extended three-dimensional region of space, a “field of consciousness,” which is the locus of awareness and self-awareness of a human being. The mind entity is ordinarily coextensive with the physical body but may separate from the body and have an independent existence. The mind entity *is* the *being* or *soul* of the individuated person.

The features and properties of the mind entity fit the substance dualist list for a “thing that has mental states” (Rickabaugh & Moreland, 2024, p. 303):

1. *The appropriate entity for exemplifying mental properties:* The mind entity possesses the mental and cognitive faculties of perception, thought, volition, memory, and feelings.
2. *The appropriate entity for holistically unifying mental properties:* The mind entity is a thinking, perceiving, feeling, and volitional being with the capacity to form and recall memories.
3. *The appropriate entity for being an enduring mental continuant:* The mind’s mental and cognitive faculties are unified in the mind entity as a center of consciousness *throughout* physical embodiment and when separated from the physical body.
4. *The appropriate entity for being the employer and referent of “I.”* As the center of the person’s sense of self, the mind entity refers to itself as “I.”
5. *The appropriate entity for having an irreducible “First-Person Point of View.”* The mind’s mental and cognitive faculties are exercised through a first-person perspective.
6. *The appropriate entity for being possibly disembodied as a unified center of consciousness:* The mind entity endures over time and has a continuous sense of self throughout physical embodiment and during the separation from and return to the physical body.
7. *The appropriate entity for ontologically grounding claims such as “Necessarily, thoughts have thinkers.”* The mind entity is a thinking being with the capacity to intuit, reason, analyze, and plan.
8. *The appropriate entity for exercising active power and teleologically guiding a deliberative process toward an end:* The mind entity has agency and can direct and guide its will toward a purposeful outcome.

Empirical evidence of the existence and properties of the mind entity comes from the experiences of hundreds of millions of people who have undergone an NDE. The measure of an NDE, the NDE Scale, shows that NDEs are a *consistent structured ‘core’ experience* that is common for people of all ages, cultures, and historical periods.

Empirical evidence of the mind entity’s features and properties shows that the mind entity is wholly nonmaterial, having only a minimal ability to interact with physical forces and material objects. Empirical evidence also shows that the mind entity is the seat of consciousness of the person, including all mental and cognitive faculties, completely independent of the physical body.

Empirical evidence in hundreds of millions of cases of the mind entity separating from the physical body, leaving the physical body effectively dead, and then rejoining the body, thereby *re-enlivening* it, shows that the mind entity is essentially, wholly, and intrinsically distinct from the physical body and is the carrier of the body’s life forces.

Empirical evidence from numerous NDEs shows that the out-of-body mind entity is an *objectively real thing* (Mays & Mays, 2021, Section 4). In verified “apparitional” cases, the NDEr is seen by in-body people (Rivas et al., 2023, Chapter 7). In numerous other cases, the NDEr sees deceased persons as mind entities whom they recognize and knew in life; whom they know but did not know they had died; and whom they did not know but later identified as related to them in some way (Mays & Mays, 2021, Section 10).

Thus, the empirical evidence from NDEs shows that *the mind entity is not only metaphysically possible* but is also *metaphysically real* and is *a separate ontological category* distinct from the physical body and other physical objects.

Basic Neurological Principles for Embodied Consciousness

We turn now to the hard problem of how the mind entity interacts with the physical body. We begin with a brief tutorial on basic neurological principles.

Cortical Gray Matter and Dendritic Spines

Cortical gray matter is the major component in the upper 2–4 mm of the brain’s cerebral cortex, consisting of neuronal cells. Each neuron

has a cell body—soma—with dendritic branches and an axon projecting from the soma.

Most of the neurons in the gray matter of the cortex are pyramidal neurons, which have vertical apical dendrites reaching from the soma to the surface and basal dendrites branching out horizontally from the soma (**Figure 3**). The dendrites feature numerous tiny nodules known as *dendritic spines*. Dendritic spines can form a synaptic connection with another neuron's axon.

Neurons connect electrochemically through a *synapse*, a gap between the axon terminal of one neuron and the dendritic spine of another. The sending neuron releases a chemical neurotransmitter from its axon terminal that activates the receiving neuron's spine and dendrite to release electrically positively charged ions. *Excitatory* neurotransmitters can lead to an accumulation of charge in the soma, causing the receiving neuron to “fire,” that is, *generate* an action potential, whereas *inhibitory* ones can *prevent* the neuron from firing.

We propose a *second purpose* for dendritic spines: that the *mind entity* can *also* trigger action potentials by interacting with the spines. We detail this process below.

Modular Cortical Organization

The brain's cortex is organized in specialized domains or modules responsible for specific mental functions, such as recognition of faces, words, shapes, speech, language, pitch, and places (**Figure 4**). Other domains support general mental functions, including arithmetic calculations (**Figure 5**), making shopping lists, and holding thoughts in “working memory.” The evidence for these domains comes from functional magnetic resonance imaging (fMRI) studies, which associate activation of a specific module with specific mental activities (Kanwisher, 2010, 2017).

The domains can be very specific in function. Related functions can have overlapping domains, for example, separate and overlapping domains for addition, subtraction, and multiplication mental operations (Arsalidou, 2011). Several generalized domains in the frontal and parietal regions also support general-purpose cognitive and neural mechanisms “from mental arithmetic, to holding information in working memory, to filtering and suppressing task-irrelevant information” (Fedorenko et al., 2013).

The evidence for specialized domains or modules also comes from brain lesions in which cases a particular damaged module is associated

with the loss of a specific cognitive function. Examples include various forms of aphasia—an inability to understand or produce language, and agnosias—an inability to recognize objects, persons, sounds, or shapes.

The specialized modules generally operate independently of one another. Evelina Fedorenko and Rosemary Varley (2016) studied people with *global aphasia*, who have almost no ability to understand or produce language but who, nonetheless, are able to add and subtract, solve logic problems, and appreciate music. Brain imaging of healthy adults showed that many aspects of *thought* involve general domains and do not depend on the specialized domains of language. The existence of severely aphasic individuals with intact executive functions suggests that the language system is not essential for those functions.

Principles of the Mind Entity Framework for Embodied Consciousness

Principle 1: The mind entity is a unitary being.

The mind entity framework differs radically from the physicalist neuroscientific framework. The mind entity *is a separate ontological category*, the locus of personal identity, separate from the physical body. The mind *is* the *being* or *soul* of the individuated person; it is the seat of an individual's consciousness.

Evidence from NDErs clearly shows that the mind or soul is a *unitary* three-dimensional being that fully inhabits the physical body during embodiment. NDEr Erica McKenzie described reentering her body:

In a split second, I was shoved back into my limp body like a hand in a glove, only the glove was too small. Each part of my spiritual body squeezed its way into my physical counterpart. I could feel my spiritual big toe fit back into the spot of my physical big toe along with each one of my fingers, my hands, feet, arms and legs. My body felt heavy and confined as if I'd been zipped inside a jacket two sizes too small. (McKenzie, 2015, pp. 98–100)

Principle 2: The mind entity is the seat of consciousness.

In this framework, brain processes do not generate consciousness. Rather, the mind entity is the seat of consciousness. In it, there are no neural calculations; there are no neural representations of mental content; there are no neural quantum computations or non-local entanglement. There is no neural storage of short-term or long-term memories or of “working” memory.

On the other hand, neural activity *supports* the mind's mental and

cognitive faculties during embodiment. It *supports* the mind entity to *exist* in the physical world, to become *conscious* in a physical body, and to have *agency* with control of voluntary movements.

Principle 3: The mind entity can exist in two different states: embodied within the physical body or separated from it.

According to this principle (Mays & Mays, 2015, 2024), in the *in-body state*, the mind entity—or soul—is *coextensive* with the physical body, *merging* with all parts of the brain and nervous system and operating through neural activity. The mind must, therefore, interact physically at some level with the brain's neurons.

- Awareness then arises out of the brain's neural activity. Through its brain interface, especially at the surface of the cortex, the mind has awareness of its surroundings, its physical body, and its own mental content. Thus, the brain's *neural activity* (action potentials) is highly correlated with the mind's *awareness*.
- During embodiment, the mind works with the brain to *induce* and then to *detect* neural activity. The presence of neural activity—except in sensory areas—*indicates the activity of the mind to bring its mental content to awareness*.
- The mind's inherent mental and cognitive faculties must perform the *intermediate step* of neural activation for the mental content to become conscious in the mind and for willed actions to be carried out in the body. Thus, in going through this intermediate step, in-body awareness is felt to be “damped down” compared to out-of-body awareness.

The NDEr's *out-of-body* experiences delineate what aspects of consciousness are in fact independent of the brain. From the evidence of the *out-of-body state*, we can conclude that *all mental and cognitive faculties are based in the mind*. In the embodied state, the mind works *through* the brain.

In the *out-of-body state*, conceptual content is received through *intuition*, that is, immediate, direct mental apprehension without reasoning. Intuition arises as the initial stage of inward thought. In the *in-body state*, concepts first arise as thoughts via intuition and can then be articulated in *words*.

Principle 4: Embodied conscious awareness can be achieved only through cortical neural activity.

Therefore, the mind entity must be able to work with the brain to *detect* and to *induce* neural activity. Sensory cortical activations occur through neural impulses from the sense organs. All other cortical acti-

variations are *induced by the mind* in different brain regions beyond the primary sensory brain areas. The *presence of neural activity beyond the sensory areas indicates the activity of the mind to bring its mental content to awareness*.

Coming to awareness. Different mental content *comes to awareness* in the mind when different brain regions are activated. Specifically:

- Neural activity *from the primary senses* produces *percepts*. For instance, occipital neural activity brings the percept of a visual image to awareness.
- Neural activity *induced by the mind* brings *conceptual content* to awareness. The mind *activates* a specific brain region specialized for its mental content. Neural activation of that region brings the *concept* to awareness. For instance, neural activity in Wernicke's area brings a word's meaning to awareness.

Specialized and generalized cortical domains. The mind uses various *specialized domains* to become aware of specific mental content such as language comprehension, arithmetic calculations, and face recognition (*cf.* Arsalidou et al., 2011; Kanwisher et al., 2017).

The mind uses *general domains* in frontal areas for *sequences of thought* to solve a problem, to map out a plan of action, or to work iteratively with concepts in working memory.

If the module is damaged or absent, the mind's mental content cannot *come to awareness* (*cf.* Damasio & Damasio, 1989). The mind's complex thought processes can simultaneously integrate many geographically separate and distinct brain modules across the cortex (*cf.* Damasio & Damasio, 1989, pp. 65–66); direct neural linkage between the separate areas is not needed.

Sensory Perception. The process of sensory perception begins when sensory neural stimulation activates the percept. Thereafter, the mind *adds its intuitive conceptual content*, its interpretation of the percept. The *perception*—the percept linked to the concept—then comes to awareness.

At least two brain regions are involved: one for the percept and one for the concept. Further regions are involved if the perception occurs within a *context*. In this case, the conceptual content is evaluated for its congruity with the given context. The new concept is then integrated to form a revised conceptual context.

Memory. Rather than being stored in the brain, memory is “carried” in the mind. This principle aligns with the observation that during an NDE, with the mind entity out of the body, an NDEr has access to all declarative and episodic memories prior to the NDE and creates new episodic memories *of the NDE*. While embodied, the mind accesses *declarative* or *explicit* knowledge directly through intuition.

While embodied, the mind forms *episodic memories* through the hippocampi and subsequently recalls these memories through the hippocampi so that their perceptual and emotional character reactivates the appropriate brain structures. These memories, nevertheless, are carried in the mind. The hippocampi act as an *interface* with the mind.

“Long-term potentiation” in hippocampal neurons occurs because the *mind’s repeated activity* in the processes of forming, consolidating, and recalling episodic memories uses common neural pathways in the hippocampi. A similar form of potentiation occurs in other regions of the brain in the formation of additional dendritic spines as a person matures (Elston et al., 2009; Oga et al., 2017, p. 2).

Willed Action. Organized cortical neural activity, beyond the primary sensory areas, is *initiated by the mind* and involves the mind’s *willed action*, such as to think a thought, to focus attention, to imagine an image, or to initiate specific voluntary motor movements by activating certain motor modules.

Other types of mental willed action involve *long-distance neural synchrony*, that is, the activation of synchronous neural pathways across widely separated brain regions:

- Long-distance neural synchrony is initiated by the mind to *focus attention* by increasing neural excitability in certain brain regions while inhibiting activity in others.
- Long-distance synchrony is also initiated by the mind to *coordinate mental content* between the hemispheres through the corpus callosum.

Beyond the principles presented in this section, two critical questions remain:

1. What mechanisms enable the nonmaterial mind entity *to interact* with brain processes to detect and induce neural activity? We address this question in the next section.
2. How does the mind entity *work with* the brain to produce conscious awareness? We address this question in the subsequent section.

Some Philosophical Implications of the Mind Entity

Framework The mind entity framework carries several philosophical implications. In this section, we discuss two such implications: for the “hard problem” of consciousness and for an extra dimension of reality.

How the Mind Entity Framework Addresses the “Hard Problem” of Consciousness

The *hard problem of consciousness* is to explain how and why an organism has experiences of qualia, phenomenal consciousness, or subjective experience (Chalmers, 1995). We have proposed that the mind is a *separate entity* from the physical body, belonging to a *distinct ontological category* which has the *intrinsic property of awareness*.

- The mind entity has subjective experiences when it thinks or perceives, and *there is something it is like to be a mind entity* (Nagel, 1974).
- When out of body and operating independently of the brain, the mind entity has the intrinsic property of awareness.
- When embodied, the mind entity becomes aware when neural electrical activity occurs—the *neural correlates of embodied awareness*.

Thus, human consciousness is explained by the presence of a mind entity embodied in a human physical body. The mind thus embodied has subjective experiences by virtue of its intrinsic property of awareness.

A Broader Framework of NDE Phenomena— an Extra Dimension of Reality, a Transcendent “Timeless” Realm

The present mind entity framework fits in a broader framework of NDE and related phenomena. NDE phenomena imply not only the existence of a distinct ontological category of the mind entity or soul but also that there is an *extra-spatial dimension of reality*. The evidence for this dimension comes from NDErs’ reports of the quality of their perceptions while out of body in the physical realm.

The link between additional dimensions and consciousness in NDEs was first developed by Arnette (1992), who proposed that Einstein’s

general relativity theory allows for connections—“wormholes”—between physical reality and higher dimensions beyond “this universe’s definition of time, space, and gravity” (1992, p. 14). Subsequently, using NDErs’ reports of perceptions while out of body, Jean-Pierre Jourdan (2000, 2011), Robert Brumblay (2003), and John Smythies (2012) proposed a model whereby the point of perception is in an extra-spatial dimension, based on an analysis of hyperdimensional geometry, for example, *Flatland* (Abbott, 1884).

In their 2019 study, Jourdan and Smythies analyzed 50 NDErs’ descriptions of perceptions of the physical environs during the material aspect of their NDE. These experiencers’ average NDE Scale score was 18.6. The authors identified six *perceptual themes* from the NDErs’ written narratives and questionnaires (Jourdan & Smythies, 2019, p. 72):

- *Non-sensory perception*: Participants reported that their perceptions did not involve their physical sense organs, such as eyes and/or ears.
- *Perception at any distance*: Participants stated that they perceived some phenomena outside the vicinity of their physical bodies—with some of these perceptions *a posteriori* verified as accurate.
- *Omni-directional “vision”*: Participants referred to “seeing” in all directions; a 360° or spherical “vision.”
- *Simultaneous omni-directionality*: Participants declared that they “saw” an object or a scene from “everywhere *at once*.”
- *Perception through solid matter*: Participants described “vision by transparency” through an object that, in physical perception, would have constituted a perceptual barrier.
- *Instantaneous (re)location of focus, or “zoom”*: Participants reported that during their NDEs, when they were interested in a detail or other phenomenon, their focus would instantly locate or relocate close to it and/or “zoom in” on it.

Referring to the two-dimensional example of objects and beings in *Flatland* (Abbott, 1884), the objects in a *two-dimensional* universe are perceptible in their entirety *at a glance* from a place located *outside* that universe, in a *third* dimension. Generalizing this principle, the objects in any N-dimensional universe are perceptible in their entirety from a place located outside this universe: in an N+1 dimension (p. 76).

In embodied consciousness, a person must shift their angle of vision to see everything. During an NDE, however, one can perceive all surroundings *at once* without moving; objects remain in their usual positions, but nothing is obscured from view. For example, Jourdan and Smythies (2019) quoted NDEr J.M. as having reported:

I was surprised that I could see at a 360° angle: I could see in front and behind me, I could see underneath, I could see far away, I could see up close and also transparently. I remember seeing a stick of lip-stick in one of the nurses' pockets. If I wanted to see inside the lamp which illuminated the room, I'd manage to do so, and all of this instantly, as soon as I wanted to. I could see how people were dressed, I could see the sandstone wall, I could also see the stone slabs of the floor. I was able to verify their presence in a photograph later on since I thought it was strange and anachronistic to have such slabs in an operating room. It was surprising and I could see, *all at once*, a green plaque with white letters saying, "Manufacture de Saint Etienne." *The plaque was under the edge of the operating table, covered up by the drape I was lying on. I could see with multiple axes of vision, from many places at once. This is the reason why I saw this plaque under the operating table, from a completely different angle, since I was up there by the ceiling and I still managed to see this plaque located under the table, itself covered by a sheet. When I wanted to check this, the surgeon and I realized the plaque was actually there and read "Manufacture d'armes de Saint Etienne."* (p. 83)

One curious aspect of the *extra-spatial* dimension is the ability to relocate *instantly* to a completely different location. In some cases, there is a brief *visual transition*, as NDER Tibor Putnoki described. Tibor was out of body in the hospital prep room. The nurse was talking to her husband on the phone. Tibor wondered where her husband was: "*Suddenly a thick fog surrounds me* and I'm standing in the living room of a strange flat, on the third floor of an unknown building. There is a man standing in front of me in a jogging suit, still holding the phone receiver tightly . . ." (Putnoki, 2014, p. 79, emphasis added). These perceptions were later verified as accurate by an independent third party.

We propose that there is, indeed, an additional spatial dimension encompassing all of physical three-dimensional space, implying a "transcendent realm" that encompasses all of physical reality.

Further NDE phenomena imply a "timelessness" of the transcendent realm. For example, NDEs that lasted only minutes of physical time involved events in the transcendent realm which, to the NDER, appeared to have occurred over days, weeks, or even years. Another example that involves both transcendence of time and of singular perspective: The "life review" typically includes the accurate replay and reliving *from the NDER's past* of significant interactions with other persons from *both* the NDER's and the other person's perspective. We will address these topics more fully in a future paper.

The Mechanisms of Mind-Brain Interaction

Near-Death Experience Phenomenology of Interaction With Physical Processes

Evidence of Interaction From NDE Cases

In general, the NDEr's "body" appears to be nonmaterial. Nevertheless, there are subtle interactions with physical processes such as light and sound, and in some cases subtle interactions with solid objects and in-body people (Mays & Mays, 2008, pp. 32–34).

- Although the NDEr's "body" generally is not seen by in-body people, it apparently may be seen by animals, in one case by a dog. In verified "apparitional" cases, the NDEr is seen by an in-body person (Mays & Mays, 2021, Section 4; Rivas et al., 2023, Chapter 7).
- The NDEr's "body" appears to interact with physical energies. The NDEr's "sight" interacts with light to provide veridical perceptions with normal colors. For some NDErs, visual perception is dependent on the ambient light. The NDEr's "hearing" interacts with sound vibrations from heart monitors, fluorescent lights, and human speech to provide veridical auditory perceptions.
- The NDEr's "body" appears to have subtle interaction with solid objects. Some NDErs report a slight resistance in passing through objects, the ability to "bob" against the surface of the ceiling or feel the support of the hospital roof, and the ability to "touch" and feel an object or to have a subtle interaction with a physical object. In one account, an NDEr's "body" appears to have interacted with fog on a cold night. In desperation to get help after a car accident, the out-of-body NDEr jumped up and down, and the "jumping fog" was seen by another man who was able to find the wrecked car (Mays & Mays, 2011, p. 8).
- Some NDErs appear to have a very strong experience of their immaterial "bodies," including the senses of touch and smell, including feeling the slickness and coolness of the floor and acutely smelling the odors of the hospital room (Storm, 2000, p. 13) or the awful smell of pus during surgery (Parti & Perry, 2017, p. 23).
- In some cases, the NDEr's "body" appears to interact with another person's physical body. Penetrating another person's body can feel like a thick liquid. In other cases, the interaction is felt subtly by the embodied other person such that the person reacts in some way.

Following are specific cases of NDEr interactions that are worthy of note:

- NDEr Howard sensed different densities when passing through layers of insulation in the ceiling above his ICU room (Mays & Mays, 2021, Section 2C).
- A 10-year-old girl left her body during sleep and tried desperately to force herself through her parents' bedroom door. "It felt as if I was pressing through a cotton ball. Some resistance" (Mays & Mays, 2021, Section 6B-2).
- The nurse stood in front of NDEr Tibor Putnoki and, with a quick movement, bent down. "The force of her rapid movement [pushed] me half way into the [brick] wall" (Putnoki, 2014, p. 82).
- NDEr László Dobronay observed that his out-of-body form was "wafted" when a man ran past him, and the man's body passed through his shoulder the way a hand wafts through cigarette smoke (Mays & Mays, 2021, Section 6B-2).
- The NDEr tried to stop physician Raymond Moody from inserting a needle into her physical arm and later related to him what happened. Moody said, "Her hand passed right through my arm. But when she did that, she later claimed that she felt something that was the consistency of 'very rarified gelatin' that seemed to have an electric current running through it. *I have heard similar descriptions from other patients*" (Mays & Mays, 2021, Section 6B-3, emphasis added).
- NDEr Tibor Putnoki tried to grab the doctor's arm, but "his body [leaked] through my fingers like a thick liquid" (Putnoki, 2014, p. 82).
- During his NDE, Jerry Casebolt playfully tickled another patient's nose until the latter sneezed (Mays & Mays, 2008, p. 33).
- NDEr Al Sullivan hovered above his body while undergoing open-heart surgery. His deceased mother drifted out of the light toward him. He reported:

All at once my mother's expression changed to that of concern. At this point she left my side and drifted down toward my surgeon. She placed the surgeon's hand on the left side of my heart and then returned to me. I recall the surgeon making a sweeping motion as if to rid the area of a flying insect. (Cook et al., 1998, p. 399).

The deceased mother induced the doctor to move his hand. The doctor reacted as if he had felt a fly touching his hand.

- In at least three cases, an NDEr reportedly "merged" with another person and was able to see and feel what the other was seeing, feeling, and thinking (Mays & Mays, 2011, p. 8). In the most notable case, George Rodonaia had an extensive experience in the material realm during his NDE. He was able to enter his wife's mind as she was picking out his grave and heard all of her thoughts, which she later verified as completely accurate (Rivas et al., 2023, pp. 193–196).

Taken together, these NDER reports strongly suggest that subtle interactions with physical energies, material objects, and neural activity *can* occur. In particular, interactions with and influence over neural activity in the brain can occur.

Mind Entity Interactions With Physical Processes During an NDE

The mind entity's interactions with physical processes can be summarized as follows:

- The NDER's accurate visual perceptions, including color and depending on ambient light, suggest interaction with *electromagnetic radiation*. For these perceptions to occur, the NDER's nonmaterial field of consciousness must interact with visible light waves—photons.
- Accurate auditory perceptions suggest interaction with *sound vibrations*. For these perceptions to occur, the NDER's nonmaterial field of consciousness must interact with coherent movements of air molecules.
- Subtle interactions with solid objects, including experiencing a slight resistance or change in density when passing through them, touching solid surfaces, and bobbing against the ceiling suggest interaction with *solid matter*. With the perception of resistance when *passing through a solid object*, the NDER's nonmaterial field of consciousness must interact with the solid object's rigid matrix of electrons and nuclei. Touching and bobbing against solid surfaces suggest interaction with the *surface of solid matter* but not penetration within the solid matter—although NDERs have also reported such penetration.
- The sudden movement of an in-body person in the vicinity of the NDER pushing the NDER or causing a “wafting” of the NDER's form suggests a *subtle pressure* against the NDER's nonmaterial “body.”
- The NDER's feeling of electricity when penetrating another person's arm and the ability to merge with an in-body person and interface with their neural activity suggests an interaction with *neural activity to sense action potentials*.
- The NDER's ability to tickle the nose of an in-body person until the person sneezed and a surgeon's response to a deceased person's touch, suggest interactions with *neurons to induce neural action potentials*. The nonmaterial field of the out-of-body person touching the in-body person's nose or hand generates neural activity in the latter person's tactile nerves.

- Interactions with living tissue resulting in the sensation of a viscous or gelatinous substance suggest a weaker interaction *inside a living body* that differs from passing through solid matter.
- Accurate olfactory perceptions suggest interaction with *unique molecular structures*. The NDEr's nonmaterial field of consciousness must interact with molecules in the air producing a specific smell due to a specific molecular structure, for instance, vinegar (acetic acid) or spearmint oil (*R*-(–)-carvone).

In all these interactions, the NDEr's *nonmaterial* field has interacted directly with physical processes. These interactions occur entirely while the NDEr's mind entity is out of body and in no way involve mediation by the NDEr's physical sensory structures.

Analysis of Different Forms of Physical Interaction During an NDE

The out-of-body NDEr perceives directly *without* physical sense organs. Out-of-body perceptions without intervening sense organs and neural activity are reported to be more vivid and real than in-body perceptions. In particular, visual perception occurs with 360-degree spherical vision.

The mind entity perceives *visually* via direct interaction with the electromagnetic waves of visible light, *auditorily* with the sound vibrations of molecules in the air, *tactilely* with the molecules at the surface of solid objects, and *olfactorily* with the molecular structures of specific substances. The mind entity *senses resistance* when penetrating the atoms and molecules within a solid object or bobbing against a ceiling.

We suggest that the *mechanisms* of the mind entity's interactions consist of the following, in order of increasing density of matter and increasing force of resistance. The nonmaterial body's interactions with:

- The weak force of *electromagnetic waves (photons)* in light.
- The weak force of *molecular structures* of volatile odoriferous substances, such as vinegar or spearmint.
- The *weak resistance forces* of air molecules in sound waves.
- The *somewhat stronger resistance forces* of the molecules *within fluids* or *within a living organism's body*.
- The *strong resistance forces* within the *fixed matrix* of atomic nuclei and electrons *within solid matter*, such as a concrete wall.

When passing through a solid object, the energetic field of the nonmaterial body interacts with the electrons and atomic nuclei in the solid, which are densely packed together and strongly held in the struc-

ture of the solid. In water or a living body, molecules are not held in a rigid structure, so the force of resistance would be less, probably accounting for NDERs' reports of a gelatinous sensation or a thick liquid when passing through a person's arm.

The resistance NDERs experience in passing through solid objects indicates that the mind entity can *exert a subtle force on physical matter*, in accordance with Newton's third law of motion that every action has an equal and opposite reaction. Similarly, the sudden movement of an in-body person in the vicinity of the NDER can exert pressure against the NDER's "body." Thus, the force of interaction with solid objects is a two-way push-pull force.

The General Principle of the Mind Entity's Interactions With Physical Processes

The empirical evidence of NDER out-of-body interactions with physical processes has the following implications:

- Photon interactions imply *sensitivity to electromagnetic oscillations*, that is, rapid positive and negative oscillating fields, resulting in the NDER's sense of sight;
- Surface and molecular interactions imply *sensitivity to outer electrons of atoms and molecules*:
 - *in solid surfaces*, resulting in the NDER bobbing against the ceiling and the NDER's sense of touch;
 - *in sound waves*, resulting in the NDER's sense of hearing; and
 - *in odoriferous molecular configurations*, resulting in the NDER's sense of smell.
- Resistance when penetrating solid matter implies that *the mind entity exerts a weak repulsive force against the electrons and atomic nuclei within the solid matter*.

The common factor appears to be the mind entity's interaction with electrical charges, particularly negatively charged electrons, which appear to be repulsive interactions. The interactions appear to occur when there is *movement of the charge relative to the mind entity field*.

The general principle of the mind entity's physical interactions appears to be that *the mind entity's nonmaterial field interacts with moving or oscillating electrical charges, resulting in direct conscious sensations and perceptions in the mind*. These interactions occur directly with the nonmaterial field and do not involve mediation by the NDER's physical sensory structures.

The typical cases are interactions with photons, sound waves in the air, odoriferous airborne molecules, movements against a solid surface, and penetration into solid objects. This principle must also apply to the embodied mind entity's interactions with the brain.

Mechanism for the Mind Entity to Detect Neural Activity

Evidence of the mind entity's ability to *detect neural activity* comes from (a) reports of feeling of electricity when penetrating another person's arm and (b) the NDER's ability to merge with a person, interface with their neural activity, and later report their thoughts. We propose that the *spiking of neural action potentials* in the cortex can be detected by the mind entity.

Neurons at rest have a strongly negative charge—approximately -75 millivolts (mV). Action potentials are sudden pulses of positive charge within the neuron caused by the back propagation of positive calcium ions in the dendrites, reaching a strong positive charge at its peak of approximately +25 mV—at the soma—cell body—and spreading throughout the dendritic arbor in less than 20 milliseconds (msec).

Figure 6, from Smith et al. (2013; reference includes video down-link), shows an action potential spike in a single L2/L3 mouse neuron in the primary visual cortex *in vivo*. The neuron was injected with a voltage-sensitive dye to show the change in voltage from -75 mV at rest, reaching to +25 mV in the soma at the peak, and the propagation of positive charges back through the dendrites. The video frames in this figure track a single action potential in the voltage trace at the bottom of each frame. The time scale of 20 msec is shown on the graphs.

The neuron's voltage is regulated by the concentration of calcium ions (Ca^{2+}) in the dendrites. High calcium concentrations result in brief positive voltages (red and orange colors) in backpropagation steps 1 and 2.

We propose that the mind entity *detects the simultaneous coherent spiking* of numerous neurons in specialized brain regions of the cortex, bringing specific mental content to awareness, based on the earlier principle that a moving or oscillating electrical charge within the mind entity's field results in awareness in the mind. Later we propose more specifically that the coherent spiking of neural activity *mirrors* the mind's mental content and brings it to awareness.

Mechanism for the Mind Entity to Induce Neural Activity

Evidence From Inhaled Anesthetics

According to the mind entity framework, the mind activates cortical neurons in a brain region, triggering action potentials. The mind must first trigger action potentials in the brain region to bring the mind's mental content to awareness. Otherwise, the mental content remains subliminal.

We propose that the interaction between the mind and the brain occurs in the dendritic spines of pyramidal neurons at the cortical surface (**Figure 3**). Dendritic spines form synaptic connections with other neurons, which can activate or inhibit the neuron. We suggest that some percentage of the dendritic spines have a *different purpose* rather than interneural connections, namely to *interface with the mind entity* to trigger action potentials.

Inhaled anesthetics, such as diethyl ether or isoflurane, provide evidence for how the mind entity operates with the brain. Inhaled anesthetics readily cause the loss of consciousness and, therefore, inhibit mental action.

Inhaled anesthetics also *alter the properties* of the cortical dendritic spines. Jimcy Platholi et al. (2014) showed that isoflurane rapidly reduced and shrank dendritic spines by dissolving the rigid structural microfilaments called F-actin. Inhaled anesthetics pass through the spine wall and unravel the spine's F-actin cytoskeleton. Isoflurane-induced spine shrinkage and loss are reversed when isoflurane is eliminated from the body.

Figure 7 shows the effects of isoflurane on dendritic spines *in vitro* (Platholi et al., 2014, p. 5). The normal spine structure is shown at the top. In the middle, with isoflurane at clinical concentrations, the spines have shrunk and collapsed. The bottom shows how these effects were reversed when the anesthetic was washed out and the cytoskeleton had reassembled. The F-actin concentration in the spines was calculated using a fluorescent dye for about 1,600 spines at the start of the anesthetic, at the start of washout, and the end of washout. When the disassembly of the F-actin was blocked with an actin filament stabilizer, the spines were not affected by the anesthetic.

F-actin filaments maintain the spine's shape and rigidity. They enable the movement of molecules and organelles within the spine. F-actin filaments are polymers of *actin* units strung together. Inhaled

anesthetics unravel these filaments, which are then reassembled when the anesthetic is removed.

Inhaled anesthetics cause dendritic spines to shrink by dissolving the cytoskeleton and also cause loss of consciousness. We suggest that these two facts are related. We suggest that the loss of consciousness is *due to* the collapse of the dendritic spine structure, which must inhibit the mind entity from triggering the action potentials needed to bring mental content to awareness. Thus, we propose that *the interface for the mind entity to trigger action potentials is located in the cortical dendritic spines and requires the presence of F-actin filaments.*

The Mechanism of Mind-Induced Action Potentials

Dendritic Spines and Neuron-Neuron Excitation. Dendritic spines were first identified by Santiago Ramón y Cajal (1888) as the contact points between neurons. One role of the dendritic spine is *neuron-neuron excitation*. An impulse from another neuron through its axon causes the release of neurotransmitters in the synaptic connection with the spine.

The neurotransmitters open ion channels to allow calcium ions (Ca^{2+}) from outside the dendrite to enter the spine. The voltage in the spine increases, which causes a significant release of additional Ca^{2+} from a compartment in the spine called the *spine apparatus* (SA), which is an extension of the cell's endoplasmic reticulum. The excess Ca^{2+} ions flow out of the spine into the dendrite and to the neural cell body, or soma.

Positive impulses from multiple dendritic spines can initiate a similar process in the soma's *initial axon segment*—the axon hillock—to release a large amount of Ca^{2+} from a larger compartment called the *cisternal organelle*, leading to a full action potential. The process in the cisternal organelle in the axon hillock resembles that of the spine apparatus (Falahati et al., 2022; Maciąg et al., 2024). The voltage at the hillock increases to a tipping point, which causes the full release of Ca^{2+} ions from the organelle, triggering the action potential—the firing of the neuron.

During the action potential, calcium ions propagate from the soma back through the dendritic arbor (**Figure 6**), refilling calcium stores in the spines (Johanning et al., 2015; Yuste & Denk, 1995). Ion channels, called SERCA in the SA, pump the excess Ca^{2+} ions back into the SA compartment (Garaschuk, 1997), and the entire neuron returns to its resting state.

Dendritic Spines and Mind-Neuron Excitation. We suggest that some dendritic spines have another function wherein the *mind* triggers cortical action potentials. The mind entity can exert a slight force against *F-actin filaments* connected to the spine apparatus, which *mechanically* triggers the release of SA Ca^{2+} stores. Slight movements of the F-actin filaments trigger ryanodine receptor ion channels (RyR3) on the SA to open and release the Ca^{2+} stores.

The elements of our proposed mind-interface mechanism have been identified in recent years. The main elements are:

- *Synaptopodin* (SP) is a protein embedded in the spine apparatus. SP is present in ~30% of large dendritic spines *in vivo* and *in vitro*. SP has long been identified as an important source of Ca^{2+} released from the SA and regulates Ca^{2+} dynamics within spines (Wu et al., 2024).
- RyR3 is considered a key player in the release of Ca^{2+} from internal SA stores. The presence of SP is strongly correlated with the presence of RyR3. In most cases, the SP protein and the RyR3 channel were found *adjacent to and touching each other* within the same spine (Vlachos et al., 2009).
- SP can also anchor structural *F-actin filaments*, which are dissolved by inhaled anesthetics, as mentioned earlier. SP has been shown to bind *actin* and *alpha-actinin-2* molecules, which then grow F-actin microfilaments. The F-actin filaments are linked specifically to the *surface* of the SA calcium stores via SP (Falahati et al., 2025; Vlachos et al., 2009).
- *Mechanical coupling* between the F-actin filament-synaptopodin combination and the adjacent RyR3 channel is possible, triggering the channel's opening. A similar mechanism was hypothesized for calcium release in skeletal muscle contractions, whereby conformational changes in a calcium channel are transmitted *mechanically* to the RyR3, triggering its opening (Woll & Van Petegem, 2022, p. 246). The conformational flexibility of the RyR3 structure implies the possibility of a "long-range allosteric gating mechanism" that could trigger the release of Ca^{2+} ions (Bai et al., 2016).
- From our analysis of the mind entity's interaction with solid matter, we suggest that the mind entity can *exert sufficient force* against the F-actin filaments in the spine to transmit a mechanical force through the SP molecule to the adjacent RyR3 channel to trigger its opening. F-actin filaments are rigid and are typically 6–7 nanometers (nm) in diameter and up to several hundred nm in length (Cooper, 2000, chapter 11). A 200 nm filament would be 30 times longer than its diameter. The force of the mind entity's interaction against the filaments would be multiplied by *mechanical advantage* and transmitted to the SP molecule. The force needed to trigger calcium release is probably comparable to the *subtle resistance* NDErs report when passing through solid matter.

- * *Sarcoplasmic-endoplasmic reticulum Ca^{2+} -ATPase (SERCA)* is an ATP-driven enzyme pump. After the action potential, the Ca^{2+} in the spine is replenished, and multiple SERCA pumps transfer Ca^{2+} from the spine's intracellular fluid into the SA (Garaschuk et al., 1997).

Figure 8 summarizes the main mind-interface spine elements.

The Mind Interface in Dendritic Spines. We suggest that *mind-interface spines* are the intersection point of the mind with the brain. They probably *do not* include synaptic ion channels or form synaptic connections with other neurons. The mind entity triggers the mind-interface spines to release stored calcium ions into the dendrite, which then triggers an action potential. To activate neural activity in a brain region, the mind entity impresses its field into the region's gray matter. In each spine, the mind entity's force against the filaments moves SP molecules against their adjacent RyR3 channels, as depicted in **Figure 9**.

Figure 9 shows a schematic of a dendritic spine with its spine head and spine neck, connected to its dendrite. The SA contains stores of positively charged calcium ions, with its surface covered with RyR3 ion channels paired with SP molecules, each of which supports an F-actin filament. The mind entity's force passes through the brain region and affects the filaments in numerous dendritic spines in the pyramidal neurons in the region.

The SP molecules fit in one or more of the four clefts in the RyR3 molecule viewed from above, as depicted in **Figure 10**. The rotating force or torque of the SP movement, magnified by the rigid filament's mechanical advantage on the SP molecule, triggers the necessary conformational change in RyR3 to open the channel.

Figure 10 depicts the molecular surface representation of a ryanodine 2 (RyR2) receptor, similar to an RyR3 receptor, showing tetrameric composition and a calcium channel in the center. The pore domain—visible red portion—is embedded in the membrane of the sarcoplasmic or endoplasmic reticulum.

The *ideal mechanical advantage* of the torque on the connection point of the F-actin filament and SP protein is $\frac{1}{2}$ the filament length divided by $\frac{1}{2}$ the diameter of the SP molecule. This configuration assumes that the SP molecule connects the RyR3 channel at an activation point that causes a conformational change and opens the Ca^{2+} channel. The average length of F-actin filaments on the spine apparatus is 200 nm (Koskinen & Hotulainen, 2014, p. 2). The diameter of the SP molecule is 66 nm (Wang et al., 2016, p. 5). Therefore, a conserva-

tive estimate of the ideal mechanical advantage is $100 \text{ nm} / 33 \text{ nm} = 3$. Thus, the torque on the RyR3 channel is roughly 3 times the force on the F-actin filament.

The mind entity's force on the filaments transfers to the SP molecules, causing a conformational change in the RyR3 channels, which releases Ca^{2+} ions into the dendrite. (**Figure 11**).

Enough dendritic spikes then initiate an action potential in the soma. The resulting action potential, in turn, causes an influx of calcium ions back through the dendrites and into the spines (**Figure 6**). The calcium ions are stored again in the SA, resetting the neuron for further action potentials.

The mind entity does not act on individual spines but on segments of a brain region, probably on the order of a cortical column, about 0.5 mm in diameter (Mountcastle, 1957). Approximately 80 minicolumns make up a cortical column. A cortical column consists of subunits called minicolumns, each consisting of about 100 neurons. In activating a cortical column, the mind entity would activate countless dendritic spines (**Figure 12**). Ca^{2+} ions released from countless spines generate widespread action potentials in the brain region, which the mind detects as a surge of neural activity in the region.

The activation of specific brain regions brings certain mental content into awareness (**Figures 4 & 5**). Neural activity "mirrors" this content to the mind, which then becomes conscious of it. Similar calcium-driven mechanisms with RyR calcium release are well understood and operate throughout the body in regulating "excitation-contraction coupling" in heart contractions and in skeletal muscle contractions.

Validating Evidence of the Mind-to-Spine Interface

Higher Density of Dendritic Spines in Brain Regions Involving Mind Activations

In the mind entity theory, the mind activates most cortical regions, such as those devoted to perceptual processing, semantic tasks, and the "default network." The main exceptions are the primary sensory regions for sight, hearing, and touch. Because the primary sensory areas are *purely input modalities*, the mind does not activate these areas but may increase or decrease their excitability to focus attention.

These points suggest that there should be *more dendritic spines* in the temporal and frontal cortical lobes compared to the primary sensory regions. This prediction was validated by studies shown in Ta-

Table 3 *Number of Dendritic Spines in Human Layer III Pyramidal Neurons, Comparing Occipital Lobe vs. Temporal and Frontal Lobes*

Brain region	Designation	Spines per Layer III pyramidal neuron	Reference
Occipital	V2	2,400	Elston et al. (2001)
Ventral temporal	Brodmann 20	10,000	Benavides-Piccione et al. (2024)
Inferior temporal	Brodmann 21	12,700	Elston et al. (2001)
Ventromedial infe- rior temporal	Brodmann 21	8,000	Benavides-Piccione et al. (2024)
Anterolateral middle temporal (T2)	Brodmann 21	11,500	Benavides-Piccione et al. (2021)
Anterior cingulate	Brodmann 24	8,600	Benavides-Piccione et al. (2013)
Granular prefrontal/ anterior frontal	Brodmann 9/10	15,100	Elston et al. (2001)

ble 3, which shows the estimated number of spines in various regions of the visual cortex and specific Brodmann areas (Benavides-Piccione et al., 2013, 2021, 2024; Elston et al., 2001).

In the human brain, the dendritic spine densities are significantly higher in the temporal and frontal lobes compared to the occipital lobe. The ratios are considerable: as much as six times more in prefrontal areas and five times more in the temporal lobe. Overall, there are three to six times as many dendritic spines in temporal and frontal brain regions as in the primary occipital area. We would expect this relationship to apply to all cognitive regions compared to primary sensory areas, to enable the mind entity to induce neural activity for cognitive faculties.

In Guy Elston et al.’s (2001) study, a similar result was found for macaques and marmosets as well as humans (**Figure 13**). Dendritic spines in the prefrontal cortex of humans (15,138) and temporal lobes (12,700) are considerably more numerous than those in the occipital lobe (2,417).

Improvement of Cognitive Performance With Caffeine

In the mind entity theory, the mind entity impresses its field into a brain region’s gray matter. The mind exerts a subtle force on the den-

dritic spines to release Ca^{2+} ions through the RyR channels, triggering action potentials in the region. The mind's exertion of force is felt subjectively as mental effort. The neural activations in the region bring the mind's mental content to awareness.

The presence of certain substances in the brain can enhance or inhibit the process of neural activation. These differences are felt subjectively as either increased or diminished mental responsiveness and acuity, which can be explained physiologically by alterations of the efficiency of the proposed mind-brain mechanism.

At normal doses, *caffeine* generally improves reaction time, wakefulness, concentration, and motor coordination (Nehlig, 2010). Caffeine binds *within* the RyR channel's molecular structure and *lowers the energetic barrier* toward channel opening (Woll & Petegem, 2022, p. 231). The presence of caffeine thus facilitates channel opening.

Within the mind entity framework, caffeine reduces the energetic threshold for RyR channel opening, thereby enabling the mind to initiate action potentials more efficiently. The mind-neuron mechanism with caffeine *more readily facilitates* the conscious emergence of mental content. This framework explains the increased excitatory effect of caffeine on conscious experience.

Impairment of Cognitive Performance With Lead Poisoning

Lead ion (Pb^{2+}) exposure has an opposite effect to caffeine. Lead exposure is linked to cognitive impairment, long-term reduction of IQ, executive function alterations, and fine motor control perturbations. Increased blood lead levels in children have been correlated with decreases in intelligence, nonverbal reasoning, short-term memory, attention, and reading and arithmetic ability. The effect of lead on children's cognitive abilities takes place at very low levels. The magnitude of these effects depends on the level of toxicity exposure (Cleveland et al. 2008; Ortega et al., 2021).

Both Pb and Ca are chemically similar, divalent metals. Pb^{2+} ions have a slightly larger ionic diameter (0.240 nm) versus Ca^{2+} ions (0.212 nm). "Moreover, the transport mechanisms of the two metals are similar. Therefore, Pb^{2+} can simulate Ca^{2+} signaling, disturb Ca-dependent biological processes, and result in intracellular Ca disorders" (Zhou et al., 2020).

The mechanism of lead-induced neurodegeneration is not well understood. However, the effects of Pb^{2+} in neurons have been experimen-

tally observed in rat brain tissue exposed to varying doses of Pb^{2+} in the neural developmental and neurodegeneration stages, both *in vitro* and *in vivo* (Zhou et al., 2020). There was a *sustained increase in the number of RyR channels* and an *increase in the Ca^{2+} levels in the intracellular fluid* (outside the SA).

The precise effect of the substitution of Ca^{2+} ions with Pb^{2+} ions is not clear. However, the two observed experimental effects would significantly interfere with the ability of the mind to initiate action potentials in the mind entity framework. Thus, the presence of Pb^{2+} in dendritic spines would inhibit the mind-neuron mechanism and would reduce or eliminate the conscious emergence of mental content. This framework explains the increased inhibitory effect of lead poisoning in conscious experience, with increased lead toxicity resulting in increased cognitive impairment.

Functional Relationships of the Mind Entity to the Brain

Delayed Awareness and Subliminality – Benjamin Libet

Benjamin Libet uncovered the relationship between neural activation and conscious awareness. His experiments from 1964 to 1993 demonstrated that a stimulus requires a certain minimum intensity and duration in order to be consciously perceived; otherwise, it remains unconscious—or *subliminal*. When the stimulus meets or surpasses the *liminal* threshold, conscious awareness typically arises after 300 to 500 milliseconds of neural activity. Libet (2004) referred to this phenomenon as the *time-on principle*.

Responses can happen within 100 msec, such as braking a car when a child appears suddenly in the street. If neural activity is under 300 msec, the stimulus stays subliminal, does not reach conscious awareness, but is still *detected* by the mind such that the driver instinctively avoids hitting the child. The driver then becomes aware that the child had run into the road.

Libet distinguished between *detection* and conscious awareness: “All quick behavioral, motor responses to a sensory signal are performed unconsciously. These are responses that can be made within 100–200 msec after the signal, well before awareness of the signal could be expected.” For example, a baseball batter has only 250 msec to decide whether and how to swing at a 90-miles-per-hour pitch. The recognition of the ball’s trajectory and the decision to swing are *initially* unconscious (Libet, 2004, pp. 109–111).

Libet's experiments indicated that the delay of awareness applies to all sensations, as well as to *endogenous mental processes*, such as thoughts, volition, planning, daydreaming, and imaginations.

Unconscious mental functions can proceed at a higher speed, if they are carried out by shorter-lasting neuronal activities . . . [T]he effective time-on for neural activities in unconscious functions can be very short indeed—about 100 msec or less. This implies that the series of unconscious processes involved in solving a problem can proceed speedily, each brief process after another. (Libet, 2004, p. 111)

After sufficient duration, the unconscious mental content becomes conscious. In our view, *the primary function of neural activations is to make mental content conscious.*

Coming to Awareness (“Ignition”) – Stanislas Dehaene et al.

In a series of experiments, Stanislas Dehaene et al. (2001) observed clear differences between subliminal and consciously perceived stimuli. A visual word that is flashed for only 30 msec remains readable. However, when the word is presented immediately followed by a “masking” image, the word becomes indistinct or even invisible. This perceptual phenomenon is called masking and occurs regardless of the stimulus modality—visual or auditory—or the method used to manipulate consciousness, such as masking, reduced visibility, or inattention (Mashour et al., 2020, p. 779).

The most significant difference between masked and unmasked words was the presence of increased neural activity, measured by both EEG and functional magnetic resonance imaging (fMRI), at *distant* parietal, prefrontal, and cingulate sites, only when the words were visible—unmasked. In effect, “unmasking the words enabled the propagation of activation and the ignition of a large-scale correlated cerebral assembly” (Dehaene et al., 2001, p. 757).

Ignition is characterized by the sudden, coherent, and exclusive activation of brain regions “coding” for the specific conscious content, while other brain regions are inhibited. Ignition is accompanied by synchronous amplification of the primary perceptual area and by long-range thalamocortical gamma synchrony (20–100 Hz; Dehaene et al., 2003, p. 8525).

In our framework, ignition is what we call the “process of coming to awareness.” In our view, the brain regions “coded” for specific content

are *activated by the mind* in the specific regions for that content. Such cases of “coding” are further examples of the cortex’s modular organization for distinct types of cognitive information. Masking a visual word stimulus immediately after the word is shown prevents the mind from *fully* activating the fusiform Visual Word Form Area needed to bring *recognition* of the word form to awareness. Dehaene et al. (2001, **Figure 2**, middle, p. 755) showed that the activation reached only 8% of the full intensity of the unmasked case, yet fMRI image showed clearly that the fusiform activation had begun, even in the masked case. The presentation of the mask interrupts the mind’s process of coming to awareness, and the word recognition remains subliminal.

Ignition may be triggered by an external stimulus, as part of a cognitive task, or may occur spontaneously. In our view, spontaneous ignition nearly always occurs by the *endogenous willed activity of the mind*, enabling the mind to continuously activate mental representations in an endogenous manner.

In our view, the observed long-range gamma synchrony in the ignition of a large-scale correlated cerebral assembly most likely occurs to focus attention on the mental content that has come to awareness. We propose that attentional focus is one of the main purposes of gamma synchronization. Because the mind is unitary, when mental content reaches conscious awareness, there is no need for the content to be “globally accessed” by further neural assemblies, as Dehaene and colleagues proposed.

Long-Distance Synchrony – Francisco Varela

Neuroscientist Francisco Varela (1996) introduced *neurophenomenology*, a research method that gives “an explicit and central role to first-person accounts and to the irreducible nature of experience.” With this method, he sought to correlate participants’ *subjective* experiences and their corresponding *observed neural activity*. In applying neurophenomenology to a specific cognitive task, Varela and colleagues demonstrated a striking correlation between research participants’ neural electrical activity and their subjective experiences (Lutz et al., 2002; Lutz & Thompson, 2003).

Participants first received extensive training in a task that used three-dimensional autostereoscopic images to improve their perceptual discrimination. They became familiar with the images and the variations in their mental processes during the task as the 3D image emerged. After training, participants completed trials with EEG re-

cording and immediately gave verbal reports of their experience. They labelled each trial using their own “phenomenal categories” identified during the training period, such as, “Steady Readiness” to indicate focused attention or “Spontaneous Unreadiness” to indicate mind wandering. The result for each trial was the subject’s introspective report and the corresponding EEG recording (Lutz & Thompson, 2003).

The EEG recordings matched the subjects’ self-reports. During Steady Readiness, one subject reported being prepared for the stimulus, with a sense of continuity when the stimulus occurred and the impression of fusion between himself and the percept. The corresponding EEG showed strong frontal inter-hemisphere gamma band synchrony (30–70 Hz) prior to the stimulus and intensified frontal inter-hemisphere synchrony as the image appeared. At 273 msec, the subject indicated the image was seen (**Figure 14**, upper series).

During Spontaneous Unreadiness, the same subject reported being distracted and unprepared for the stimulus. When the stimulus occurred, there was a strong sense of discontinuity in his mental states and a clear impression of differentiation between himself and the percept. The corresponding EEG showed no phase-synchrony prior to the stimulus. When the stimulus occurred, only a weak pattern of synchronization and massive desynchronization between frontal and posterior lobes appeared, followed by a weaker, delayed frontal inter-hemisphere synchrony. At 520 msec, the subject indicated the image was seen (**Figure 14**, lower series).

The precise form of the subjects’ phenomenal categories varied widely. For example, a third category, “Fragmented Readiness,” was identified with sub-variations for the preparation period. The subject was less ‘sharply’ prepared—due to tiredness, was less ‘focally’ prepared—due to distractions or discursive thoughts, or was prepared with ‘open attention’ without ‘active preparation.’

Thus, the four participants in the study demonstrated three major phenomenal categories with individual variations. Not surprisingly, the precise form, frequency, and time course of the EEG synchrony patterns during the preparation period also varied widely between participants. However, *within individual participants*, the distinct dynamical neural signatures remained stable throughout several recording sessions over several days.

In our view, the Antoine Lutz et al. study demonstrates that the mind’s activity can be studied both with objective measurements and with introspection of a participant’s experiences in the experimental

setting. The uniqueness of the mind's activity in each trial is reflected in the brain's neural signature. Its unique neural signature shows the consistent signature of a subject's cognitive strategy or aptitude to perform the perceptual task. The mind's idiosyncratic activity appears as idiosyncratic *neural activity*, which strongly suggests that the mind *drives* the brain's activity. In our view, the mind's activity is the *crucial determinant* of the experimental result.

Steps of Cognition in Perception – Marta Kutas & Kara Federmeier

Distinct Cognitive Steps in Perception

Distinctive patterns of event-related potentials (ERPs) show that the mind entity proceeds in distinct sequential steps over time and in distinct brain regions during perception and comprehension. The paradigmatic expression of this phenomenon is the N400 phenomenon (Kutas & Federmeier, 2011).

A 2004 study by Peter Hagoort et al. provides an excellent example. When a Dutch participant read a word in a sentence, the ERP recorded the process of (a) detecting the *percept* of the word, (b) comprehending the word's *meaning*, and (c) evaluating the word in the *preceding context* of the sentence. **Figure 15** shows the EEG traces for three target words—yellow, white, and sour—when read in the context of “The Dutch trains are . . .”. In fact, Dutch people's world knowledge is that Dutch trains are yellow. With “yellow” as the target word, there is a normal-sized peak at 400 msec. If the target word is “white” or “sour,” there is an elevated peak at 400 msec, the N400 effect, indicating a cognitive response to the incongruity.

- At 115 msec, the N1 negative voltage-peak was associated with the participant detecting the target word *percept*—the *form* of the word.
- At 200 msec, the P2 positive voltage-peak was associated with the participant detecting the *meaning* of the word, the meaning or concept of “yellow,” namely, a bright, warm color.
- At 400 msec, the minus voltage peak was associated with awareness of how *congruent* or *incongruent* the word was in context. Because *yellow* was congruent, the trace followed the typical neural pattern of the black line.
- When the target word changed to *white* or *sour*, there was a large peak at N400, because *white* was incongruent—a world knowledge violation, and *sour* was anomalous—a semantic violation.

When someone reads words in a sentence, *the earlier words establish the context*. When a participant read an *incongruent* word in a sentence, there was an unusual, strong minus voltage peaking at 400 msec (called N400). There was an immediate, precise neural reaction to the word depending on the prior context. In some cases, the context had been established many sentences prior to the target word (Nieuwland & Van Berkum, 2006). In addition, the N400 has tracked closely with the degree of abnormality of the word, measured in a separate norming exercise (Kutas & Federmeier, 2011). These results strongly suggest that the mind (a) retains the broader context of a paragraph of text and evaluates each new word relative to the broader context and (b) *accurately* evaluates the *degree of fitness* of the word relative to its context.

In the mind entity framework, the mind activates the specific brain regions for that cognitive function. The neural activations in these regions bring the mind's mental content to subjective awareness. In our view, the mind is engaged throughout this process. Thus, word perception and comprehension proceed in three distinct stages in time:

- *Detect* the form of the word,
- *Recognize* the meaning of the word, and
- *Evaluate* the word's meaning *in the current context*,
as the word comes to awareness.

All Perceptions Interpreted in a Conceptual Context

In our view, *all perception occurs within a context*, whether the context is explicit, implied, or must be guessed by the subject. The analysis of a percept's meaning in context, such as a word's meaning in its textual context, is complex and nuanced. For example, Edward Kelly and Philip Stone (1975) pointed to the *active contribution* of the subject to comprehension by "filling in" when the text is incomplete or grammatically "degenerate" (p. 70). Kelly and Stone also pointed to the use of metaphor, which requires the subject to construe a concept in a novel way—a "shift of realm"—when it is used metaphorically (pp. 74–75). Mante Nieuwland & Jos Van Berkum (2006) gave the example of a story about a peanut singing a song about his new girlfriend: "The peanut was *in love*." In the context of a peanut with a new girlfriend, the peanut being *in love* makes sense. Saying, "The peanut was *salted*" in this context would be completely incongruent.

We believe this principle applies generally to all perceptions: *Cognitively, all perception has a conceptual content that is interpreted in*

a context. The mind must interpret sensory stimuli within a context. The contextual interpretation serves to complete the perception, for example, by filling in sensory gaps by contextual interpretation in optical illusions, as in the checker shadow illusion depicted in **Figure 16**, or by adjusting perspective in the rabbit-duck illusion and the Necker cube, depicted in **Figure 17**.

In the checker shadow illusion (**Figure 16**), the left image shows a checkerboard in which some of the light and dark squares are in a shadow. Area A is seen as a dark square in full light. Area B is seen, *within the context of the shadow*, as a white square in a shadow. In the right image, areas A and B are depicted with identical brightness, but, because of the shadow, B appears lighter than A. Rather than showing how easily our perceptions are tricked, this case demonstrates how automatically we humans adjust perception given the context of a shadow. From the moment of birth, we are shown thousands of cases every day of objects in shadows and in full light, such that the perception of an object in a shadow is recognized immediately. In the present framework, the interpretation of a visual perception *in its broader context* occurs in the third step of perception, percept–concept–context.

The images in **Figure 17** illustrate how ambiguous images change meaning or orientation *depending on a selected perspective*. The left image can be seen as either a rabbit or a duck. Most people can switch perspective readily by focusing attention on only one part of the image and changing the perspective based on that part. For example, focusing on the left side of the image, that part can be *seen as* a beak, such that the whole picture is *seen as* a duck. Similarly, focusing on that same area, it can be *seen as* long ears extending up to the left, such that the whole picture is *seen as* a rabbit. The right image of a transparent three-dimensional cube, a Necker cube, can be seen, *as if looking up through the bottom*, as a cube with the closest face pointing up to the right. From the perspective of *looking down from the top*, the closest face points down to the left.

The mind's active selection of the perspective in perceptual cognition is a clear demonstration of the element of *will in perception*. We believe that the will is exerted by the mind in many cases of “filling in” the gaps of normal sensory perception.

Pauses Between Cognitive Steps in Perception

Magnetoencephalography (MEG) provides the precise brain regions, as well as the timing, involved in reading words. MEG is similar to EEG

but measures the magnetic fields produced by the brain regions rather than the electrical fields.

Riita Hari and Riita Salmelin (2012) measured the cortical dynamics of silent reading using MEG and found the same three stages as shown in the EEG study by Hagoort et al. (2004). The last MEG stage was designated “N400m” to distinguish it from the corresponding EEG N400 measurement.

Figure 18 shows their results. We have arranged the tracings of MEG activation to line up the temporal course of the measurements. The tracings show the same three steps, to detect the *form* of the word—at 115 msec, to recognize the *meaning* of the word—at 165 msec, and to evaluate the word’s meaning in the current *context*—at 400 msec.

We noted that there are two distinct pauses: pause A—between steps 1 and 2, and pause B—between steps 2 and 3. The pauses start *after* the peak of activation in one region, when the neural activity begins to subside, and end when activation starts in the following region.

- **Pause A:** We note that there is a brief pause between the peak in the occipital region at 115 msec, as the neural activity subsides and *before* the neural activation in the next region, the left inferior occipitotemporal cortex, begins.
 - In this gap, we propose that the mind recognizes the percept as the form of a word, intuits its *meaning*, and activates the next regions, the “visual word form area” and related language regions, to bring the *meaning* of the word to awareness.
 - The neural activity in these regions begins, and at 165 msec, the mind *becomes aware* of the meaning of the word.
- **Pause B:** We note that there is a second brief pause between the peak in the left inferior occipitotemporal cortex at 165 msec, as the neural activity subsides and *before* the neural activation in the next region, the left superior temporal cortex, begins.
 - In this gap, we propose that the mind recognizes the concept of the word and evaluates the *congruity or incongruity* of the word in the *context* of the sentence. The mind activates the next regions to bring the *revised context* of the sentence to awareness.
 - The neural activity in these regions begins, and at 400 msec, the mind *becomes aware* of the meaning of the word and the revised context.

The brief pauses between the cognitive steps in perception are relevant because there is no apparent neural activity between the steps that would warrant a *neural basis* for steps from percept to concept to revised context. However, *the mind’s internal activity* between the

steps is the mental basis for the additional mental content. The mind *actively develops* the internal mental content that appears as neural activity *in the next stage*.

Further Elaboration of the Process of Coming to Awareness (“Mirroring”)

A major feature of the mind entity framework is that mental content *comes to awareness* in the mind when different brain regions are activated. Coming to awareness, or *ignition*, is characterized by the sudden, coherent activation of specific brain regions that “code” for the specific conscious content, while other brain regions are inhibited.

To review, from empirical NDE evidence, we have shown that all conceptual content resides in the mind and is received through *intuition*, that is, direct mental apprehension. The Libet and Dehaene studies show that **the embodied mind requires a certain level of neural activation to become aware of its own mental content**. Therefore, the sequence must be (a) the subliminal mental content triggers (b) the brain electrical activity, which causes (c) the mental content to come to awareness. In the embodied state, the mind must work *through the brain* to come to awareness. In contrast, NDErs *who are out of body* experience greatly enhanced cognition because their mind is freed from the constraint of working through the brain.

Proceeding from these premises, we envision that the mind entity’s three-dimensional field is *coextensive* with the brain’s entire cortical surface, including sulci. The mind does not stand apart from the brain but, rather, merges with every part of the cortex. It can induce action potentials in specific locations and can detect their activations.

The mechanism we propose is that the mind entity triggers neural activation, causing back propagation of positive charges in an ensemble of neurons in the specific brain region specialized for a given type of mental content. The mind entity *detects the simultaneous coherent spiking* of numerous neurons in specialized brain regions of the cortex, bringing specific mental content to awareness, based on the earlier principle that a moving or oscillating electrical charge within the mind entity’s field results in awareness in the mind.

We are not suggesting that the mental content is somehow “encoded” in the neural activation or that there is some kind of transfer of the information to the neurons. We suggest that the activations in the specialized region, for example, the visual word form area (VWFA), will be nearly the same in intensity and size *regardless of the specific*

word perceived. Therefore, there is no distinct encoding for each word in the VWFA. The neural activation simply brings the mind's concept of the specific word's meaning to awareness. *The meaning is in the mind, not in the brain.*

Rather, we propose that neural activation in the region *mirrors* the mind's mental content *back to itself*. The neural activation *illuminates* the mind's *current mental content* so that the mind can become aware of it.

As an analogy, physical embodiment is like being imprisoned in darkness. In a completely dark room, a person can stand in front of a mirror but will not see the message written on their exposed forehead. However, if they shine a flashlight *at the mirror*, the reflected light will illuminate their forehead so they can read the message. Similarly, when the mind has a thought, it must activate neural activity in a brain region so the activity can *illuminate* the mind's thought.

Figure 19 depicts the process of coming to awareness in more detail: The mind first receives the intuition of some mental content—for example, the meaning of a word, the yellow arrow, and activates the brain module associated with that type of concept—the red arrow. The neural activation in that module acts as a *mirror* to illuminate that mental content in the mind. Finally, the conceptual content comes to awareness—the orange arrow.

Rudolf Steiner (1914) had a similar intuition about the mind coming to awareness. Steiner (1861–1925) was an Austrian philosopher, scientist, and clairvoyant who worked introspectively. In his 1914 lecture, his description of how the mind's activity comes to awareness matches the mind-entity framework. Here we substitute the updated terminology of “neuron” for Steiner's term, “atomistic portions of the brain:”

The uncompromising materialist of our day finds it suits his purpose to say that the brain forms the thought—more exactly, that the central nervous system forms the thought. For anyone who sees through things, this is about as true as to say when one looks into a mirror that the mirror has “made” the face. In fact, the face is outside the mirror; the mirror only reflects the face, throws it back. The experience a man has of his thoughts is quite similar. . . .

The actual perceiving of a thought is preceded by a thinking activity that works upon the brain. . . . You yourself are the agent who makes the brain into a mirror. What you finally perceive as thoughts are the reflections, the mirror-pictures—what you first have to prepare, so that the right reflection may appear is some part or other of the brain. You, with your soul-activity, are the very thing that gives the brain the form and capacity for reflecting your thinking as thoughts. . . .

Human thinking-activity first lays hold of the brain . . . and sets in motion [neural activity]; by this means the [neurons] become a mirror-apparatus. The *thought* is reflected, and the soul becomes conscious of the *thought*. Thus, there are two phases: first [the mind's] work on the brain . . . in preparation of the external experience; then after [the mind's] work on the brain has prepared the ground for the act of perceiving by the soul, the [awareness] takes place.

Ordinarily, this preparatory work on the brain remains entirely unconscious What I have now explained happens continually to a person between waking up and going to sleep. (Steiner, 1914, para. 11–14)

A New Neuroscientific Framework of Consciousness

Other Modes of Neuronal Function

Given the scope of the mind entity framework and its focus on the mind's interface with cortical pyramidal neurons, it is important to mention the mind's interaction with other neural types, the mind's interaction with psychedelics, and neural function in non-human species.

The general rule is that the mind entity interface is an *excitatory interface* working through the *dendritic spine mechanism*, as outlined above, involving (a) a calcium store located in the spine smooth endoplasmic reticulum (SER), (b) ryanodine receptors (RyR1, RyR2, or RyR3) on the SER, (c) F-actin filaments that can trigger the RyRs to open, and (d) a SERCA pump of some type to restore Ca^{2+} ions in the calcium store. We believe this spine mechanism occurs generally across many neural types in addition to pyramidal neurons and across many different animal species.

We can touch on these topics only briefly here but will address them more fully in subsequent papers.

Inhibitory Interneurons

Inhibitory interneurons are primarily triggered by excitatory neurons and act as a feedback or feedforward system of specific brain regions. Interneurons do not have spines, so there is no direct mind interface. However, when the mind activates one brain area, axons from that area can trigger inhibitory interneurons in other areas.

Using this mechanism, inhibitory interneurons regulate neural circuit activity by controlling excitability, maintaining excitation-inhibition balance, and sharpening temporal precision action potentials. Feedback control by interneuron inhibition is often reflected by

synchronous oscillations, for example, gamma rhythms. Interneuron networks provide rhythm-based timing between principal cells (Roux & Buzsáki, 2015, p. 14).

In the mind entity framework, long-distance interneuron network synchrony is initiated and maintained by the mind to focus attention through willed effort. Mind-induced excitation in one area simultaneously inhibits excitation in the distal area. Synchrony is achieved when the mind shifts excitation at regular intervals between the two areas. The paired regions come to awareness simultaneously. For an example of cross-hemisphere synchrony, see **Figure 14**, upper series.

Neuronal Function in Other Neural Types: The Cerebellum

The mechanism for mind-entity awareness does not specifically require cortical pyramidal neurons. The cerebellum has several different cell types, for example, Purkinje cells, mossy fibers, Golgi cells, and granule cells (Buckner, 2013), several of which contain numerous dendritic spines.

Mental functions such as motor coordination, language and cognitive patterns, habit patterns, emotional patterns, and other behavioral patterns are dependent on the cerebellum (Peterburs & Desmond, 2016). The patterns are learned through repetitive behaviors. Performance monitoring of behavioral effects is compared via feedback circuits resulting in performance adjustment and articulation, probably involving complex cerebrocerebellar feedforward and feedback circuits (Buckner, 2013).

In the present framework, the memory of motor and other behavioral patterns is formed in mind by repetition and is recalled from the mind when needed. The mind impresses the specific memory patterns on the appropriate cerebellar regions to instantiate the desired behavioral pattern.

Some animals display instinctual behavior patterns. The best examples of this are the species-unique mating behaviors of various birds. We propose that these instinctual behaviors are inherited from the mother via some mechanism associated with the developing embryo. The instinctual pattern is then expressed through the cerebellar structures in the offspring.

Neuronal Function in Non-Human Species: Avian Brains

In non-human species that do not have a cortex or pyramidal neurons yet are conscious beings, such as avian species, the mechanism in the dendritic spines is still present. The dendritic spine is the receiving part of neuron-to-neuron excitation. In avian species, the avian cerebellum is very spiny. We proposed above that the cerebellum is used in all species to receive the *memory of patterns of behavior*, which then drive the animal's behavior.

In addition, some avian studies (Airey et al., 2000) showed that the dendritic spine density in the high vocal center (HVC), which is part of the forebrain, increased significantly when juvenile Eastern marsh wrens were *song-tutored* during the early “sensitive period” after fledging and subsequently learned a larger number of song types: Out of a total of 45 song types, tutored birds displayed 40.5, whereas untutored juvenile birds displayed only 5.

The HVC is dedicated to perceiving, learning, and producing complex songs. In the present framework, the presence of more dendritic spines in the tutored wrens implies that dendritic spines are developed more readily in a rich learning environment because the mind's activity is focused more in the HVC with tutoring during the sensitive period. Subsequently, the mind demonstrates a greater facility in song production due to the increased spine density.

Neuronal Function Under the Influence of Hallucinogenic Psychedelics

Hallucinogenic psychedelics include psilocybin, dimethyltryptamine (DMT), mescaline, LSD, and ketamine. These substances produce hallucinogenic visual and other perceptual changes—with both eyes open and eyes closed, synesthesia, time distortions, ego loss, emotional changes, euphoria, heightened introspection, and mystical experiences. They bind to and activate serotonin 2A (5-HT_{2A}) receptors in the brain and thereby alter the neural activity involved with sensory perception and cognition.

In a classic study, Robin Carhart-Harris et al. (2012) showed that research participants who had been given psilocybin demonstrated a strong *negative* correlation between the intensity of subjective experiences and the neural activity in different brain regions. Neural activity *decreased* in “connector hub” regions, such as the thalamus and ante-

rior and posterior cingulate cortex. The magnitude of the neural *decrease* correlated with the *increased* intensity of the subjective effects. For each brain region measured, the *greater the decrease* in cerebral blood flow, the *more intense* were the subjective effects (p. 2139).

This result—*decreased* neural activity coupled with *increased* subjective experience—is counterintuitive, because, under normal circumstances, *increases* in neural activity in various regions is associated with specific conscious awareness. Carhart-Harris et al. attributed the decrease in neural activity to decreased *functional connectivity* (FC) between regions. However, there appears to be no evidence of a *cause* for the increased subjective experience in the *complete absence* of neural activity.

More recently, Joshua Siegel et al. (2024) performed a more comprehensive study of the effects of high-dose psilocybin compared with non-psychedelic methylphenidate (Ritalin). They found that psilocybin disrupted FC in the cortex and subcortical structures. The *reduction* in neural activity was three times greater than with methylphenidate. Individual differences in FC were strongly correlated with subjective psychedelic experience.

Siegel et al. also had psilocybin participants perform a simple auditory-visual matching task during the fMRI scan, matching an image and a coincident spoken phrase, judging whether the image and spoken phrase were congruent or incongruent. Participants performed the task with more than 80% accuracy during these sessions. Engagement in the task significantly *reduced* the size of psilocybin-associated network disruption and desynchronization. In other words, focusing on the perceptual task reduced the effect of the psilocybin and significantly *increased* neural activity. The task *reengaged* the neural activity necessary for the participants to do the task.

Performing a perceptual task is a “grounding” technique that reduces psilocybin-induced dissociation by shifting attention outward. Grounding techniques are widely applied in psychedelic psychotherapy to lessen intense or distressing thoughts and emotions.

In the present framework, the presence of *organized* electrical activity outside the primary sensory regions is the result of the mind entity activating the brain regions in order to bring perceptions and thoughts to awareness through the process of ignition. Ignition nearly always occurs by the *endogenous willed activity of the mind*, enabling the mind to continuously activate mental representations in an endogenous manner.

The serotonin 2A receptors are concentrated in Level 3 and Level 5

pyramidal neurons in the cortex, particularly in the frontal, parietal, temporal, occipital, and entorhinal areas (Zhang & Stackman, 2015). The action of psychedelics activating serotonin 2A receptors causes widespread decrease in FC and increased desynchronization, which *disables* the mind entity from bringing its mental content to awareness *through neural activation*. Instead, the mental content is apprehended *directly* and “richly” in the mind, similar to direct mental apprehension while out of body during an NDE.

In effect, the brain not only is not needed for subjective experience in these cases but actually appears to limit it. In hallucinogenic-induced dissociation, the mind is focused “inward” and has rich subjective experiences without neural activations. This model explains how introducing a perceptual task achieves “grounding.” In the task, the mind focuses on physical sensations and re-engages the effort to induce action potentials to bring the perceptions to awareness, *overcoming* the induced desynchronization.

With the mind entity’s neural activity blocked by the psychedelic, the mind will tend to partially dissociate from the brain. Sensory signals continue, and the dissociated mind experiences the associated perceptual and emotional changes, euphoria, and mystical experiences. In some instances, the dissociation can increase further and induce an out-of-body experience or a full-blown NDE; it is well known in NDE literature that psychedelics sometimes facilitate NDEs (Arnette, 1999; Liester, 2013; Sacks, 2012, pp. 101–102).

Shifts in the Neuroscientific Paradigm

The mind entity theory presents several significant shifts from the existing neuroscientific paradigm:

- **An additional source of empirical evidence:** With competing scientific paradigms, one needs to compare the theories against the available empirical evidence and facts. The mind entity framework includes new phenomenological evidence and facts, including the anomalous phenomena from NDEs, in addition to the traditional empirical neuroscientific evidence. The empirical evidence from NDE narratives can be regarded as *objectively real* such that researchers are justified in accepting NDE evidence as valid data for scientific study.
- **An additional ontological category:** Based on the NDE evidence, the mind entity framework has introduced an additional distinct ontological category, the *mind entity* or *soul*, which has philosophical validity as a form of substance dualism.

This philosophical stance contrasts with traditional physicalist neuroscience.

- **A change of conceptual framework:** A change of paradigm inevitably involves a change of conceptual framework and nomenclature (Kuhn, 1970, p. 149). The mind entity is the seat of consciousness. Brain processes do not generate consciousness; rather, neural activity *triggered by the mind* enables the mind to come to awareness. There are no neural calculations; there are no neural representations of mental content. There is no neural storage of short-term or long-term memories, declarative memories, episodic memories, or “working” memory.
- **An additional category of experimental data:** The mind entity theory favors the use of first-person experiential characterizations as empirical phenomenal data as used by Francisco Varela and colleagues, because the most accurate source of evidence of conscious awareness is a person’s actual account of conscious awareness. We believe this approach will be more fruitful than computer simulations and mathematical modeling (Mashour et al., 2020; Tononi et al., 2016).
- **A change of terminology:** The mind entity theory deals with the mind triggering action potentials in specialized brain regions and “detecting” neural activity via back propagation of action potentials, whereas neuroscience deals with neural processes performing “calculations” through synaptic connections on neural representations of mental content via feedforward and feedback cortical connectivity or recurrent loops.
- **Incommensurability** (Kuhn, 1970, p. 150): A new framework requires a *revision of interpretation* of neurological processes. Each framework needs to be evaluated from its own reference point. The entire conceptual web of the new paradigm must be “laid down again on nature whole” (Kuhn, 1970, p. 149). Therefore, one needs to compare the theories against the existing empirical and phenomenological facts, including anomalous phenomena such as NDEs. Which theory fits the facts better? Does the mind entity theory provide a better explanation for subjective phenomenal experience than physicalist neuroscience?

Philosophical Objections to Interactionist Dualism

Impossibility of Interactionist Dualism Due to Inability of Mind to Interact with Brain

Most philosophers and scientists reject interactionist dualist theories, such as the mind entity theory, because they believe it would be impossible for a nonmaterial mind to interact with a physical brain. Adherents to the predominant Western philosophical view, *physicalism*,

consider consciousness and the mind to be purely the result of physical brain processes.

Philosophers reject dualist theories because they are “obscure” and “mysterious.” Philosopher John Martin Fischer (2020) commented on nonphysical mechanisms of consciousness:

[I]t is mysterious how these [nonphysical mental] mechanisms are supposed to work, and, specifically, how they would interact with the physical world Causation implies a mechanism, understanding causation implies understanding the mechanism, and the mechanism of interaction across the physical and nonphysical realms is obscure—perhaps essentially so. (p. 151)

However, as we discussed previously, there is strong evidence that the out-of-body mind interacts with physical processes, giving rise to subjective phenomenal sensations in the NDER’s mind. In addition, there is evidence that a subtle, previously unrecognized two-way force is involved in mind-to-matter interactions.

Furthermore, the proposed mechanism for mind-brain interactions involves a point of contact for the mind to interface with the brain—in the dendritic spines of cortical pyramidal neurons—and a push-pull force acting on F-actin filaments at the mind-brain interface. The mind triggers neural action potentials by opening RyR3 ion channels in the spine apparatus to activate neurons in brain regions specific to its mental content. The resulting back propagation of action potentials brings the mind’s mental content to awareness.

Causal Pairing Problem

An important objection to interactionist dualism comes from the original description of the mind by René Descartes. For Descartes, the mind is an immaterial thing that does not exist in physical space and has no dimensions. The “pairing problem” objection (Kim, 2011, pp. 50–56) questions how a nonmaterial mind that exists outside physical space can causally interact with a physical object, such as a brain. Any causal interaction must occur in spatial relation to the physical object.

In contrast to Descartes’s theory, the mind entity theory holds that a nonmaterial mind is an extended three-dimensional object in physical space which fully merges and pairs with the physical brain and body. The mind and brain are located in intimate spatial relation to one another and exert direct causal interaction on each other. The mind entity theory thus addresses the objections posed by the “causal pairing problem.”

A natural consequence of the intimate causal pairing of the mind's interactions with neural processes is a *close correlation* between neural activity and mental states.

Causal Closure of the Physical

In philosophy, "physical causal closure" (Kim, 2011, pp. 214–217) is the principle that all physical states have purely physical causes or that physical effects have only physical causes. If one traces the "causal ancestry" of a physical event, one need never go outside the physical domain.

In our theory, the mind is nonmaterial but interacts with physical processes and thus takes part in physical causation. In particular, the mind interfaces with the brain at specific points of contact in the dendritic spines of pyramidal neurons at the surface of the cortex. A two-way push-pull force is involved in mind-to-matter interactions. The mind triggers neural action potentials by opening dendritic spine ion channels and senses the back propagation of action potentials. Therefore, the mind entity theory satisfies the "causal closure of the physical."

A skeptical philosopher can argue that the mind entity is not a physical entity; that is, it is not recognized by current physics theory. More specifically, the mind entity embodies mental properties, which are dubious as physical properties.

Throughout the history of modern science, new types of physical entities, their properties, and new physical forces have been accepted as existing based on empirical evidence of their existence. A relatively recent example is the addition of plasma as a fourth state of matter after solid, liquid, and gas (Langmuir, 1928). We propose that the mind entity is yet another example of such theoretical modification because there is ample empirical evidence, specifically the collective experience of hundreds of millions of people, that it objectively exists and has distinct properties.

Thus, we respond to skeptical philosophers that *the domain of physical reality, and specifically the domain of physics, need to be extended to include the existence of the mind entity as a distinct ontological category and its properties.*

Validation of Substance Dualism

Philosophers Rickabaugh and Moreland (2024) recognized that *causal explanations* of consciousness lie outside the purview of substance dualism as a *philosophical* ontological theory. Substance dualism, as an ontological theory, specifies only the features required for an entity to *possess* mental states.

However, Rickabaugh and Moreland suggested that a substance dualist research project could be undertaken to consider the *empirical research* on NDEs, which might provide causal explanations of consciousness. NDErs immediately experience themselves as disembodied selves, or I's. Although they appear invisible to others, they experience having a spatial location and point of view within the physical realm.

In this paper, we have presented a case based on the empirical evidence from NDEr reports that provides reasoned causal explanations for how conscious states can occur, based on the *mind entity*, a nonmaterial, spatially extended three-dimensional region of space, a "field of consciousness," which is the locus of awareness and self-awareness of a human being. In our view, the mind entity should be viewed more as an "entity" or "being" because it manifests as a *spiritual being* in the transcendent realm, similar to entities such as deceased relatives, guides, and angels that NDErs encounter, who have independent, autonomous agency. The mind entity is conscious and has a "field" of influence but is more precisely a self-actualized "being."

The features and properties of the mind entity fit the substance dualist list for a "thing that has mental states." Thus, the empirical evidence from NDEs shows that *the mind entity not only is metaphysically possible but also is metaphysically real and is a separate ontological category* distinct from the physical body and any other physical object.

Furthermore, in each of the above major sections of this paper, we have described a framework for embodied consciousness, for plausible mechanisms for mind-brain interactions, and for the functional relationships between the mind and brain. We summarized how the mind entity framework differs from the existing neuroscientific framework and responded to the main philosophical objections to interactionist dualism.

In our view, this work, based on NDE empirical phenomena, validates the philosophical stance of substance dualism.

References

- Abbott, E. A. (1884). *Flatland: A romance of many dimensions*. Retrieved from https://github.com/Ivesvdf/flatland/blob/master/oneside_a4.pdf
- Adelson, E. H. (2015). *Greysquareopticalillusionproof2* [Drawing]. Wikimedia Commons (Copyrighted free use). https://commons.wikimedia.org/wiki/File:Grey_square_optical_illusion_proof2.svg
- Adelson, E. H. (2018). *Thecheckershadowillusion* [Drawing]. Wikimedia Commons (CC BY-SA 4.0). https://commons.wikimedia.org/wiki/File:Checker_shadow_illusion.svg
- Airey, D. C., Kroodsmas, D. E., & DeVoogd, T. J. (2000). Differences in the complexity of song tutoring cause differences in the amount learned and in dendritic spine density in a songbird telencephalic song control nucleus. *Neurobiology of Learning and Memory*, 73(3), 274–281. <https://doi.org/10.1006/nlme.1999.3937>
- Anonymous. (1892). *Kaninchen und Ente* [Drawing]. Wikimedia Commons (Public domain). https://commons.wikimedia.org/wiki/File:Kaninchen_und_Ente.svg
- Arnette, J. K. (1981). Rotational relaxation of a dipole in two dimensions [Unpublished doctoral dissertation]. Florida State University.
- Arnette, J. K. (1992). On the mind/body problem: The theory of essence. *Journal of Near-Death Studies*, 11(1), 5–18. <https://doi.org/10.17514/JNDS-1992-11-1-p5-18>
- Arnette, J. K. (1995). The theory of essence. II. An electromagnetic-quantum mechanical model of interactionism. *Journal of Near-Death Studies*, 14(2), 77–99. <https://doi.org/10.17514/JNDS-1995-14-2-p77-99>
- Arnette, J. K. (1999). The theory of essence. III: Neuroanatomical and neurophysiological aspects of interactionism. *Journal of Near-Death Studies*, 18(2), 73–101. <https://doi.org/10.17514/JNDS-1999-18-2-p73-101>
- Arsalidou, M., & Taylor, M. J. (2011). Is $2+2=4$? Meta-analyses of brain areas needed for numbers and calculations. *Neuroimage*, 54(3), 2382–2393. <https://doi.org/10.1016/j.neuroimage.2010.10.009>
- Bai, X. C., Yan, Z., Wu, J., Li, Z., & Yan, N. (2016). The central domain of RyR1 is the transducer for long-range allosteric gating of channel opening. *Cell Research*, 26(9), 995–1006. <https://doi.org/10.1038/cr.2016.89>
- Benavides-Piccione, R., Fernaud-Espinosa, I., Robles, V., Yuste, R., & DeFelipe, J. (2013). Age-based comparison of human dendritic spine structure using complete three-dimensional reconstructions. *Cerebral Cortex*, 23(8), 1798–1810. <https://doi.org/10.1093/cercor/bhs154>
- Benavides-Piccione, R., Rojo, C., Kastanauskaite, A., & DeFelipe, J. (2021). Variation in pyramidal cell morphology across the human anterior temporal lobe. *Cerebral Cortex*, 31(8), 3592–3609. <https://doi.org/10.1093/cercor/bhab034>
- Benavides-Piccione, R., Blazquez-Llorca, L., Kastanauskaite, A., Fernaud-Espinosa, I., Tapia-González, S., & DeFelipe, J. (2024). Key morphological features of human pyramidal neurons. *Cerebral Cortex*, 34(5), bhae180. <https://doi.org/10.1093/cercor/bhae180>
- BenFrantzDale. (2007). *A Necker cube* [Drawing]. Wikimedia Commons (CC BY-SA 3.0). https://commons.wikimedia.org/wiki/File:Necker_cube.svg

- Brumblay, R. J. (2003). Hyperdimensional perspectives in out-of-body and near-death experiences. *Journal of Near-Death Studies*, 21(4), 201–221. <https://doi.org/10.17514/JNDS-2003-21-4-p201-221>
- Buckner, R. L. (2013). The cerebellum and cognitive function: 25 years of insight from anatomy and neuroimaging. *Neuron*, 80(3), 807–815. <https://doi.org/10.1016/j.neuron.2013.10.044>
- Carhart-Harris, R. L., Erritzoe, D., Williams, T., Stone, J. M., Reed, L. J., Colasanti, A., Tyack, R. J., Leech, R., Malizia, A. L., Murphy, K., Hobden, P. Evans, J., Feilding, A., Wise, R. G., & Nutt, D. J. (2012). Neural correlates of the psychedelic state as determined by fMRI studies with psilocybin. *Proceedings of the National Academy of Sciences*, 109(6), 2138–2143. <https://doi.org/10.1073/pnas.1119598109>
- Chalmers, D. J. (1995). Facing up to the problem of consciousness. *Journal of Consciousness Studies*, 2(3), 200–219.
- Charland-Verville, V., Jourdan, J.-P., Thonnard, M., Ledoux, D., Donneau, A.-F., Quertemont, E., & Laureys, S. (2014). Near-death experiences in non-life-threatening events and coma of different etiologies. *Frontiers in Human Neuroscience*, 8, 203. <https://doi.org/10.3389/fnhum.2014.00203>
- Cleveland, L. M., Minter, M. L., Cobb, K. A., Scott, A. A., & German, V. F. (2008). Lead hazards for pregnant women and children: part 1: immigrants and the poor shoulder most of the burden of lead exposure in this country. Part 1 of a two-part article details how exposure happens, whom it affects, and the harm it can do. *AJN The American Journal of Nursing*, 108(10), 40–49. <https://doi.org/10.1097/01.NAJ.0000337736.76730.66>
- Cook, E. W., Greyson, B., & Stevenson, I. (1998). Do any near-death experiences provide evidence for the survival of human personality after death? Relevant features and illustrative case reports. *Journal of Scientific Exploration*, 12(3), 377–406.
- Cooper, G. M. (2000). *The cell: A molecular approach* (2nd ed.). Sinauer. Retrieved from: <https://www.ncbi.nlm.nih.gov/books/NBK9908/>
- Damasio, H., & Damasio, A. R. (1989). *Lesion analysis in neuropsychology*. Oxford University Press.
- Dehaene, S., Kerszberg, M., & Changeux, J. P. (1998). A neuronal model of a global workspace in effortful cognitive tasks. *Proceedings of the National Academy of Sciences*, 95(24), 14529–14534. <https://doi.org/10.1073/pnas.95.24.14529>
- Dehaene, S., Naccache, L., Cohen, L., Bihan, D. L., Mangin, J. F., Poline, J. B., & Rivière, D. (2001). Cerebral mechanisms of word masking and unconscious repetition priming. *Nature Neuroscience*, 4(7), 752–758. <https://doi.org/10.1038/89551>
- Dehaene, S., Sergent, C., & Changeux, J. P. (2003). A neuronal network model linking subjective reports and objective physiological data during conscious perception. *Proceedings of the National Academy of Sciences*, 100(14), 8520–8525. <https://doi.org/10.1073/pnas.1332574100>
- Depraz, N., Varela, F. J., & Vermersch, P. (2003). *On becoming aware: A pragmatics of experiencing*. John Benjamins. <https://doi.org/10.1075/aicr.43>
- Elston, G. N., Benavides-Piccione, R., & DeFelipe, J. (2001). The pyramidal cell in cognition: A comparative study in human and monkey. *Journal of Neuroscience*, 21(17), RC163–RC163. <https://doi.org/10.1523/JNEUROSCI.21-17-j0002.2001>

- Elston, G. N., Oga, T., & Fujita, I. (2009). Spinogenesis and pruning scales across functional hierarchies. *Journal of Neuroscience*, 29(10), 3271–3275. <https://doi.org/10.1523/JNEUROSCI.5216-08.2009>
- Falahati, H., Wu, Y., Feuerer, V., Simon, H. G., & De Camilli, P. (2022). Proximity proteomics of synaptopodin provides insight into the molecular composition of the spine apparatus of dendritic spines. *Proceedings of the National Academy of Sciences*, 119(42), e2203750119. <https://doi.org/10.1073/pnas.2203750119>
- Falahati, H., Wu, Y., Fang, M., & De Camilli, P. (2025). Ectopic reconstitution of a spine-apparatus-like structure provides insight into mechanisms underlying its formation. *Current Biology*, 35(2), 265–276. <https://doi.org/10.1016/j.cub.2024.11.010>
- Fedorenko, E., Duncan, J., & Kanwisher, N. (2013). Broad domain generality in focal regions of frontal and parietal cortex. *Proceedings of the National Academy of Sciences*, 110(41), 16616–16621. <https://doi.org/10.1073/pnas.1315235110>
- Fedorenko, E., & Varley, R. (2016). Language and thought are not the same thing: evidence from neuroimaging and neurological patients. *Annals of the New York Academy of Sciences*, 1369(1), 132–153. <https://doi.org/10.1111/nyas.13046>
- Fischer, J. M. (2020). *Death, immortality, and meaning in life*. Oxford University Press.
- Garaschuk, O., Yaari, Y., & Konnerth, A. (1997). Release and sequestration of calcium by ryanodine-sensitive stores in rat hippocampal neurones. *Journal of Physiology*, 502(1), 13–30. <https://doi.org/10.1111/j.1469-7793.1997.013bl.x>
- Greyson, B. (1983). The near-death experiences scale. *Journal of Nervous and Mental Disease*, 171(6), 369–375. <https://doi.org/10.1097/00005053-198306000-00007>
- Greyson, B. (2007). Consistency of near-death experience accounts over two decades: Are reports embellished over time? *Resuscitation*, 73(3), 407–411. <https://doi.org/10.1016/j.resuscitation.2006.10.013>
- Greyson, B. (2021). *After: A doctor explores what near-death experiences reveal about life and beyond*. St. Martin's Essentials. <https://doi.org/10.17514/JNDS-2021-39-3-p184-194>
- Hagoort, P., Hald, L., Bastiaansen, M., & Petersson, K. M. (2004). Integration of word meaning and world knowledge in language comprehension. *Science*, 304(5669), 438–441. <https://doi.org/10.1126/science.1095455>
- Hari, R., & Salmelin, R. (2012). Magnetoencephalography: From SQUIDs to neuroscience: *NeuroImage* 20th anniversary special edition. *NeuroImage*, 61(2), 386–396. <https://doi.org/10.1016/j.neuroimage.2011.11.074>
- Holden, J. M. (1988). Visual perception during naturalistic near-death out-of-body experiences. *Journal of Near-Death Studies*, 7(2), 107–120. <https://doi.org/10.17514/JNDS-1988-7-2-p107-120>
- IANDS. (2023). IANDS Experience Registry [Data set]. International Association for Near-Death Studies. Retrieved December 19, 2023, from <https://research.iands.org/ndes/nde-stories/iands-nde-accounts.html>
- Johanning, F. W., Theis, A. K., Pannasch, U., Rückl, M., Rüdiger, S., & Schmitz, D. (2015). Ryanodine receptor activation induces long-term plasticity of spine calcium dynamics. *PLoS Biology*, 13(6), e1002181. <https://doi.org/10.1371/journal.pbio.1002181>
- Jourdan, J.-P. (2000). Just an extra dimension . . . *Les Cahiers de IANDS*.

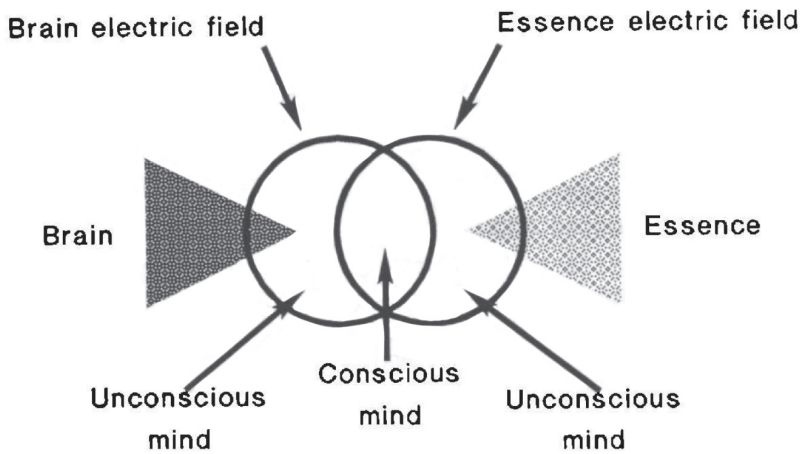
- France (special scientific issue No. 1). Retrieved from <http://www.iands-france.org/SRC/PDF/justextra.pdf>
- Jourdan, J.-P. (2011). Near death experiences and the 5th dimensional spatio-temporal perspective. *Journal of Cosmology*, 14. Retrieved from <http://cosmology.com/Consciousness152.html>
- Jourdan, J.-P., & Smythies, J. (2019). An exploratory study of perceptual and cognitive features in near-death experiences: A proposed model and research recommendations. *Journal of Near-Death Studies*, 37(2), 65–97. <https://doi.org/10.17514/JNDS-2019-37-2-p65-97>
- Kanwisher, N. (2010). Functional specificity in the human brain: A window into the functional architecture of the mind. *Proceedings of the National Academy of Sciences*, 107(25), 11163–11170. <https://doi.org/10.1073/pnas.1005062107>
- Kanwisher, N. (2017). The quest for the FFA and where it led. *Journal of Neuroscience*, 37(5), 1056–1061. <https://doi.org/10.1523/JNEUROSCI.1706-16.2016>
- Kelly, E. F., & Stone, P. J. (1975). *Computer recognition of English word senses*. North-Holland.
- Kim, J. (2011). *Philosophy of mind* (3rd ed.). Westview Press.
- Koskinen, M., & Hotulainen, P. (2014). Measuring F-actin properties in dendritic spines. *Frontiers in Neuroanatomy*, 8, 74. <https://doi.org/10.3389/fnana.2014.00074>
- Kuhn, T. S. (1970). *The structure of scientific revolutions* (2nd enl. ed.). University of Chicago Press.
- Kutas, M., & Federmeier, K. D. (2011). Thirty years and counting: Finding meaning in the N400 component of the event-related brain potential (ERP). *Annual Review of Psychology*, 62(1), 621–647. <https://doi.org/10.1146/annurev.psych.093008.131123>
- Kwan, K. Y., Šestan, N., & Anton, E. S. (2012). Transcriptional co-regulation of neuronal migration and laminar identity in the neocortex. *Development*, 139(9), 1535–1546. <https://doi.org/10.1242/dev.069963>
- Lange, R., Greyson, B., & Houran, J. (2004). A Rasch scaling validation of a ‘core’ near-death experience. *British Journal of Psychology*, 95(2), 161–177. <https://doi.org/10.1348/000712604773952403>
- Langmuir, I. (1928). Oscillations in ionized gases. *Proceedings of the National Academy of Sciences*, 14(8), 627–637. <https://doi.org/10.1073/pnas.14.8.627>
- Libet, B. (2004). *Mind time: The temporal factor in consciousness*. Harvard University Press.
- Lieber, M. B. (2013). Near-death experiences and ayahuasca-induced experiences – two unique pathways to a phenomenologically similar state of consciousness. *Journal of Transpersonal Psychology*, 45(1), 24–48.
- Liu, Z., Zhang, J., Sharma, M. R., Li, P., Chen, S. W., & Wagenknecht, T. (2001). Three-dimensional reconstruction of the recombinant type 3 ryanodine receptor and localization of its amino terminus. *Proceedings of the National Academy of Sciences*, 98(11), 6104–6109. <https://doi.org/10.1073/pnas.111382798>
- Lutz, A., Lachaux, J. P., Martinerie, J., & Varela, F. J. (2002). Guiding the study of brain dynamics by using first-person data: Synchrony patterns correlate with ongoing conscious states during a simple visual task. *Proceedings of the National Academy of Sciences*, 99(3), 1586–1591. <https://doi.org/10.1073/pnas.032658199>

- Lutz, A., & Thompson, E. (2003). Neurophenomenology: Integrating subjective experience and brain dynamics in the neuroscience of consciousness. *Journal of Consciousness Studies*, 10(9–10), 31–52.
- Maciag, F., Chhikara, A., & Heine, M. (2024). Calcium channel signalling at neuronal endoplasmic reticulum-plasma membrane junctions. *Biochemical Society Transactions*, 52(4), 1617–1629. <https://doi.org/10.1042/BST20230819>
- Martial, C., Simon, J., Puttaert, N., Gosseries, O., Charland-Verville, V., Nyssen, A.-S., Greyson, B., Laureys, S., & Cassol, H. (2020). The Near-Death Experience Content (NDE-C) scale: Development and psychometric validation [Supplementary Material B]. *Consciousness and Cognition*, 86, 103049. <https://doi.org/10.1016/j.concog.2020.103049>
- Mashour, G. A., Roelfsema, P., Changeux, J. P., & Dehaene, S. (2020). Conscious processing and the global neuronal workspace hypothesis. *Neuron*, 105(5), 776–798. <https://doi.org/10.1016/j.neuron.2020.01.026>
- Mays, R. G., & Mays, S. B. (2008). The phenomenology of the self-conscious mind. *Journal of Near-Death Studies*, 27(1), 5–45. <https://doi.org/10.17514/JNDS-2008-27-1-p5-45>
- Mays, R. G., & Mays, S. B. (2011, September 2). A theory of mind and brain that solves the ‘hard problem’ of consciousness. Paper presented at the annual conference of the International Association for Near-Death Studies, Durham, NC. Retrieved from <https://selfconsciousmind.com/papers.html#theory-article>
- Mays, R. G., & Mays, S. B. (2015). Explaining near-death experiences: Physical or non-physical causation? *Journal of Near-Death Studies*, 33(3), 125–149. <https://doi.org/10.17514/JNDS-2015-33-3-p125-149>
- Mays, R. G., & Mays, S. B. (2021). There is no death: Near-death experience evidence for survival after permanent bodily death. Bigelow Institute for Consciousness Studies. Also in *Winning essays 2023: Proof of survival of human consciousness beyond permanent bodily death* (Vol. 4, pp. 1–85). <https://www.bigelowinstitute.org/wp-content/uploads/2022/10/mays-there-is-no-death.pdf>
- Mays, R. G., & Mays, S. B. (2024). Near-death experiences are caused by the separation of consciousness from the body: An NDE Scale analysis. *Journal of Scientific Exploration*, 38(2), 190–211. <https://doi.org/10.31275/20243317>
- McKenzie, E. (2015). *Dying to fit in*. Amazon CreateSpace.
- Moody, Jr., R. A. (1975). *Life after life*. Mockingbird Books.
- Moore, L. E., & Greyson, B. (2017). Characteristics of memories for near-death experiences. *Consciousness and Cognition*, 51, 116–124. <https://doi.org/10.1016/j.concog.2017.03.003>
- Mountcastle, V. B. (1957). Modality and topographic properties of single neurons of cat's somatic sensory cortex. *Journal of Neurophysiology*, 20, 408–434. <https://doi.org/10.1152/jn.1957.20.4.408>
- Nagel, T. (1974). What is it like to be a bat? *Philosophical Review*, 83, 435–450. <https://doi.org/10.2307/2183914>
- Nehlig, A. (2010). Is caffeine a cognitive enhancer? *Journal of Alzheimer's Disease*, 20(s1), S85–S94. <https://doi.org/10.3233/JAD-2010-091315>
- Nieuwland, M. S., & Van Berkum, J. J. (2006). When peanuts fall in love: N400 evidence for the power of discourse. *Journal of Cognitive Neuroscience*, 18(7), 1098–1111. <https://doi.org/10.1162/jocn.2006.18.7.1098>
- Oga, T., Elston, G. N., & Fujita, I. (2017). Postnatal dendritic growth and spino-genesis of layer-V pyramidal cells differ between visual, inferotemporal, and

- prefrontal cortex of the macaque monkey. *Frontiers in Neuroscience*, 11, 118. <https://doi.org/10.3389/fnins.2017.00118>
- Ortega, D. R., Esquivel, D. F. G., Ayala, T. B., Pineda, B., Manzo, S. G., Quino, J. M., Mora, P. C., & de la Cruz, V. P. (2021). Cognitive impairment induced by lead exposure during lifespan: mechanisms of lead neurotoxicity. *Toxics*, 9(2), 23. <https://doi.org/10.3390/toxics9020023>
- Parti, R., with Perry, P. (2017). *Dying to wake up: A doctor's voyage into the after-life and the wisdom he brought back*. Atria.
- Peterburs, J., & Desmond, J. E. (2016). The role of the human cerebellum in performance monitoring. *Current Opinion in Neurobiology*, 40, 38–44. <https://doi.org/10.1016/j.conb.2016.06.011>
- Platholi, J., Herold, K. F., Hemmings Jr, H. C., & Halpain, S. (2014). Isoflurane reversibly destabilizes hippocampal dendritic spines by an actin-dependent mechanism. *PLOS ONE*, 9(7), e102978. <https://doi.org/10.1371/journal.pone.0102978>
- PolyMurrase. (2023, May 13). Cytoplasmic face of phosphorylated RyR2 in open conformation. PDB: 7U9R. Copyright CC BY-SA 4.0. <https://commons.wikimedia.org/w/index.php?curid=131894859>
- Putnoki, T. (2014). *9 minutes: My path to the Light* (Hungarian-English bilingual publication). Szeretet Fénye Közhászú Alapítvány.
- Ramón y Cajal, S. (1888). Estructura de los centros nerviosos de las aves [Structure of avian nerve centers]. *Revista Trimestral de Histología Normal y Patológica*, 1, 1–10.
- Rickabaugh, B., & Moreland, J. P. (2024). *The substance of consciousness: A comprehensive defense of contemporary substance dualism*. Wiley Blackwell.
- Ring, K. (1980). *Life at death: A scientific investigation of the near-death experience*. Coward, McCann, and Geoghegan.
- Rivas, T., Dirven, A., & Smit, R. H. (2023). *The self does not die: Verified paranormal phenomena from near-death experiences* (2nd ed.). International Association for Near-Death Studies.
- Rousseau, D. (2011). Near-death experiences and the mind-body relationship: A systems-theoretical perspective. *Journal of Near-Death Studies*, 29(3), 399–435. <https://doi.org/10.17514/JNDS-2011-29-3-p399-435>
- Roux, L., & Buzsáki, G. (2015). Tasks for inhibitory interneurons in intact brain circuits. *Neuropharmacology*, 88, 10–23. <https://doi.org/10.1016/j.neuropharm.2014.09.011>
- Sabom, M. B. (1982). *Recollections of death: A medical investigation*. Harper and Row.
- Sacks, O. (2012). *Hallucinations*. Alfred A. Knopf.
- Schifilliti, D., Grasso, G., Conti, A., & Fodale, V. (2010). Anaesthetic-related neuroprotection: Intravenous or inhalational agents?. *CNS Drugs*, 24, 893–907. <https://doi.org/10.2165/11584760-000000000-00000>
- Siegel, J. S., Subramanian, S., Perry, D., Kay, B. P., Gordon, E. M., Laumann, T. O., Reneau, T. R., Metcalf, N. V., Chacko, R. V., Gratton, C., Horan, C., Krimmel, S. R., Shimony, J. S., Schweiger, J. A., Wong, D. F., Bender, D. A., Scheidter, K. M., Whiting, F. I., Padwaer-Currey, J. A. . . . Dosenbach, N. U. (2024). Psilocybin desynchronizes the human brain. *Nature*, 632(8023), 131–138. <https://doi.org/10.1038/s41586-024-07624-5>
- Smith, S. L., Smith, I. T., Branco, T., & Häusser, M. (2013). Dendritic spikes

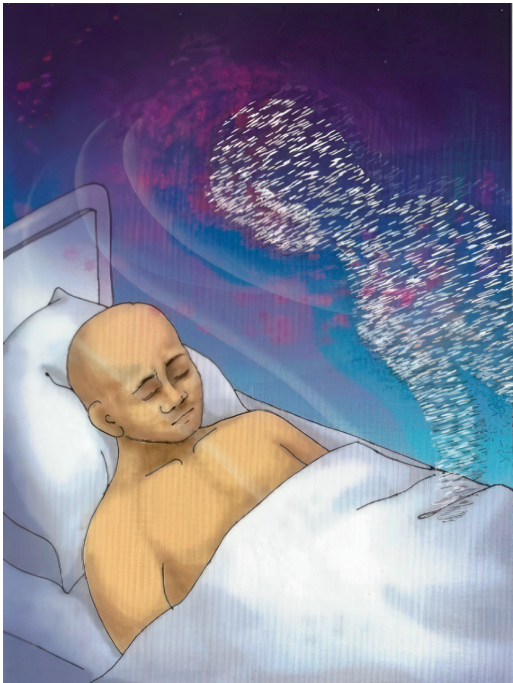
- enhance stimulus selectivity in cortical neurons *in vivo*. Supplementary information. *Nature*, 503, 115–120. Video download: https://selfconsciousmind.com/41586_2013_BFnature12600_MOESM31_ESM.mov <https://doi.org/10.1038/nature12600>
- Steiner, R. (1914, January 23). *Human and cosmic thought, Lecture 4* [Lecture transcript] (C. Davy, Trans.). Paper presented at the Second General Meeting of the Anthroposophical Society, Berlin, Germany. <https://rsarchive.org/Lectures/GA151/English/RSP1991/19140123p02.html>
- Storm, H. (2000). *My descent into death and the message of love which brought me back*. Clairview.
- Tononi, G., Boly, M., Massimini, M., & Koch, C. (2016). Integrated information theory: from consciousness to its physical substrate. *Nature Reviews Neuroscience*, 17, 450–461. <https://doi.org/10.1038/nrn.2016.44>
- Varela, F. J. (1996). Neurophenomenology: A methodological remedy for the hard problem. *Journal of Consciousness Studies*, 3(4), 330–349.
- Vlachos, A., Korkotian, E., Schonfeld, E., Copanaki, E., Deller, T., & Segal, M. (2009). Synaptopodin regulates plasticity of dendritic spines in hippocampal neurons. *Journal of Neuroscience*, 29(4), 1017–1033. <https://doi.org/10.1523/JNEUROSCI.5528-08.2009>
- Wang, L., Dumoulin, A., Renner, M., Triller, A., & Specht, C. G. (2016). The role of synaptopodin in membrane protein diffusion in the dendritic spine neck. *PloS One*, 11(2), e0148310. <https://doi.org/10.1371/journal.pone.0148310>
- Woll, K. A., & Van Petegem, F. (2022). Calcium-release channels: structure and function of IP3 receptors and ryanodine receptors. *Physiological Reviews*, 102(1), 209–268. <https://doi.org/10.1152/physrev.00033.2020>
- Wu, P. Y., Inglebert, Y., & McKinney, R. A. (2024). Synaptopodin: a key regulator of Hebbian plasticity. *Frontiers in Cellular Neuroscience*, 18, 1482844. <https://doi.org/10.3389/fncel.2024.1482844>
- Yuste, R. (2010). *Dendritic spines*. MIT Press.
- Yuste, R., & Denk, W. (1995). Dendritic spines as basic functional units of neuronal integration. *Nature*, 375(6533), 682–684. <https://doi.org/10.1038/375682a0>
- Zhang, G., & Stackman Jr, R. W. (2015). The role of serotonin 5-HT2A receptors in memory and cognition. *Frontiers in Pharmacology*, 6, 225. <https://doi.org/10.3389/fphar.2015.00225>
- Zhou, F., Du, G., Xie, J., Gu, J., Jia, Q., Fan, Y., Yu, H., Zha, Z., Wang, K., Ouyang, L., Shao, L., Feng, C., & Fan, G. (2020). RyRs mediate lead-induced neurodegenerative disorders through calcium signaling pathways. *Science of the Total Environment*, 701, 134901. <https://doi.org/10.1016/j.scitotenv.2019.134901>

Figure 1 *Arnette’s Structural Model for the Definition of Mind*



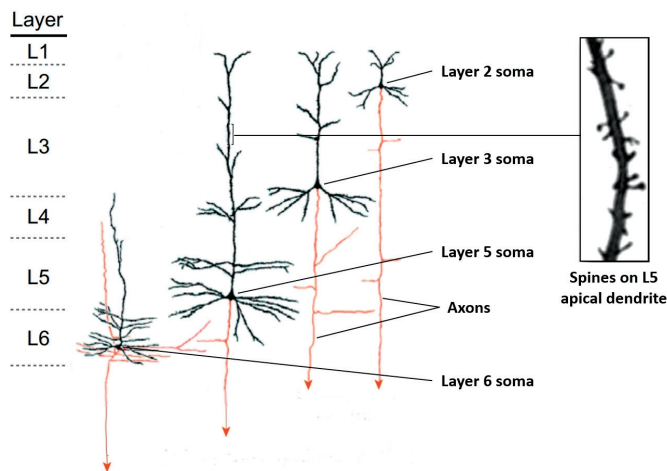
Note. Source: Arnette (1995, p. 94). Reproduced with permission.

Figure 2 *Tibor Putnoki’s Depiction of His Immaterial NDE Body*



Note. “Who could that patient be? . . . I’m deeply shocked—the face is my own!” Source: Putnoki (2014, p. 54) Reproduced with permission from Szeretet Fénye Közhasznú Alapítvány, Light of Love Public Benefit Foundation. Art by Beáta Vavrínecká.

Figure 3 *Cortical Pyramidal Neurons, Dendrites, and Spines*



Note. Source: Adapted from Kwan et al. (2012, p. 1537); annotations added. Used with permission of Kwan et al. (2012), conveyed through Copyright Clearance Center, Inc.

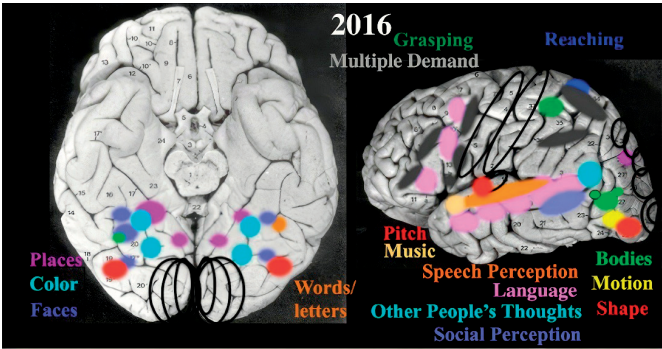


Figure 4
Specialized Cortical Domains

Note. Source: Kanwisher (2017, p. 1059). Used with permission of Kanwisher (2017), conveyed through Copyright Clearance Center, Inc.

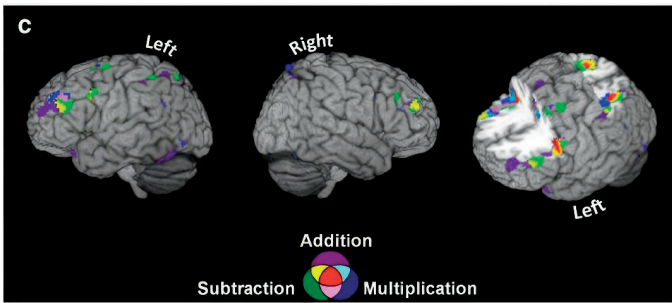
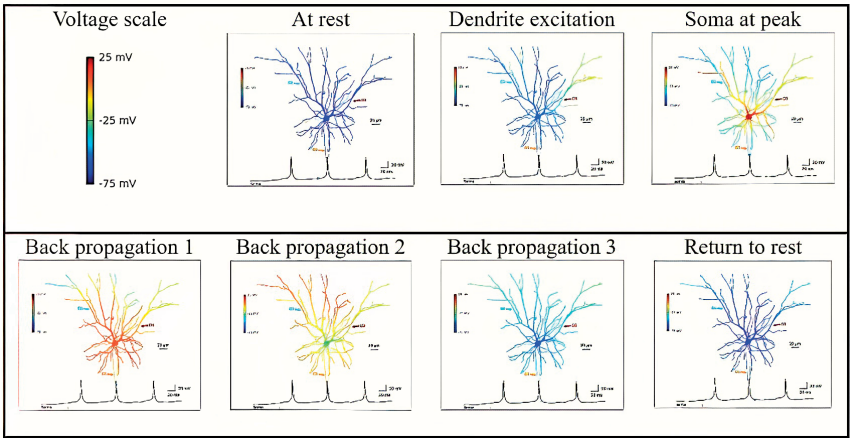


Figure 5
Cortical Domains for Mathematical Calculation

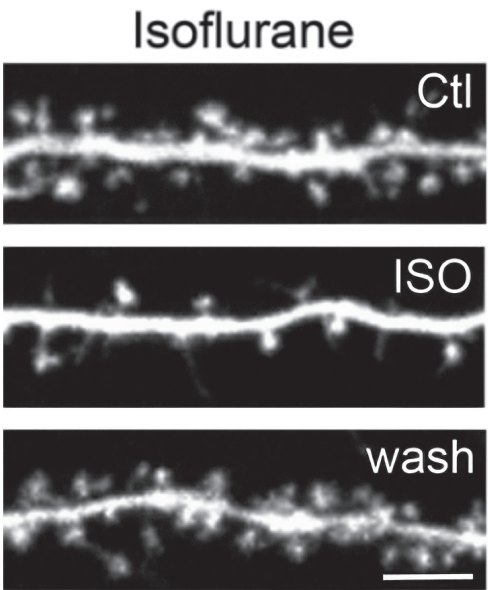
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Figure 6 *Back Propagation of Positive Charge in a Level 2/3 Neural Action Potential Lasting ~20 msec*



Note. Source: Adapted from Smith et al. (2013, Supplementary information). Reproduced with permission from Smith et al. (2013), Springer Nature.

Figure 7 *Effects of Isoflurane Anesthetic on Dendritic Spines*



Note. Source: Platholi et al. (2014, p. 5). © 2014 Platholi et al. (CC BY 4.0).

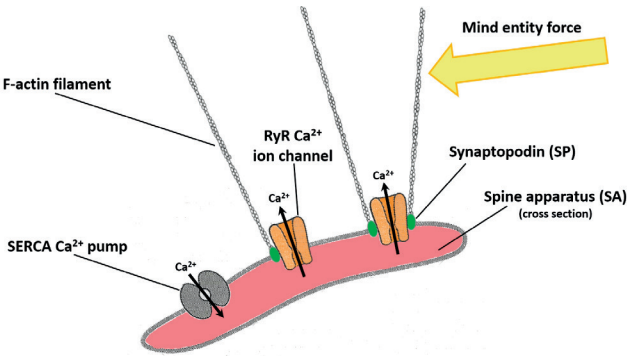


Figure 8
Proposed Elements Governing Mind-Interface Spine Calcium Dynamics

Note. The circular spine apparatus is on the order of 500 nanometers in diameter. Depicted elements are not drawn to scale. Source: Adapted from Yuste (2010, p. 152). © 2010 Massachusetts Institute of Technology, Fig. 7.2, by permission of The MIT Press. Annotations added..

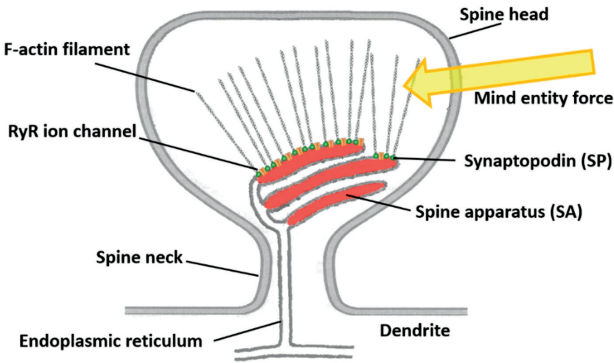


Figure 9
Diagram of the Principal Elements of the Proposed Mind-Interface Dendritic Spine

Note. Source: Adapted from Yuste (2010, p. 57). © 2010 Massachusetts Institute of Technology, Fig. 4.5, by permission of The MIT Press. Annotations were added.

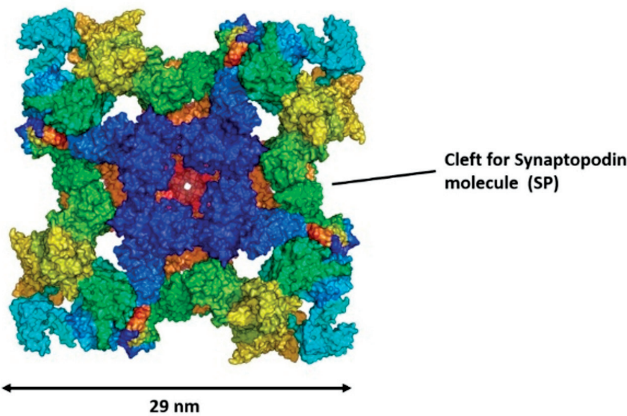
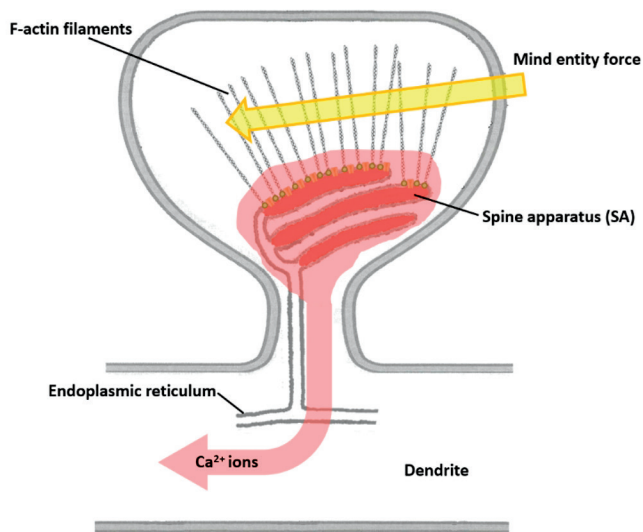


Figure 10 *RyR2 Receptor in Open Position, Viewed From Above the Surface of the Spine Apparatus*

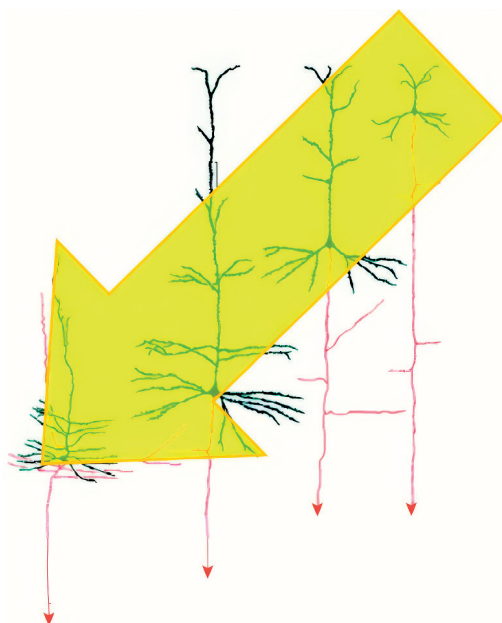
Note. Sources: RyR2 receptor structure (PolyMurrase, 2023), copyright CC BY-SA 4.0. RyR2 receptor dimensions (Liu et al., 2001, p. 6107). Annotations added.

Figure 11 *Mind Entity Force Within the Interface Spine Releases Calcium Ions*



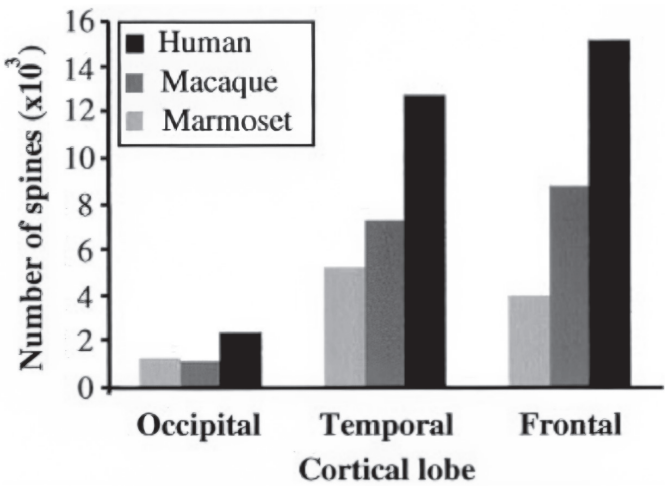
Note. Source: Adapted from Yuste (2010, p. 57). © 2010 Massachusetts Institute of Technology, by permission of The MIT Press. Annotations added.

Figure 12 *Mind Entity Force Within a Cortical Minicolumn*



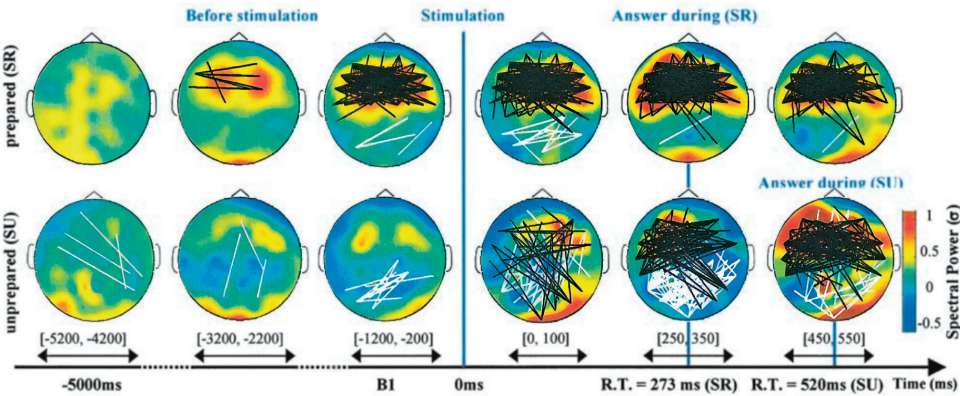
Note. Source: Adapted from Kwan et al. (2012, p. 1537). Used with permission of Kwan et al. (2012), conveyed through Copyright Clearance Center, Inc.

Figure 13 *Estimated Total Pyramidal Cell Spines in Three Brain Regions of Three Primate Species*



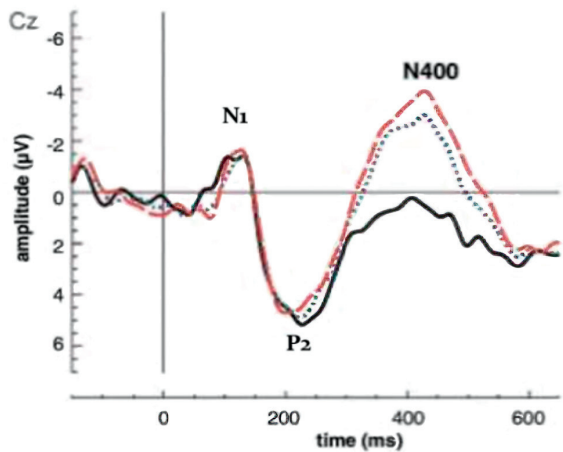
Note. Source: Elston et al. (2001, p. 3). Copyright 2001 Society for Neuroscience.

Figure 14 *Comparison of EEG Between the Two Subjective States of Spontaneous Readiness and Unreadiness in the Same Research Participant*



Note. Source: Lutz et al. (2002, p. 1589). Copyright (2002) National Academy of Sciences, U.S.A.

Figure 15 *EEG Traces Associated With Reading a Target Word in a Sentence*



Note. Source: Hagoort (2004, p. 439) . Reproduced from Hagoort et al., *Science*, DOI 10.1126/science.1095455, 2004, AAAS.

The Dutch trains are yellow and very crowded.
The Dutch trains are white and very crowded. (elevated N400)
The Dutch trains are ~~slow~~ and very crowded. (elevated N400)

Figure 16 *The Checker Shadow Illusion*

Note. Source: Left (Adelson, 2018), Wikimedia Commons (CC BY-SA 4.0). Right (Adelson, 2015), Wikimedia Commons (Copyrighted free use).

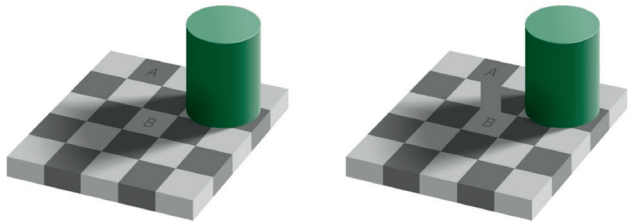
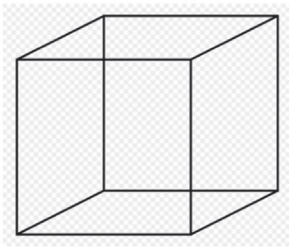
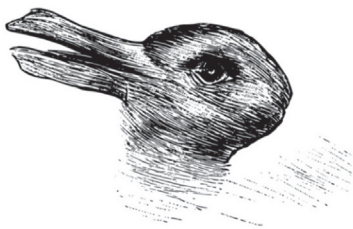


Figure 17 *The Rabbit-Duck Illusion and the Necker Cube*



Note. Sources: Left, Rabbit-duck illusion illustration (Anonymous, 1892), Wikimedia Commons (Public domain). Right, Necker cube illustration (BenFrantz-Dale, 2007), Wikimedia Commons (CC BY-SA 3.0).

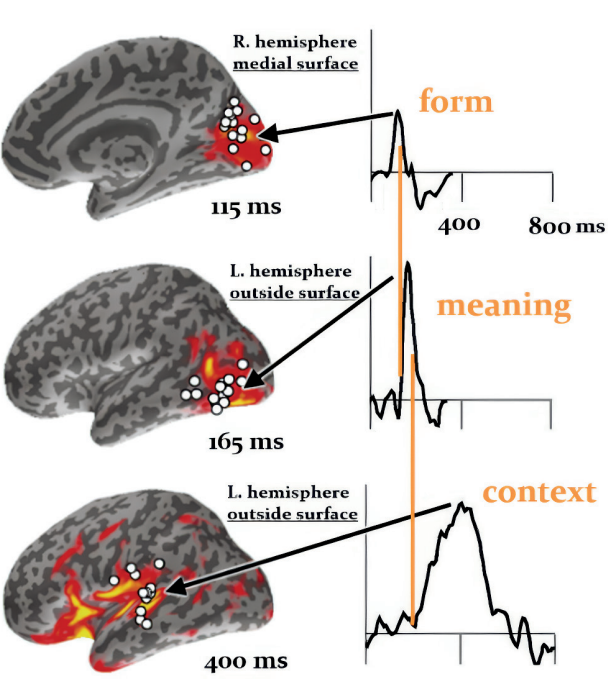
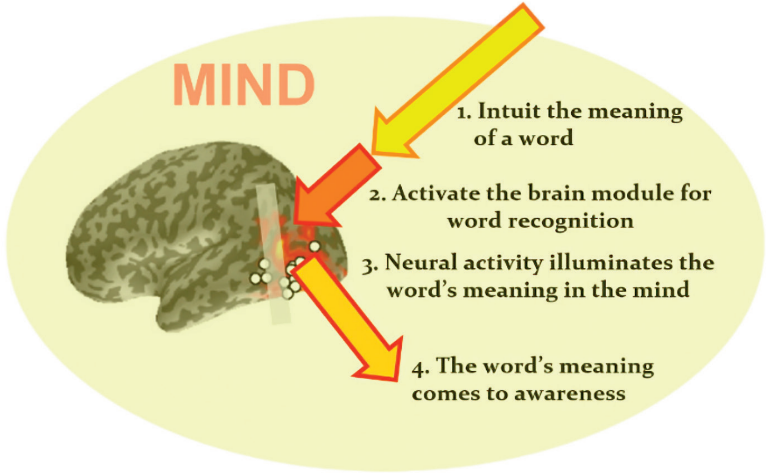


Figure 18
*MEG Cortical
Dynamics During
Silent Reading*

Note. The dots in the brain images are specific regions of “equivalent current dipoles” (ECDs), where the magnetic dipole strength is highest. Note that the first brain image is the medial occipital region showing the *inside* or medial surface of the *right* hemisphere. Adapted from Hari & Salmelin (2012, Figure 2, p. 390). Copyright © 2011 Elsevier Inc. (CC-BY-NC-ND). Annotations added.

Figure 19 *The Process of Coming to Awareness*



Note. Source: Adapted from Hari & Salmelin (2012, Figure 2, p. 390). Copyright © 2011 Elsevier Inc. (CC-BY-NC-ND).