Framework and Mechanism for Mind-Brain Interaction based on NDE and neurological evidence

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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 suggests 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.

KEY WORDS: Consciousness, mind entity, substance dualism (SD), mind-brain interface, inhaled anesthetics, dendritic spines.

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1. INTRODUCTION

1.1 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 comprised of an immaterial soul and a physical body. Philosophers Brandon Rickabaugh and J. P. Moreland (2024) give 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 believe that substance dualism, while 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 recognize 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)

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)

Their conclusion is that "souls are essentially constituted by properties and property-instances, and not [physical] stuff." (p. 303).

While philosophical inquiry is not intended to provide a *causal explanation* for the occurrence of conscious states, they 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 NDEr reports *can be the basis* for a substance dualist ontological framework that can provide convincing causal explanations for how conscious states can occur.

This paper reviews previous substance dualist NDE research and outlines a new substance dualist framework for understanding consciousness. The framework is based on NDE and neurological evidence, integrating both substance dualist philosophy and empirical science.

NDE research based on a substance dualist framework has been underway for more than 30 years. However, we are aware of only three NDE researchers working in this way, J. Kenneth Arnette (1992, 1995, 1999) and ourselves (2008, 2011, 2015, 2021, 2024).

1.2 Substance dualist NDE research: Kenneth Arnette – Theory of Essence

1.2.1 Theory of Essence

Arnette (1992, 1995, 1999) proposed that the classical mind-body problem can be approached *empirically*, using instances of NDEs as experimental data. Ideally, a theory of interactionism should be grounded in empirical data. Indeed, specific details of NDEs can provide phenomenological evidence of how the mind and body as separate entities can interact. NDEs provide a reproducible body of data which the materialist view has difficulty explaining.

Arnette termed the dissociated human consciousness the *essence*. He described the essence in detail in his 1995 paper:

> I proposed that the human being is composed of two parts: body and *essence* (Arnette, 1992). The essence is that part of the person that survives the death of the body. It is composed of something other than matter, and thus is not subject to many of the physical laws of this universe, such as gravity or other constraints on motion. The essence contains the essential elements of the human personality or consciousness. The theory of essence holds that upon bodily death, the essence is disengaged from both the body and this universe (or *spacetime*), and travels via a connecting wormhole to locales imperceptible to us while in physical form. The theory suggests that the observations made by the essence during NDEs constitute empirical data, and that these data could be used to construct a scientifically valid model of human nature based on well-established principles of physics and chemistry. (1995, p. 80)

Arnette employed a method of *content analysis* of textual NDE narratives and interviews with NDErs to identify prevalent features of the phenomenon which would be pertinent to the interaction of the essence with the body in numerous cases. He focused on three independent NDE studies by Raymond Moody (1975), Ken Ring (1980), and Michael Sabom (1982). In particular, Arnette noted specific cases from Sabom's study because many of the NDErs' observations were verified:

> Sabom identified ten cases of autoscopic [out-of-body] NDEs occurring in operating rooms, and accessed the medical records for these cases. He compared the NDE interview data with these records—which the patients had never seen—and found that in every case, the NDEr's report was consistent with the medical records. A great many of the observations thus verified could have only been obtained visually by the NDEr. (1995, p. 82)

Arnette focused on phenomena in the three studies involving interactions of the out-of-body NDEr (i.e., the essence) and identified four classes of interaction: interactions of the essence with the NDEr body, with the NDEr brain, with other bodies, and with other essences. He used these specific features

> … to construct an explanatory theory from the connections. The unifying perspective that emerges from the four interactional classes of data is that of electromagnetic-quantum mechanical theory. This perspective organizes the data in a consistent and logical fashion, revealing relationships between seemingly unconnected phenomena. (1995, pp. 82–83)

Arnette described the empirical observations reported in NDE cases from the Moody, Ring, and Sabom studies.

- **Interactions of the NDEr's essence with its body**: Arnette focused on experiences of returning to the body when the NDEr's stopped heart was defibrillated. When shocked, two NDErs reported being quickly forced and pushed back and one NDEr reported falling back into the body. Some kind of force seemed to be involved. (1995, pp. 83–84).
- **Interactions of the NDEr's essence with other living bodies**: Two NDErs reported trying to grab the attendants to stop them from trying to revive them but the NDEr's hand went through the attendant's body. In the third case, the attendants didn't seem to see the NDEr and just walked *through* the NDEr. Thus, it appears that "the essence can occupy the same space as a [physical] body, without interacting with it." (1995, pp. 84–85).
- **Interactions of the essence with the NDEr brain**: The three NDErs described or implied that their "cognitive functioning is noticeably improved by essence/body dissociation. Thinking is clearer, more rational, and more efficient when separated from the brain." (1995, p. 85).
- **Interactions of the NDEr's essence with other out-of-body essences**: In one of these three cases, the NDEr would know telepathically exactly what an in-body essence was thinking just before the person opened their mouth to speak. In interacting with a discarnate essence in the other two cases, the NDEr would receive an answer to a question telepathically, like it was being projected into their mind. Arnette concluded, "The data indicate that the essence can interact with other essences by exchanging information at a distance in the form of thought. The essence can also receive the thoughts of those in physical form before the words are spoken." (1995, p. 86).

1.2.2 Essence/Body Interaction

Arnette then elaborated his electromagnetic-quantum mechanical theory of interaction based on these cases, using analogical reasoning. There appears to be a strong attractive force at work between the NDEr's essence and its body in the first set of cases cited above.

> While it is conceivable that the body generates some unknown force that can act upon the essence, it is more reasonable and fruitful to propose that a known force is at work. A strong candidate for this operative force is electromagnetism, since the central nervous system is an electrochemical generator of electromagnetic energy. Neural impulses are, in

> fact, electromagnetic field pulses. … The living body is therefore a producer of a temporally varying and spatially extended electric field. (1995, p. 87)

Arnette also cited empirical evidence from NDEr accounts in Moody's study that the *essence itself* has extension in space and is composed of some sort of substance with an electrical or energetic aspect. "There is reason, then, to proceed with the notion that the essence is associated with a spatially extended electric field, and to explore the ramifications of that notion." (1995, pp. 87–88).

First, the interaction of the essence with the body involves a force similar to the force observed between *electric* or *magnetic dipoles*. A dipole is defined as a positive charge held at a fixed distance from an equal negative charge and represents the simplest distribution of charge separation.

> An analogy with magnetism is illuminating here. Permanent bar magnets (magnetic dipoles) possess two ends or poles arbitrarily designated as north (N) and south (S). Similar poles held in close proximity repel each other, while opposite poles attract each other. If two magnetic dipoles are oriented so that two N-S pairs are formed (the antiparallel configuration), the magnets are found to attract each other strongly. When one varies the distance between antiparallel magnets, one can feel the rapid change in the attractive force. (1995, p. 88)

This model explains the cases of the strong force of attraction of the NDEr's essence with the NDEr's body when returning to its body—like two antiparallel magnetic dipoles. In this case, the essence and the physical body consist of innumerable electric dipoles.

Secondly, in the *composite* of a person's essence and the body (a superposition of the person's essence and its body), the essence is specifically *tuned* to its physical body. For example, the dipoles of the body and essence have a characteristic frequency of oscillation to which each is tuned. The living body is thus an *electrically neutral* composite entity.

In interactions of an NDEr's essence with the living body of another person, because the composite entity is electrically neutral, it would have no interaction or only very weak interaction with the NDEr's essence. Thus, in cases cited earlier, the NDEr's hand can easily pass through the attendant, and the attendant can walk through the NDEr's essence.

1.2.3 Essence/Brain Interaction

In considering the interactions of the essence with the brain, Arnette noted that in the out-of-body state the NDEr experienced *improved* cognitive functioning in the dissociated state, with clearer, more efficient thinking when separated from the brain. In effect, the interactions between the essence and the brain in the in-body state seem to *dampen* cognitive processes compared to the dissociated state.

Arnette found this empirical observation to be consistent with the dipole model of essence and brain interaction described above but on a *microscopic scale*, i.e., at the level of cortical neurons. He proposed that the essence's dynamic thought processes are associated with a spatially extended fluctuating electric field in the vicinity of cortical neurons. As the essence thinks, the field associated with the essence fluctuates. The fields in the brain also fluctuate, as demonstrated by electroencephalographic (EEG) data.

The essence's dipoles operate in the medium of their nearby cortical neurons. The essence, as the seat of thought, and the neural cells are thus mutually interacting dipoles. The fluctuations of the essence's dipole in the electric field of the medium of the brain cause both dipoles to experience a drag associated with what is called *dipolar rotational relaxation* (Arnette, 1981).

Dipole and medium are intimately intertwined; changes in the state of one cause immediate changes in the state of the other, via the mediating field. One could say that the field embodies the interaction between dipole and medium. …

> Thus, in the union between brain and essence, thought is integrally linked to the brain and is carried out in the presence of the brain's electric field. Two things are accomplished through this linkage: (1) sensory and other information from the body is available to the essence via the brain's electric field, and (2) the essence can influence the body by interacting with the brain's electric field. (1995, pp. 91–92)

This representation of the union between the essence and the brain also explains the NDEr's observation that consciousness is comparatively dampened in the in-body state. The interaction of the brain's field with the essence's field interferes with and hinders or slows the essence's cognitive processes in ordinary consciousness.

1.2.4 Essence/Essence Interaction

In the final set of cases above, one NDEr's essence knew telepathically what an in-body essence was thinking and in two cases, the NDEr's essence received an answer to a question telepathically from another essence. Arnette likened such telepathic transfers of information to the transfer of energy between molecules in *fluorescence energy transfer* in which there is a *direct exchange of energetic states* with no observable energy transfer. In the NDE cases, information can be transferred between essences at a distance with no apparent medium or mechanism of transfer.

1.2.5 A Definition of Mind

Arnette proposed that "the essence is not beyond understanding but can be described by a set of scientific laws that have analogues in the physics of the natural world." (1995, p. 94). He defined mind:

> The conscious mind is that entity that is thinking, aware, and rational. It is capable of introspection, insight, and reflection. It is also in touch with sensory, physiological, and other kinds of information associated with the body. The mind can sense and process this information and is thus affected by it; the mind can also initiate physical action based on bodily data or on the results of introspection. The mind is in this position of control by virtue of its access to both the physical and essential worlds. Mind is the interface between these worlds. (pp. 94–95)

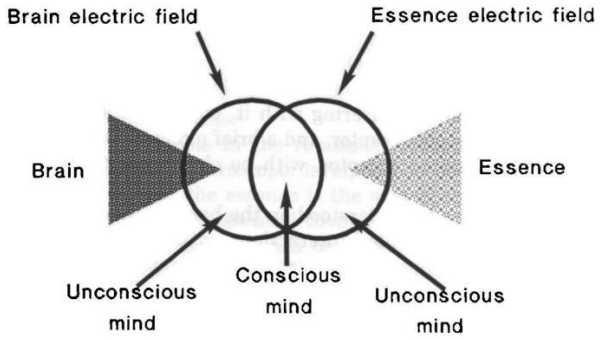


Figure 1. A structural model for a definition of mind (Arnette, 1995, p. 94).
Arnette's representation of the relationship of the mind or essence (right triangle) with the brain (left triangle). The intersecting circles represent their respective electric fields. The overlap of the circles represents the interaction between the two fields giving rise to the conscious mind.

Figure 1 is Arnette's diagrammatic representation of the mind (1995, p. 94) *in ordinary in-body consciousness*, based upon his rotational relaxation model of essence/brain interaction. The essence and body are represented by triangles. The two intersecting circles represent their respective electric fields. The conscious mind is symbolized as the overlap of the two fields, formed by the rotational relaxation interaction of their dipoles. Thus, the in-body conscious mind is a composite of elements of both the body and the essence. The composite forms the causal linkage between the two Cartesian substances. Arnette pointed out that this model allows for aspects of the mind that are unconscious.

> The unconscious mind is manifested by those portions of the two fields that do not directly overlap. The conscious mind may have access to information in those portions of the fields, but that information is by definition not directly in consciousness, and its origin may be a mystery to the conscious mind. In this model, the unconscious mind is a composite in a different sense from the dualistic conscious mind. (1995, p. 95)

The body and the essence form a union, defined above as mind, that allows each substance to influence the other. This in-body union is possible only because body and essence are posited to have a common characteristic: both are associated with temporally varying, spatially extended electric dipole fields. The mind consists of the overlap of these fields, and thus is different from either field alone, and is incomplete without the contributions from both fields.

Arnette pointed out that all interactionist theories, by their very nature, require some commonality between the body and the essence. The essence must have some physical aspect for interactions with the body to occur. Likewise, the body must have some influence on the essence as well. Both the body and the essence must have a mutual influence in order to function together. Arnette concluded:

> According to the theory of essence, the body acts as a transformational system for the essence. The body detects electromagnetic, auditory, thermal, chemical, and mechanical information and transforms it via the peripheral and central nervous systems into an electromagnetic energy pattern in the brain that the essence can sample. The essence is dependent on the accuracy and integrity of physical (biological) systems, both sensory and motor, for the sensory data and physical causality it needs in order to negotiate the world and [live] in it. (1995, p. 97)

1.2.6 The Mechanism of Neural Firing

In his third paper, Arnette (1999) detailed a mechanism to explain how the essence can *trigger* neural action potentials through fluctuations in its electromagnetic field and at the same time how the essence can *sense* the action potentials as fluctuations in the brain's electromagnetic field.

For Arnette, the essence and brain occupy the same three-dimensional space and are bound together by electromagnetic forces. They interface with each other through a mutual causal influence of their respective oscillating dipole fields. Arnette defines the basic unit of conscious experience, a thought, idea, or mental image, as the *three-dimensional configuration of the essence's electric field*, interfacing with the brain at any given time.

> During the essence's thinking process, its dipole field fluctuates and changes in configuration. These fluctuations are impressed on the neurons' axon hillocks; when the field fluctuations drive the hillock voltage past the threshold of –65 millivolts, the neuron fires. This is how an idea can fire a neuron (1999, p. 91).

Conversely, neurons affect the essence through a complementary electromagnetic mechanism when signals from the sense organs are conducted to the brain. The neural action potentials are detected by the essence as fluctuations in the brain's electromagnetic dipole field. The *three-dimensional configuration of the fluctuations transmitted by the senses* are detected by the essence as the quality of a particular color, tone, scent, etc.

Thus, the essence creates the content of thoughts, ideas, and mental images, and the sensory neurons enable the essence to detect the qualities of percepts. The essence in turn can integrate and interpret the sensory content to form thoughts, ideas, and mental images. This exchange sets up a dynamic equilibrium between the brain and the essence.

> The picture that emerges from this proposed mechanism is one of constant interaction and communication between essence and brain through the fluctuations in the electromagnetic interface. Signals generated by the brain and nervous system are continually sensed by the essence, which in turn continuously influences the brain by virtue of the essential thinking process and the associated field fluctuations. (1999, p. 91)

Arnette didn't detail the mind-brain electromagnetic dipole interface, but it can be imagined that *neural dipoles* form from backward action potentials in the cortical pyramidal neurons' apical dendrites. Hence, the *dipole fields of the mind* would be on a similar scale, with a dipole length approximately the size of the cortical apical dendrites, around 1 mm.

1.3 Substance dualist NDE research: Robert and Suzanne Mays – The Self-Conscious Mind

Our research on NDEs started in May 2005. At the time, we were unaware of Arnette's interactionist dualist model based on NDE evidence. In the spring of 2008, we became aware of Arnette's three papers, after our initial paper had been completed (Mays & Mays, 2008). Therefore, we acknowledge the scientific priority of Arnette's work.

1.3.1 The Phenomenology of the Self-Conscious Mind

1.3.1.1 Line of Reasoning

Our scientific research is based on the phenomenological examination of the detailed subjective experiences of numerous NDErs, trying to *live into* their experiences, looking for commonalities and patterns, while withholding judgment until the collective evidence becomes overwhelming, and even then, always being 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).

In our paper on the phenomenology of the self-conscious mind, 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 suggests 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 (i.e., 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, when the body and brain have ceased to function, contradicts the prevalent view of neuroscience that consciousness can occur only when there is physical brain activity. Yet the 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 *independent* of it for a time, then self-conscious awareness probably operates as an autonomous entity *as well in the body*, although 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.
- We propose that the NDEr's autonomous mind is the person's consciousness itself—it *is* the person himself/herself—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.
- 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. Consciousness 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*.

1.3.1.2 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 described these features:

- 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 (Figure 2: Putnoki, 2014, pp. 54, 81).

> 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.

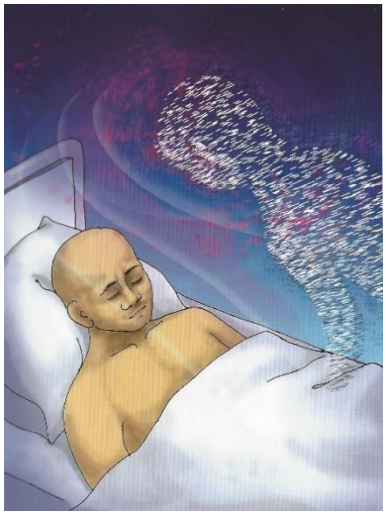


Figure 2. Tibor Putnoki's depiction of his immaterial body
[My body] appears to be me as substance-less, and yet it still has a shape; sort of amoeba-like. It looks like a TV screen when there is no program on, but there are black and white lights that are vibrant, and flickering. The whole body is like this.

- 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. 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 wrap-around 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 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.
- 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 infant 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. The NDEr can see other individuals who are also out of their bodies during the NDE in so-called "multiple simultaneous" NDEs. 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 by thought transfer or telepathy.
- The NDEr's "body" appears to be completely nonmaterial. The NDEr cannot be heard when speaking and is invisible to ordinary sight but can be sensed by animals. Some individuals 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.
- The process of returning to the physical body can be a gradual return such as walking back or falling back through the tunnel, or a quick snapping back into the body, or simply waking up instantly back in the body. The self-conscious perspective then returns to being fully within the physical body.
- 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 upon returning to the body.

1.3.1.3 Phenomenology of the Mind/Mind Entity

There is continuity of subjective experience throughout the NDE. The individual retains all the perceptual, mental, volitional, emotional, and memory faculties as within the physical body. However, several faculties are enhanced, apparently due to the liberation from the body. During the NDE, the individual appears to be a complete human being, the *same* human being as was present prior to the NDE. The separation of consciousness in the NDE is a coherent and self-consistent experience.

Thus, NDE phenomena strongly suggest that human consciousness is an entity in and of itself which, in ordinary life, is united with the brain and body but which may separate from the body during an NDE. Because the phenomena connected with NDEs strongly suggest that consciousness can operate as an agency completely

independent of the body and brain, we propose that this nonneural agency *is* the consciousness itself. In the 2008 paper, we called this entity the *self-conscious mind*. In subsequent writings, we have called this entity simply the *mind entity*.

The mind entity is an independent "field of consciousness" while out of the body. Because there is a seamless transition of consciousness in leaving the body and then returning, it is apparent that mediation by the brain does not alter the identity or unity of the mind's field of consciousness. The mediation of the brain appears to "dampen" mental faculties that appear to have less clarity and sharpness than in the NDE.

1.3.1.4 Mind Entity Interaction with Physical Processes

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

- Although the NDEr "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 "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 "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. There is one account of an NDE involving apparent interaction of the NDEr's "body" 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 "body" appears to interact with another person's physical body. When a cardiac arrest patient passed her hand through the doctor's arm, she felt it had a "very rarefied gelatin" consistency, with an electric current running through it. In other cases, the interaction can be felt subtly by the other person: one NDEr playfully tickled another patient's nose until the latter sneezed.

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

1.3.1.5 Mind Entity Interaction with the Brain:

We proposed that the self-conscious mind or mind entity is a spatially extended field of consciousness that merges with the brain and nervous system, that is, a three-dimensional field that is coextensive with the brain and body and operates through neural activity (Mays & Mays, 2008, pp. 35–36). Mind-brain interaction occurs with three main functions: (1) neural electrical activity of a certain duration and intensity brings sensations and thoughts to consciousness in the mind; (2) attentional and volitional mental events originating in the mind cause appropriate neural electrical activity to effect focus of attention and motor movements; and (3) neural electrical

activity, primarily in the hippocampus, causes the *formation* of long-term episodic memories in the mind and the *recall* of memories from the mind back to consciousness.

Memory is a good example, because memory formation, consolidation, and recall are clearly dependent on certain brain structures and pathways while in the body. On the other hand, existing episodic memories are accessible and can be recalled while out-of-body. Therefore, memory content must be "retained" somehow in the nonmaterial mind rather than in physiological brain structures. New episodic memories *of the NDE* are formed during the NDE. Therefore, memory formation is also a function of the mind. In this view, the role of the hippocampus is better considered as an *interface* with the mind to support formation, consolidation, and recall of memories rather than as *neural storage* of memory content. The memory is "carried" in the mind.

1.3.2 NDEs are Caused by the Separation of Consciousness from the Body

1.3.2.1 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 NDE Scale contains 16 items, each assigned a value of 0, 1, or 2 depending on the 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 near-death experiences (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 the NDE determine the quality or "depth" of the NDE (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 the 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. On this view, the separation of the mind entity from the physical body *is* the proximate cause of all NDEs.

1.3.2.2 NDE Scale Data Confirms 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 (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 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 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).

Figure 3 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:

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%**

Figure 3. Prevalence of Separation-Related NDE Scale Items (N=565)
The nine separation-related NDE Scale features in the study, listed in the order of prevalence in the dataset with their cumulative prevalence.

An analysis of the pairwise prevalence of the nine separation features showed that each separation feature occurs with other separation NDE features. Features like N3 Life review or N11 Life preview, which don't *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 cases of dreams, mind-altering drugs, meditation, etc. 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 since 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.
- 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 his physical body. NDE Scale data confirms the validity of the mind entity framework through the prevalence, coherence, and universality of the framework-related features (pp. 209–210).

1.3.2.3 The Mind Entity is an Objectively Real Thing

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).

2. THE MIND ENTITY FRAMEWORK

2.1 The empirical study of near-death experiences is valid

2.1.1 NDEs are a consistent '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's 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).

2.1.2 The elements in NDE narratives can be used 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.

2.1.3 The quality of evidence from NDEs is high

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).

2.2 The "mind entity" is 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 like "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 a sense of 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 a near-death experience. 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 and cultures. NDEs have been reported since ancient times.

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 in numerous NDEs shows that the out-of-body mind entity is an *objectively real thing* based on verified "apparitional" cases and numerous other cases in which the NDEr sees deceased persons whom they recognize.

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.

2.3 Two states: in-body and out-of-body

To summarize our earlier work, the mind entity can exist in two different states: embodied within a physical body or separated from the physical body (Mays & Mays, 2015, 2024).

- In the *in-body state*, the mind entity (or soul) is *coextensive* with the physical body, *merging* with 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, the mind has awareness of its surroundings, its physical body, and its own mental content. Thus, there is a high correlation between *neural activity* (action potentials) and the mind's 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-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 and work solely in the mind*.

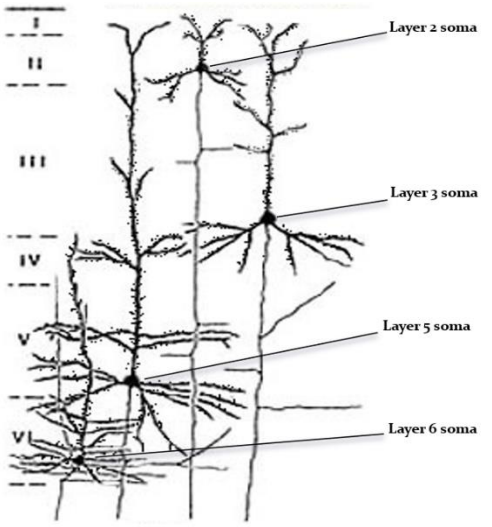
- In the *out-of-body state*, conceptual content comes *directly* to the mind through *intuition*, that is, immediate cognition. Therefore, in the *in-body state*, conceptual content comes to the mind *initially* through intuition as *thought* and then can be articulated in *words*.

2.4 Basic neurological principles for embodied consciousness

2.4.1 Cortical gray matter and dendritic spines

Cortical gray matter is the major component in the upper 2–4 mm of the 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 4a). The dendrites feature numerous tiny nodules known as *dendritic spines* (Figure 4b).



Cortical pyramidal neurons in layers 2, 3, 5, and 6 with apical and basal dendrites and dendritic spines

Figure 4a. Cortical pyramidal neurons, dendrites & spines

Pyramidal neurons in layers 2, 3, 5 and 6 of cortical gray matter. Vertical apical dendrites extend from the soma to the surface and basal dendrites branch out horizontally from the soma. Dendritic spines appear as numerous tiny nodules on the dendrites.

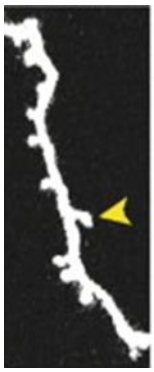


Figure 4b Dendritic spines

Dendritic spines are tiny nodules on the dendrites which can form a synaptic connection with another neuron's axon. We propose that the mind entity can also trigger action potentials by interacting with the spines.

Dendritic spines: Neurons connect through a *synapse* from the axon of one neuron to the dendritic spine of another. The sending neuron releases a neurotransmitter that activates the receiving neuron's spine and dendrite,

releasing positively charged ions. *Excitatory* neurotransmitters can lead to an accumulation of charge in the soma, causing the receiving neuron to generate an action potential, while *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.

2.4.2 Modular cortical organization

The cortex is organized in specialized domains or modules responsible for specific mental functions such as recognition of faces, words, shapes, speech, language, pitch, places, and so on (Figure 5). Other domains support general mental functions, including arithmetic calculations (Figure 6), 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; Kanwisher, 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). There are also a number of generalized domains in the frontal and parietal regions that 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).

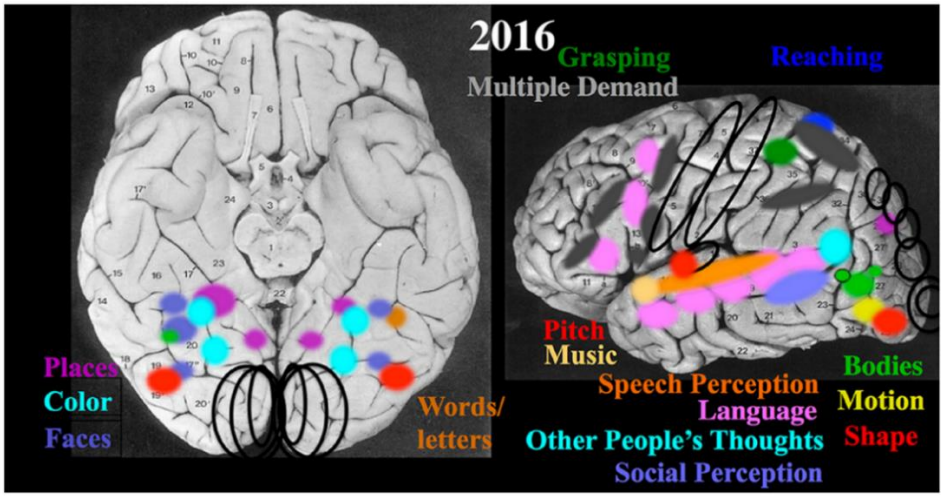


Figure 5. Specialized cortical domains
The cortex is organized in specialized domains or modules responsible for specific mental functions such as recognition of faces, words, shapes, speech, language, pitch, places, etc. From Kanwisher, 2017.

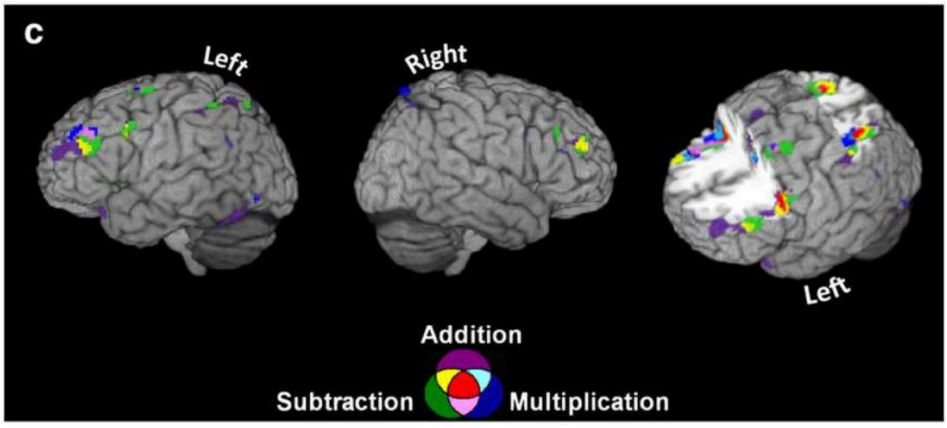


Figure 6. Cortical domains for mathematical calculation

Some cortical domains support general mental functions such as arithmetic calculations, which include separate and overlapping domains for addition, subtraction, and multiplication mental operations. From Arsalidou et al., 2011.

The evidence for specialized domains or modules also comes from brain lesions which associate a particular damaged module with the loss of a specific cognitive function, for example, with different forms of aphasias (inability to understand or produce language) and agnosias (inability to recognize objects, persons, sounds, shapes, etc.).

The specialized modules are generally independent of one another. Fedorenko & Varley (2016) studied people with *global aphasia,* who have almost no ability to understand or produce language, 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.

2.5 Principles of the mind entity framework for embodied consciousness

The mind entity as 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).

The mind entity as the seat of consciousness: In this framework, brain processes do not generate consciousness. 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 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.

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 activations 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*. Kanwisher et al., 2017; Arsalidou et al., 2011).

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). 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.

In sensory perception, the percept is first received from sensory neural activations. 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 is "carried" in the mind, rather than stored in the brain. Recall that all declarative and episodic memories are accessible out-of-body during an NDE and new episodic memories are formed during 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 reactivate 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 (see Section 3.3.3.2, below).

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.

Neural synchrony: 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.

Two critical questions remain:

1. What mechanisms enable the nonmaterial mind entity *to interact* with brain processes to detect and induce neural activity? See Section 3.
2. How does the mind entity *work with* the brain to produce conscious awareness? See Section 4.

3. THE MECHANISMS OF MIND-BRAIN INTERACTION

3.1 NDE phenomenology of interaction with physical processes

3.1.1 Evidence of interaction from NDE cases

The out-of-body experiences during an NDE suggest there are subtle interactions between the NDEr's "body" and physical processes. The initial list of interactions appeared in our first paper (Mays & Mays, 2008, p. 34) and are listed in "NDE Phenomenology" above.

Additional cases of NDEr interactions include:

- 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 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 Dr. Raymond Moody from inserting a needle in her physical arm and later related to him what happened. "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).
- 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).
- Out-of-body NDEr 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.

  > 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 moved the doctor's 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 experienced an extensive OBE 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, Case 4.3).

3.1.2 Mind entity interactions with physical processes

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 field of consciousness must interact with visible electromagnetic radiation (light waves).
- Accurate auditory perceptions suggest interaction with *sound vibrations*. For these perceptions to occur, the NDEr's 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 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.
- 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 "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 electrical activity to sense neural 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*.
- Interactions with living tissue resulting in the sensation of a viscous or gelatinous substance suggest a weaker interaction *within a living body* that differs from passing through solid matter.
- Accurate olfactory perceptions suggest interaction with *unique molecular structures.* The NDEr's 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).

3.1.3 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 nonmaterial body's interactions with the weak force of *molecular structures* of volatile odoriferous substances, like vinegar or spearmint.
- The nonmaterial body's interactions with the *weak resistance forces* of air molecules in sound waves.
- The nonmaterial body's interactions with the *somewhat stronger resistance forces* of the molecules *within fluids* or *within a living organism's body.*
- The nonmaterial body's interactions with the *strong resistance forces* within the *fixed matrix* of atomic nuclei and electrons *within solid matter*, like 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 structure 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.

3.2 Mechanism for the mind entity to detect neural activity

Evidence of the mind entity's ability to *detect neural activity* comes from (1) reports of feeling of electricity when penetrating another person's arm and (2) 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 (about –75 millivolts). 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 (about +25 millivolts) at the soma (cell body) and spreading throughout the dendritic arbor in less than 20 msec.

Figure 7, from Smith et al. (2013), 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.

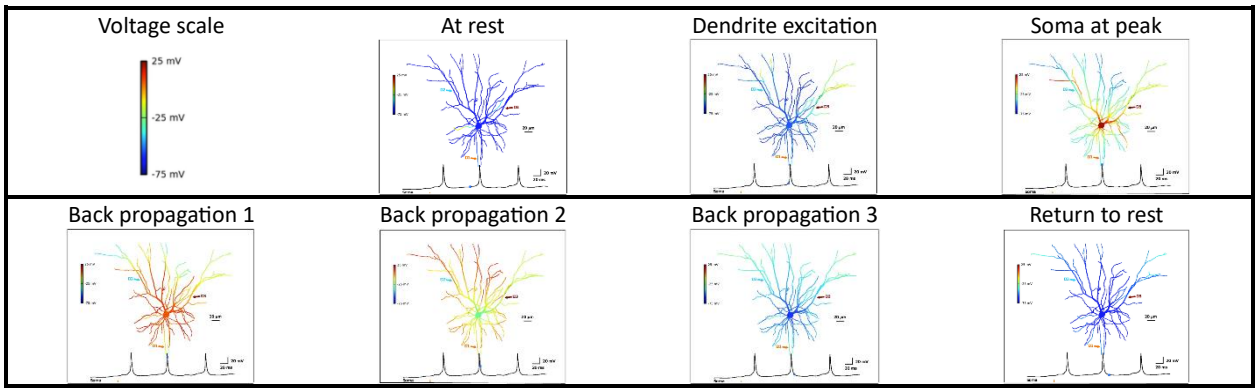


Figure 7. Back propagation of positive charge in a Level 2/3 neural action potential lasting ~20 msec
Video frames of a single action potential in an L2/L3 mouse neuron in the primary visual cortex in vivo. The sequential frames represent 20 milliseconds, spanning from the dendritic excitation through the back propagation of positive charge through the dendritic arbor, and returning to the rest state. From Smith et al., 2013.

The voltage of the neuron 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 back propagation 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.

3.3 Mechanism for the mind entity to induce neural activity

3.3.1 Evidence from inhaled anesthetics

The mind entity framework proposes that 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.

This mechanism suggests that the interaction between the mind and the brain occurs in the pyramidal neurons at the cortex surface (Figure 4). The pyramidal neurons contain dendritic spines which form synaptic connections with other neurons so that action potentials from other neurons can activate or inhibit the neuron. We suggest that some percentage of the dendritic spines have a different purpose, namely to *interface with the mind entity* to trigger action potentials.

Inhaled anesthetics like 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. Platholi et al. (2014) showed that isoflurane rapidly reduced and shrank dendritic spines by dissolving the 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 upon isoflurane elimination.

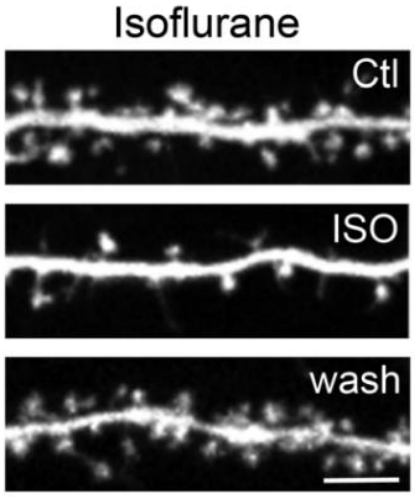


Figure 8. Effects of isoflurane anesthetic on dendritic spines
Dendrite from a rat hippocampal neuron culture. Top: Normal spine structure. Middle: With isoflurane, the spines have shrunk and collapsed. Bottom: With isoflurane wash out, the spine structures were restored. From Platholi et al., 2014.

Figure 8 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. These effects were reversed at the bottom 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 wash out, 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 allow 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 the 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*.

3.3.2 The mechanism of mind-induced action potentials

3.3.2.1 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 for 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.

During the action potential, calcium ions propagate from the soma back through the dendritic arbor (Figure 7), refilling calcium stores in the spines (Yuste & Denk, 1995; Johenning et al., 2015). 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 rest state.

3.3.2.2 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 (RyR) 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* or 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).
- *Ryanodine receptor ion channels* (RyR) are considered key players in the release of Ca^{2+} from internal SA stores. The presence of SP is strongly correlated with the presence of RyR. In most cases, the SP

protein and the RyR channel were found *adjacent to and touching each other* within the same spine. (Vlachos et al., 2009).

- Synaptopodin (SP) can also anchor structural *F-actin filaments*, which are dissolved by inhaled anesthetics, mentioned earlier. SP has been shown to bind *actin* and *α-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. (Vlachos et al., 2009; Falahati et al., 2025).
- *Mechanical coupling* between the F-actin filament-synaptopodin combination and the adjacent RyR 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 RyR, triggering its opening (Woll & Van Petegem, 2022, p. 246). The conformational flexibility of the RyR 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 RyR 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 leverage* 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 (Section 3.1.3).
- *SERCA (sarcoplasmic-endoplasmic reticulum Ca^{2+}-ATPase)* 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 9 summarizes the main mind-interface spine elements.

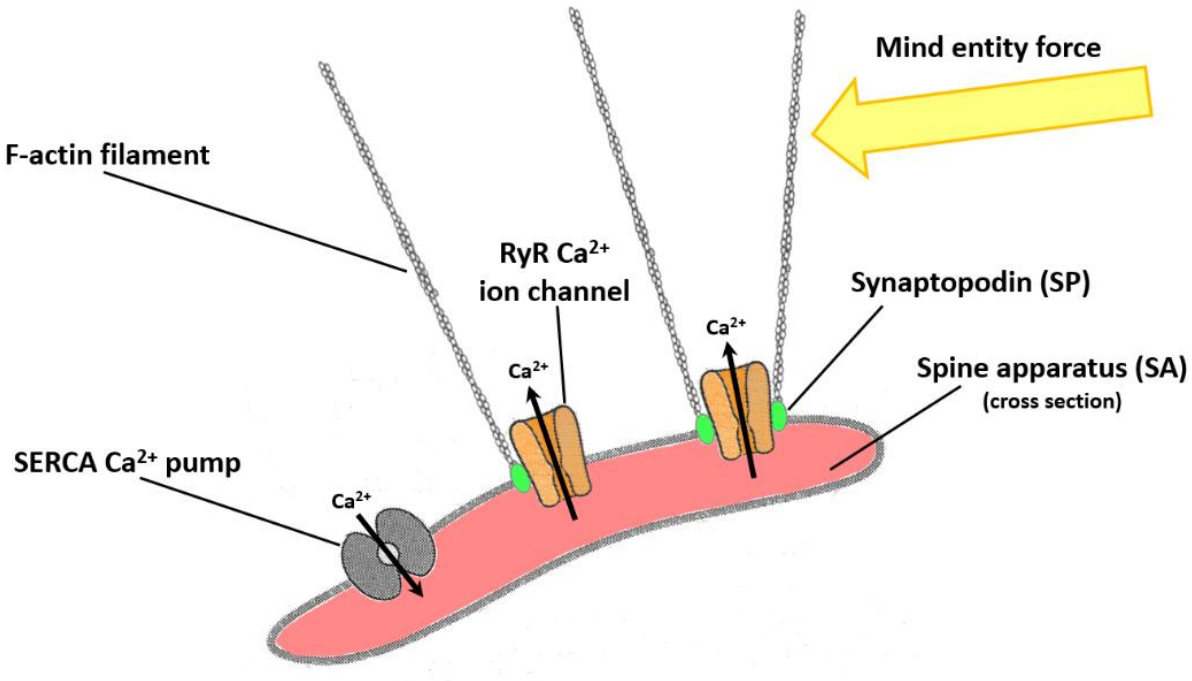


Figure 9 Proposed elements governing mind-interface spine calcium dynamics.
The circular spine apparatus is on the order of 500 nanometers in diameter. The elements depicted here are not drawn to scale. Adapted from Yuste, 2010, p. 152.

3.3.2.3 The mind interface in dendritic spines

Many dendritic spines form synapses to support neuron-to-neuron connections. We suggest that *some percentage* of the dendritic spines have a different purpose, namely to *interface with the mind entity* to trigger action potentials.

We suggest that these *mind-interface spines* probably do not include synaptic ion channels or form synaptic connections with other neurons. Rather, they are the intersection point of the mind with the brain. 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 synaptopodin (SP) molecules against their adjacent RyR channels (Figure 10a).

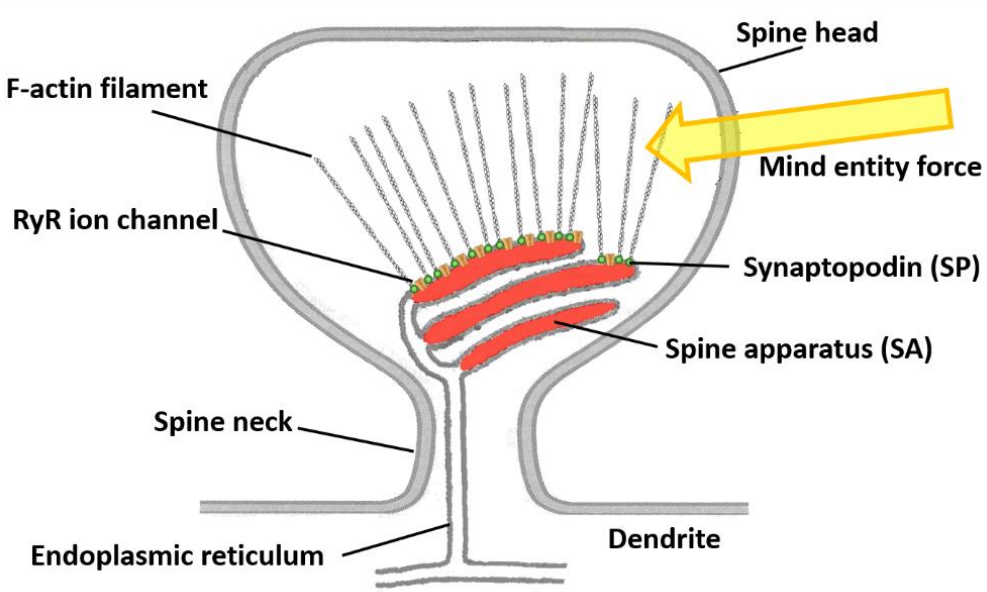


Figure 10a Diagram of the principal elements of the proposed mind-interface dendritic spine
This Figure is a schematic of a dendritic spine with its spine head and spine neck, connected to its dendrite. The spine apparatus (SA) contains stores of positively charged calcium ions, with its surface covered with RyR ion channels paired with synaptopodin (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.

A conformational change in the RyR channels releases Ca^{2+} ions into the spine and its dendrite (Figure 10b). 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 7). The calcium ions are stored again in the SA, resetting the neuron for further action potentials.

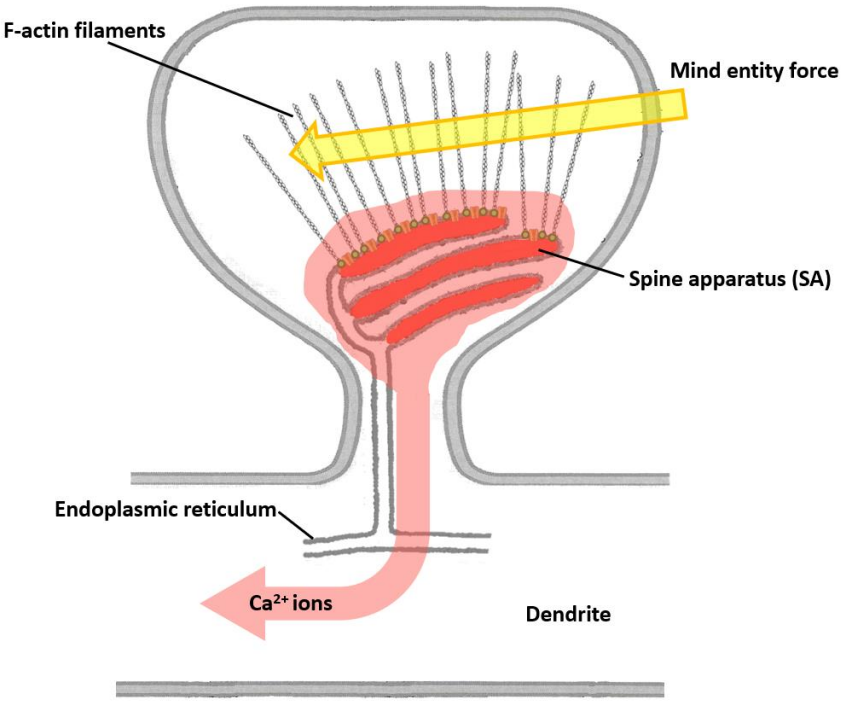


Figure 10b Mind entity force within the interface spine releases calcium ions
The mind entity's force on the filaments transfers to the SP molecules, causing a conformational change in the RyR channels which releases Ca^{2+} ions into the dendrite. Enough dendritic spikes then initiate an action potential.

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). 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 10c). 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.

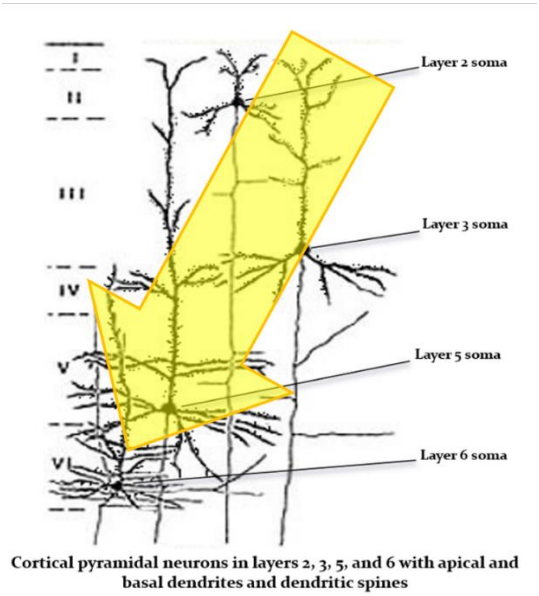


Figure 10c Mind entity force within a cortical minicolumn, many minicolumns make up a cortical column
The mind entity probably acts on cortical columns, segments of a brain region about 0.5 mm in diameter at the cortical surface. About 80 minicolumns make up a cortical column.

The activation of specific brain regions brings certain mental content into awareness (Figures 5 & 6). 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.

3.3.3 Validating evidence of the mind-to-spine interface

3.3.3.1 Dendritic spine density variations

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. Since the primary sensory areas are *purely input modalities*, the mind does not activate these areas but may increase 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 Table 1, estimating the number of spines in different regions of the cortex (Elston et al., 2001; Benavides-Piccione et al., 2013, 2021, and 2024).

In the human brain, the dendritic spine densities are significantly higher in the temporal and frontal lobes compared with the occipital lobe. The ratios are considerable: as much as 6 times more in prefrontal areas and 5 times more in the temporal lobe. 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.

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 inferior 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)

Table 1 Number of dendritic spines in human Layer III pyramidal neurons, comparing occipital lobe vs. temporal and frontal lobes
There are 3 to 6 times as many dendritic spines in temporal and frontal brain regions than in the primary occipital area.

In Elston et al.'s study (2001), a similar result was found for macaques and marmosets as well as humans (Figure 11).

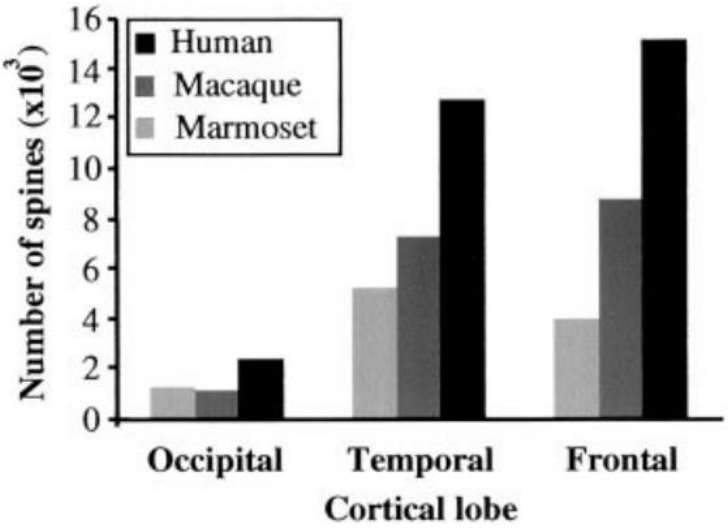


Figure 11. Estimates of the total number of spines in pyramidal cells in the occipital, temporal, and prefrontal cortex of marmosets (light gray), macaques (dark gray), and humans (black).
Dendritic spines in the prefrontal cortex of humans (15,138) and temporal lobes (12,700) are considerably more numerous than those in the occipital lobe (2,417). This pattern is also true in macaques and marmosets. Data and graph from Elston et al. (2001).

3.3.3.2 Dendritic spine density variation from infancy to maturity

A later study of macaques by Elston et al. (2009) found that spines in the temporal and prefrontal areas increased significantly in numbers at maturity compared to just after birth, whereas the number of spines in V1 actually *decreased* significantly from the number at birth to maturity. These results suggest that dendritic spines are needed to support cognitive faculties as the animal matures but are less needed for sensory faculties.

In subsequent analyses, "the differences in the developmental profiles of pyramidal cells result in systematic structural differences in the adult macaque and human brain such that pyramidal cells become more spinous as brain regions transition from sensory to association to executive cortex." (Oga et al., 2017, p. 2).

These results suggest that mind-interface spines are generated or pruned based on usage. The dendritic trees of pyramidal cells in the primary visual area actually lose more spines than they grow following the onset of visual experience.

We also propose that mind-interface spines form as different brain regions are used for cognitive functions over time. Repeated use of a region likely increases dendritic spine formation, enhancing *neuronal plasticity*, that is, a greater ease for the mind to induce regional neural activity.

3.3.3.3 Comparison of inhaled to intravenous anesthetics on the mind-brain interface

We propose that *inhaled anesthetic agents* cause unconsciousness by crossing the lipid bilayer of neural cell membranes and dissolving the F-actin filaments in dendritic spines (Section 3.3.1). These agents, though *chemically diverse with no recognizable or unifying chemical class* (Temple & Wiles, 2019), share a strong correlation between their anesthetic potency and oil solubility, the so-called Meyer-Overton correlation, particularly their ability to pass through the lipid bilayer neural cell walls (Janoff, 1981). Inhaled anesthetics dissolve F-actin filaments in dendritic spines, preventing the mind from triggering the neural activity necessary for consciousness.

The other class of anesthetic agents, *intravenous anesthetics,* are administered through intravenous infusion and now largely replace inhaled anesthetics. Their mechanism is not fully understood, but they likely work by

enhancing inhibitory $GABA_A$ receptors and blocking excitatory NMDA glutamate receptors (Schifilliti et al., 2010).

In our framework, the effect of intravenous anesthetics to enhance neural inhibition and block excitatory receptors *prevents mind-induced action potentials*, thus also inducing unconsciousness.

With both forms of anesthetics, inhaled and intravenous, the primary sensory regions—visual (V1/V2), auditory (A1), somatosensory (S1), etc.—continue to be activated through peripheral sensory organs, which transmit external stimuli to the brain. In both cases, the mind attempts to bring these percepts—mental representations of sensory stimuli—to awareness:

- With *inhaled anesthetics*, the mind is prevented from inducing the *initial* neural activity to enable the percept to be recognized. The inhaled anesthetic prevents the mind from activating the subsequent perceptual regions by disabling the mind's triggering mechanism *within* the dendritic spines. Thus, the person remains unconscious.
- With *intravenous anesthetics*, the mind is similarly disabled from activating the subsequent perceptual areas. The anesthetic enhances inhibitory receptors and blocks excitatory *synaptic* receptors. The mind's triggering mechanism in the spines remains intact but its initial neural activity cannot overcome the anesthetic's blocks. The person similarly remains unconscious.

4. FUNCTIONAL RELATIONSHIPS OF THE MIND ENTITY TO THE BRAIN

4.1 Delayed awareness & subliminality – Libet

4.1.1 Delayed awareness – 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. 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-mph 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*, like 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*.

4.1.2 Subliminal neural activity – Shevrin & Bernat

Subliminal neural activity is essentially identical to supraliminal neural activity, albeit at a reduced voltage or power level. This phenomenon can be seen in electroencephalographic (EEG) recordings. In one experiment, Bernat et al. (2001) showed emotionally evocative words (like "elated", "angry") to subjects, both subliminally (for 1 msec) and supraliminally (for 40 msec). The results are summarized in Figure 12.

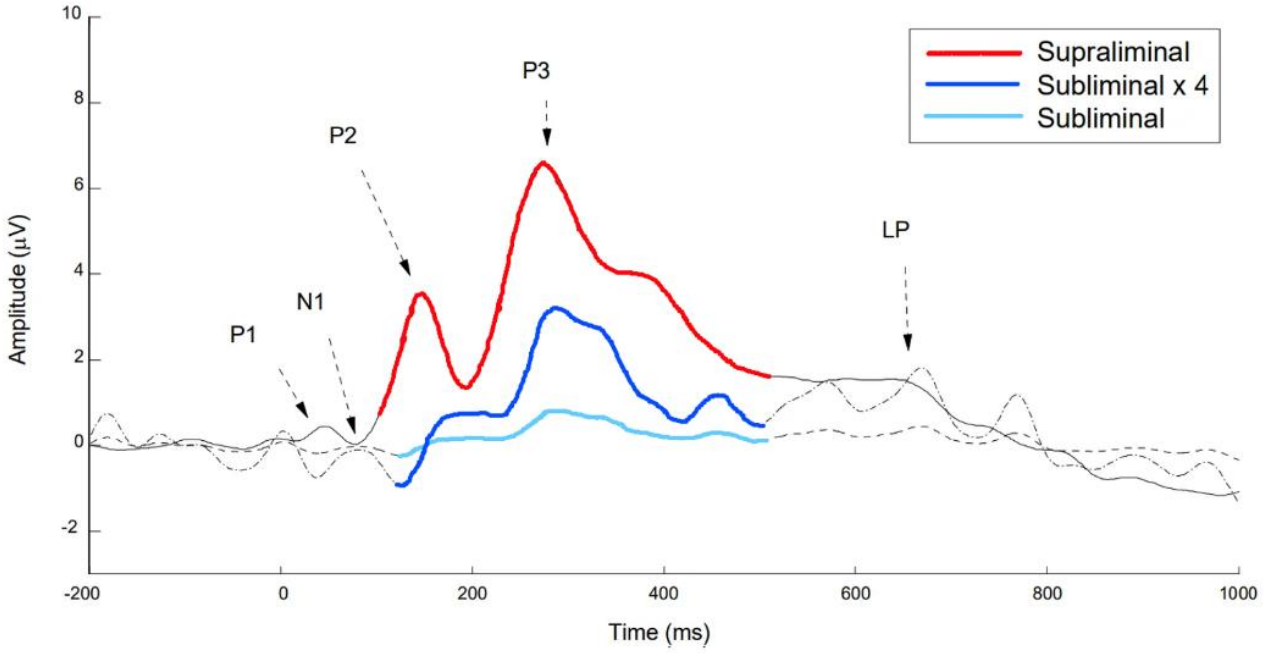


Figure 12 Neural activity with a subliminal stimulus follows a similar pattern as with a supraliminal stimulus, only at a lower voltage or power
Event-related potentials (ERPs) at supraliminal stimuli (red) and subliminal stimuli (light blue). For comparison, calculated subliminal x 4 (dark blue). From Bernat, Bunce, & Shevrin, 2001, Figure 1.

Supraliminally, the evocative words produced a characteristic event-related potential (ERP) (shown in red) with a positive peak P3 at 250 msec. *Subliminally*, the ERPs were quite small (in light blue), and the shape is ambiguous. However, multiplying the subliminal ERPs by a factor of four revealed a "visually apparent component structure (in dark blue) nearly identical" to that of supraliminal ERPs (Shevrin, 2001).

The substantial similarities in the subliminal and supraliminal ERP patterns suggest that the same neural activity in the same brain regions is involved but at a reduced voltage or power level. Each type of stimulus causes specific regions in the brain to fire, creating a characteristic pattern of ERPs over time. This result implies that the *same neural activity occurs* with subliminal stimuli as with stimuli that reach conscious awareness.

These phenomena suggest that early neural activity can be detected and recognized by the mind, enabling a response. When the intensity or duration of early neural activity does not reach a certain threshold, the stimulus does not *proceed to a second stage* where the stimulus becomes conscious in the mind.

4.2 Coming to awareness ("ignition") – Dehaene et al.

In a series of experiments, 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, or the method used to manipulate consciousness (Mashour et al., 2020).

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 that "code" 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. Masking a visual word stimulus immediately after the word is shown prevents the mind from *fully* activating the fusiform word form area needed to bring the *recognition* of the word form to awareness. Dehaene et al. (2001, Figure 2, middle, p. 755) shows that the activation reaches only 8% of the full intensity of the unmasked case, yet fMRI image shows clearly that the fusiform activation has 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 it 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 attentional focus is one of the main purposes of gamma synchronization. Since 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 propose.

4.3 Long-distance synchrony – 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." This method seeks correlations between participants' subjective experiences and the corresponding observed neural activity. In applying neurophenomenology to a specific cognitive task, Varela and colleagues demonstrated a striking correlation between neural electrical activity and the subjects' subjective experiences (Lutz et al., 2002; Lutz & Thompson, 2003).

Subjects 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, subjects completed trials with EEG recording 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" (focused attention) or "Spontaneous Unreadiness" (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 13, upper series).

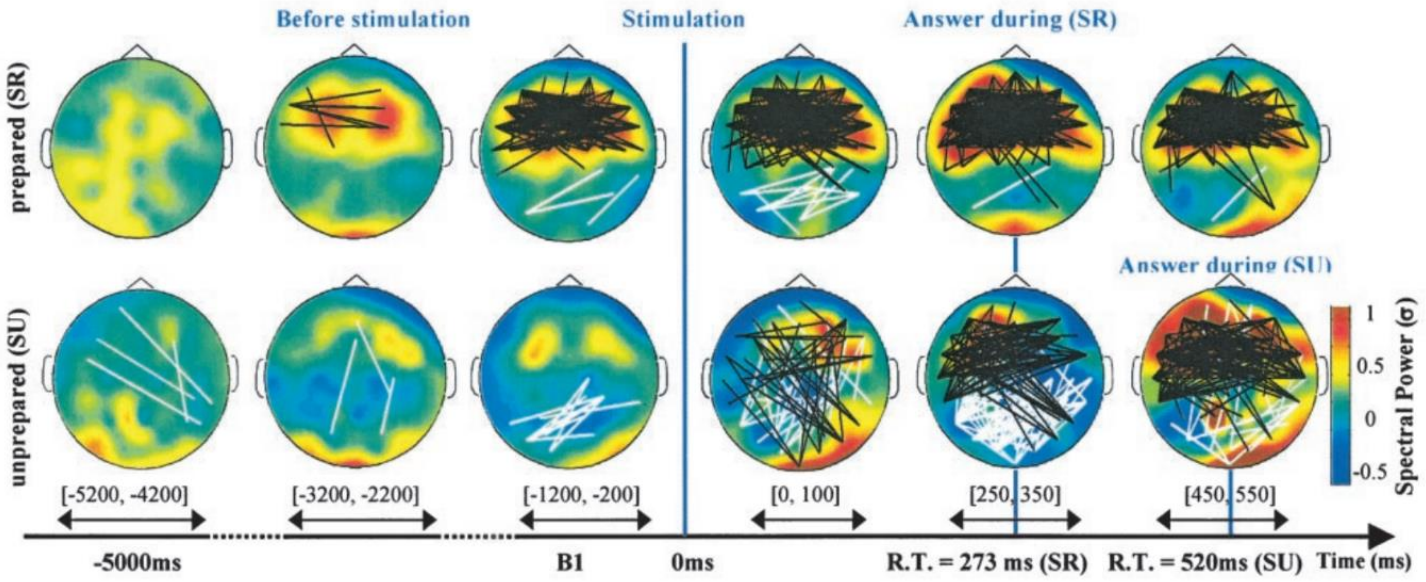


Figure 13 EEG recordings during Steady Readiness (SR, upper series) and Spontaneous Unreadiness (SU, lower series)
From Lutz et al., 2002.

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 13, lower series).

There were wide variations in the precise form of the subjects' phenomenal categories. 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), less 'focally' prepared (due to distractions or discursive thoughts), or was prepared with 'open attention' without 'active preparation'.

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

In our view, the Lutz et al. study demonstrates that the mind's activity can be studied both with objective measurements and with introspection of the subject'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. In our view, the mind's activity is the crucial determinant of the result. 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.

4.4 Steps of cognition in perception – Kutas

4.4.1 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 from Hagoort et al. provides an excellent example. When a subject reads a word in a sentence, the ERP records the process of (1) detecting the *percept* of the word, (2) comprehending the word's *meaning*, and (3) evaluating the word in the *preceding context* of the sentence.

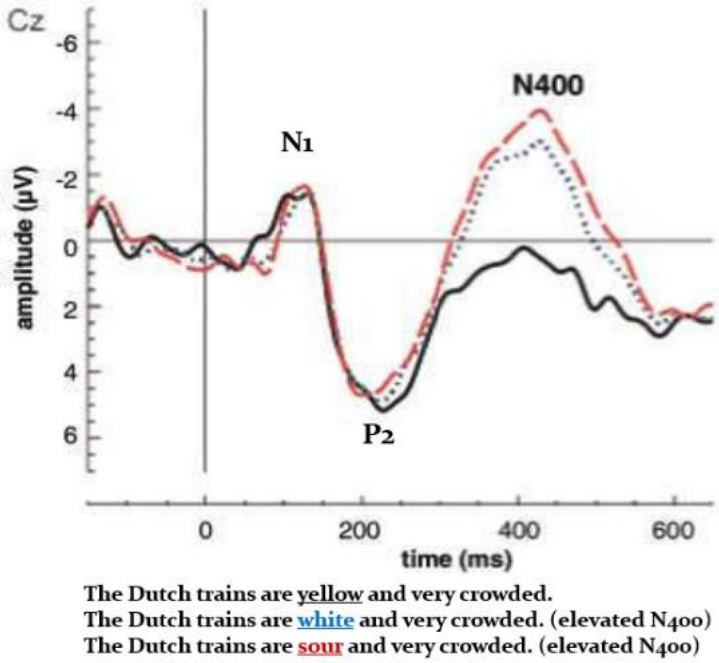


Figure 14 EEG traces on reading a target word in a sentence
The EEG traces for the target word when read in the context of "The Dutch trains are …". In fact, Dutch trains are yellow. With "yellow" as the target word, there is a normal-sized peak at 400 msec. If the target word is "white" or "sour," there is an elevated peak at 400 msec, the N400 effect, indicating a cognitive response to the incongruity. From Hagoort et al., 2004.

Figure 14 shows these steps for the target word of the sentence, "The Dutch trains are yellow …" Yellow is the target word. For Dutch people, their "world knowledge" is that Dutch trains are, in fact, yellow. In the ERP trace:

- At 115 msec, the N1 negative voltage-peak is associated with detecting the target word *percept* (the *form* of the word).
- At 200 msec, the P2 positive voltage-peak is associated with detecting the *meaning* of the word, the meaning or concept of "yellow," namely, a bright, warm color.
- At 400 msec: the minus voltage-peak is associated with awareness of how *congruent* or *incongruent* the word is in context. Since "yellow" is congruent, the trace follows the typical neural pattern of the black line.
- If the target word changes to "The Dutch trains are 'white' or 'sour,' " there is a large peak at N400, because "white" is incongruent (a world knowledge violation) and "sour" is anomalous (a semantic violation).

When a subject reads words in a sentence, *the earlier words establish the context*. When the subject reads an *incongruent* word in a sentence there is an unusual, strong minus voltage peaking at 400 msec (called N400).

There is an immediate, precise neural reaction to the word depending on the prior context. In some cases, the context can be established many sentences prior to the target word (Nieuwland & Van Berkum, 2006). In addition, the N400 tracks 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, 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.

4.4.2 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 uses the magnetic fields produced by the brain regions rather than the electrical fields.

In a similar study to Hagoort et al. summarized in Hari & Salmelin (2012), "MEG displayed a salient N400m in the left superior temporal cortex" (Figure 2, pp. 389–390). This study measured the cortical dynamics of silent reading. The MEG measurement is designated "N400m" to distinguish it from the corresponding EEG measurement. 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.

In Figure 15, we 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 distinct pauses between steps 1 and 2 and steps 2 and 3.

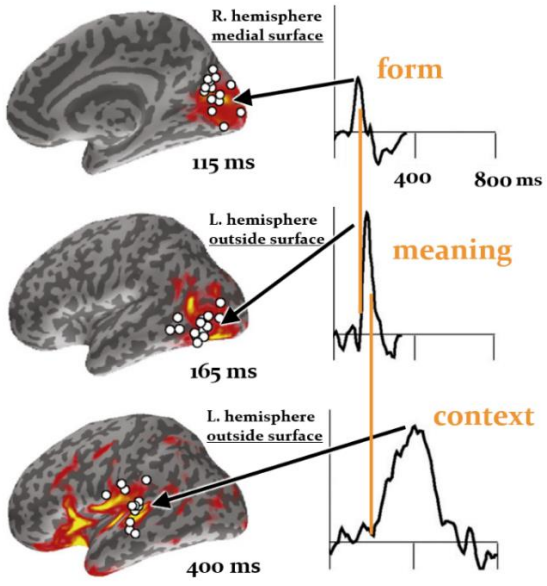


Figure 15 MEG cortical dynamics during silent reading.

The dots are specific regions of "equivalent current dipoles" (ECDs), where the magnetic dipole strength is highest. From Hari & Salmelin, 2012, Figure 2.

- **Pause 1**: We note that there is a brief pause between the peak in the occipital region at 115 msec and the beginning of the neural activation of the left inferior occipitotemporal cortex.
  - In this gap, we propose that the mind recognizes the percept as the form of an English 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 2**: We note that there is a second brief pause between the peak in the left inferior occipitotemporal cortex at 165 msec and the beginning of the neural activation of the left superior temporal cortex.
  - In this gap, we propose 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 provides a mental basis for the additional mental content.

4.5 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 depending on the specific brain region activated.

Coming to awareness or *ignition* was confirmed by the study done by Dehaene et al. (2001) and related studies: when words are visible (unmasked), there is propagation of neural activation and ignition of a large-scale correlated cerebral assembly. Recall that ignition occurs regardless of the stimulus modality, or the method used to manipulate consciousness. 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.

From empirical NDE evidence, we have shown that all conceptual content resides in the mind (Section 2.3). From the Libet and Dehaene studies we know that the embodied mind requires a certain level of neural activation to become aware of its own mental content.

We envision that the mind entity's three-dimensional field is *coextensive* with the brain's entire cortical surface, including sulci. The mind doesn't stand apart from the brain but 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.

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.

Rather, we propose the 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 man can stand in front of a mirror but will not see the message written on his forehead. However, if he shines a flashlight *at the mirror*, the reflected light will illuminate his forehead so he 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 16 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).

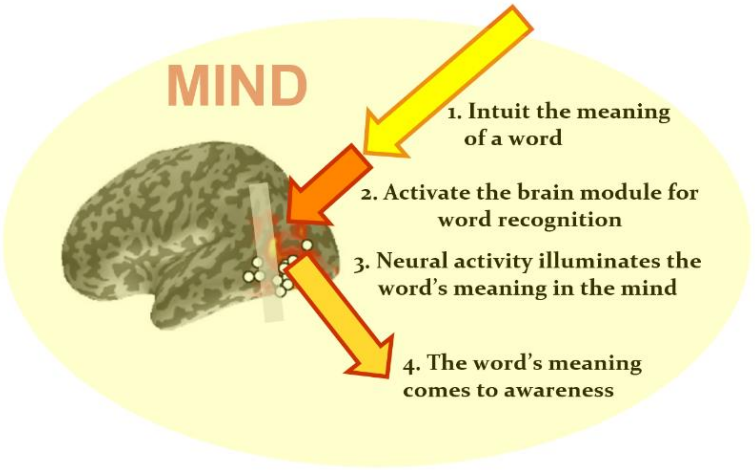


Figure 16 Process of coming to awareness
The four steps of mental content coming to awareness: 1. The mind intuits the mental content (here recognizing the meaning of a word); 2. The mind activates the appropriate brain region; 3. The neural activity in the brain region illuminates the conceptual content in the mind; 4. The mental content comes to awareness.

Rudolf Steiner had a similar intuition about the mind coming to awareness. Steiner (1861–1925) was an Austrian philosopher, scientist, and clairvoyant who worked introspectively. In a lecture in 1914, Steiner gave a description of the mind's activity in coming to awareness which 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, 1914/2024, Lecture 4).

5. PHILOSOPHICAL OBJECTIONS TO INTERACTIONIST DUALISM

5.1 Interactionist dualism

Most philosophers and scientists reject interactionist dualist theories, like the mind entity theory, because it would be impossible for a nonmaterial mind to interact with a physical brain. The predominant view, *physicalism*, considers 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 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. (Fischer, 2020, p. 151).

However, 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 (Section 3.1.1). And there is evidence that a subtle, previously unrecognized two-way force is involved in mind-to-matter interactions (Section 3.1.3).

Furthermore, the proposed mechanism for mind-brain interactions (Sections 3.2 and 3.3) involves a point of contact for the mind to interface with the brain—in the dendritic spines of cortical pyramidal neuron—and a push-pull force acting on F-actin filaments at the mind-brain interface. The mind triggers neural action potentials by opening RyR 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 (Section 4.5).

5.2 The 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" (Kim, 2011, pp. 50–56) questions how a nonmaterial mind that exists outside physical space can causally interact with a physical object (like 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 with each other (Sections 3.2 and 3.3). 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.

5.3 The causal closure of the physical

In philosophy, "physical causal closure" (Kim, 2011, pp. 214–217) states that all physical states have pure 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 (Section 3.1.3). The mind triggers neural action potentials by opening dendritic spine ion channels (Section 3.3.2.3) and senses the back propagation of action potentials (Section 3.2). 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. In both cases, we respond that the domain of physical reality and specifically the domain of physics need to be extended to include the existence of mind entities as a *distinct ontological category* (Section 2.2) and their properties.

6. MIND ENTITY NEUROSCIENCE versus PHYSICALIST NEUROSCIENCE

6.1 The mind entity framework as a new neuroscientific framework

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 has brought into consideration phenomenological evidence and facts, including the anomalous phenomena from near-death experiences, 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 NDEs as providing valid data for scientific study (Section 2.1.2).

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* (Section 2.2) which has philosophical validity as a form of substance dualism (Section 1.1). 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 (Section 4.3) since the most accurate source of evidence of conscious awareness is the subject's actual account of conscious awareness. We believe this approach will be more fruitful than computer simulations and mathematical modelling (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" brain neural activity via back propagation, whereas neuroscience deals with neural processes performing "calculations" through synaptic connections on neural representations of mental content via feedforward and feedback cortical connectivity.

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 like NDEs. Which theory fits the facts better? Does the mind entity theory provide a better explanation for subjective phenomenal experience than physicalist neuroscience?

6.2 Comparing the mind entity framework to current neuroscientific theories

A comparison between the mind entity framework and current neuroscientific theories can contrast the fundamental assumptions present in each. Over the years we have examined in detail the Global Neuronal Workspace hypothesis (GNW, Dehaene et al., 1998; Mashour et al., 2020) and Integrated Information Theory (IIT, Tononi et al., 2016). Both theories rely on mathematical models or computer simulations of cortical neural structures, comparing the theory's predictions and its explanation of empirical results.

The GNW model is a neural network computer model of the neural correlates of consciousness. The resulting model contains "local, specialized cortical processors [that] are linked, at a central level, by a core set of highly interconnected areas" (Mashour et al., 2020, Figure 1). Information within peripheral processors can be amplified and broadcast to other processors, making it consciously accessible via the central *workspace* (Figure 17, left). The wide accessibility of information in the global workspace is hypothesized to constitute conscious experience.

Integrated Information Theory (IIT) is a mathematical model for the consciousness of a system (e.g., a person). In IIT, a person's consciousness is conjectured to be identical to the *causal properties* of the physical substrate of consciousness (PSC), that is, the brain. In other words, the PSC must have intrinsic cause-effect powers to be conscious. A particular experience is identical to a *conceptual cause-effect structure* specified by a particular set of relationships of the parts of the PSC (Figure 17, right). The cause-effect structure can alter over time as each of its component parts changes, based on probabilities of past and future states, and constraints. The set of concepts and their relations in the cause-effect structure are identical to the *quality of the experience*.

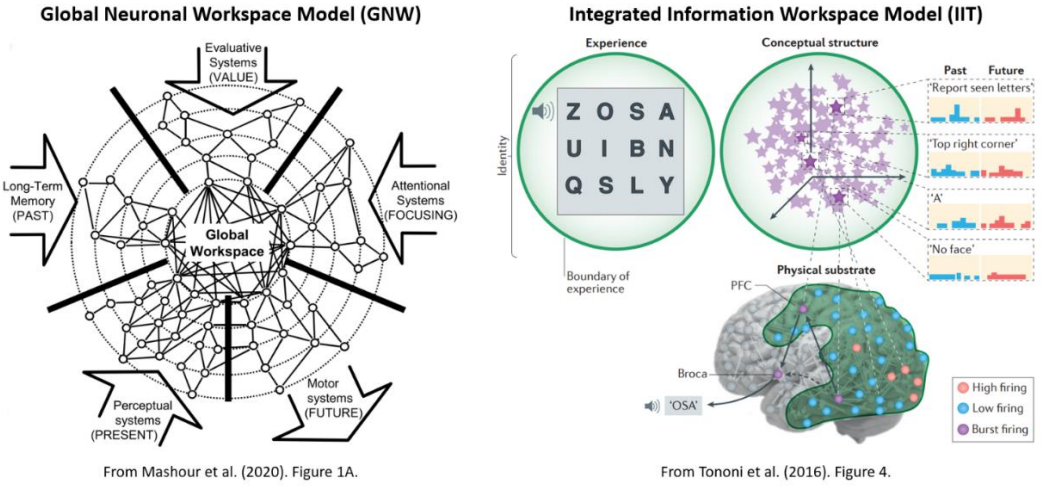


Figure 17 Two models of consciousness
Left: Global Neuronal Workspace theory from Mashour et al. (2020). Right: Integrated Information Theory from Tononi et al. (2016).

Both the GNW and IIT models of consciousness propose that consciousness *originates in* and *arises* in some way from the operation of the brain, either by the wide accessibility of information in the global workspace

(GNW) or by a cause-effect structure instantiated in a particular set of relationships of the parts of the PSC, that is, cortical neurons (IIT).

Neither theory addresses how subjective experience arises from the operation of the brain from the accessibility of information or from the conceptual cause-effect structure of the physical substrate. These fundamental relationships are taken as self-evident or necessary axioms and postulates.

Moreover, neither theory addresses the empirical evidence from NDEs that consciousness exists as a separate, independent entity while out of body.

From the perspective of the Mind Entity framework, the empirical evidence of mind entity is sufficiently compelling to propose that the mind entity or soul is a distinct ontological category (Section 2.2). The proposed mechanisms of interaction (Sections 3.2 and 3.3) and neurological evidence (Section 4) warrant proposing that the GNW and IIT models are actually describing the mind entity as the central feature in each model, as depicted in Figure 18.

The accessibility of information in the mind entity framework is explained (in Section 4.5) by the evidence Dehaene et al. (2001) used to describe the ignition of awareness (coming to awareness). The conceptual cause-effect structure in the mind entity framework is described (in Section 4.5, Figure 16) by the neural process of coming to awareness.

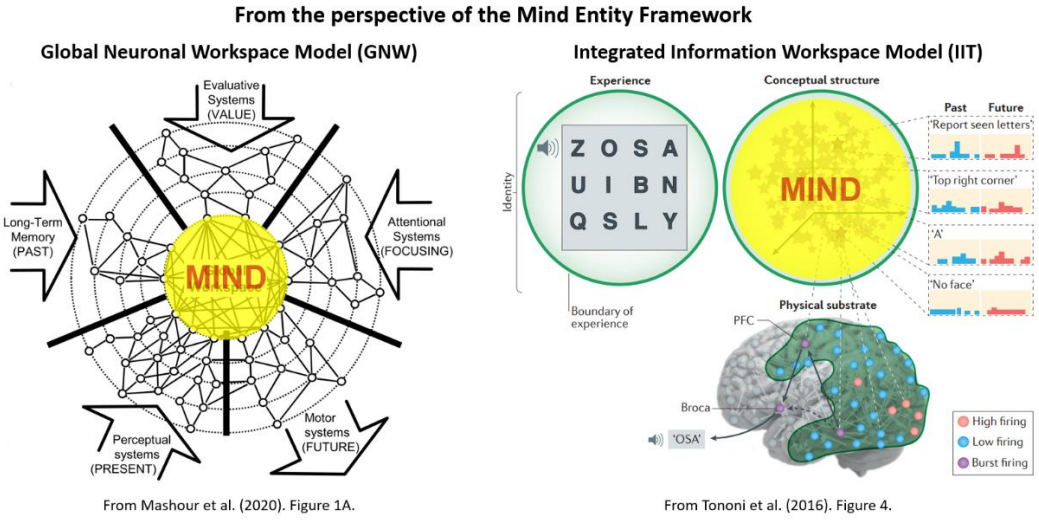


Figure 18 Models of consciousness from the Mind Entity perspective
The perspective of the Mind Entity framework in models of embodied consciousness.

7. DISCUSSION

7.1 Dualist interactionist theories based on NDE and neuroscientific evidence

Kenneth Arnette's theory of essence (Arnette, 1992, 1995, 1999) and our mind entity framework (Mays & Mays, 2008) were initially developed completely independently.

Our research on NDEs started in May 2005. At the time, we were unaware of Arnette's interactionist dualist theory based on NDE evidence. In the spring of 2008, we became aware of Arnette's three papers, after our initial paper had been completed. We met Kenny in 2010, and we have talked regularly since then. We recognize the scientific priority of Arnette's work. None of us is aware of any other published interactionist dualist models based on NDE evidence.

Arnette's theory of essence and our mind entity framework are based primarily on NDE evidence. They 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. Both frameworks propose mechanisms for embodied mind-brain interaction based on electrical brain interactions which give rise to consciousness, perceptions, thoughts, memory, motor actions, and unconscious mental effects.

Both frameworks propose mechanisms for the mind-essence to causally trigger neural activity and to causally interact with the brain's neural electrical fields to become aware of sensory percepts.

The differences between the two frameworks are primarily in the details of the causal connections between the mind and the brain.

7.2 NDE research as validation of substance dualism

Philosophers Brandon Rickabaugh and J. P. 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 near-death experiences which might be able to 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 (Section 1.1).

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.

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 is not only metaphysically possible but is also metaphysically real and is a separate ontological category* distinct from the physical body and any other physical object (Section 2.2).

Furthermore, we have described a framework for embodied consciousness (Section 2), for plausible mechanisms for mind-brain interactions (Section 3), and for the functional relationships between the mind and brain (Section 4). We have addressed the most prevalent philosophical objections to substance dualism (Section 5) and have contrasted the mind entity framework with two prevalent physicalist theories of consciousness (Section 6).

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

7.3 Further steps forward

In further papers, we will cover additional neurological topics not discussed in this work, focusing on different aspects of memory (episodic, declarative, procedural) and its basic processes (formation, consolidation, recall, and forgetting).

We will also address NDE phenomena relating to the transcendent aspects of reality (hyperdimensional perception, experiences of the transcendent realm, life reviews, and precognitive visions and knowledge).

With the mind entity framework, all aspects of neuroscience are now open to reexamination and reformulation (Kuhn, 1970, p. 150). We intend to address various neurological enigmas like split-brain and phantom limb phenomena.

More importantly, the mind entity framework can be applied by researchers to clinical cases, for example, autism and disorders of consciousness (DOC).

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