Self-Location Kinematics Influence the Generation of Near-Death Experience Cognitive and Affective Perceptions

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ABSTRACT: To date, researchers have focused mainly on verbal descriptions of near-death experience (NDE) phenomenology but have not investigated experiencers' (NDErs') graphic representations to understand NDE phenomenology through the physical body location and the subjective sense of self-location, that is, the feeling of "where I am" spatially located. Using graphic representations, we explored the topography (spatial features) of 15 NDErs' recollections of their body locations and self-location positioning. We specifically considered NDErs' kinematics (movements) visual field of view, and affects during distinct phases of the NDE. The various paths between successive self-location positions depicted in participants' drawings suggested specific subjective velocities, directionalities, and temporalities in which the physiological interaction of the visuo-vestibular and somatosensory signals produce a phenomenon known as *vection*. These signals act as motor agents in the NDEr's sense of self-location position and motion. Bodily self-awareness appeared to be transferred affectively to a self-location depending on how much the NDEr's multisensory integration of the visuo-vestibular and somatosensory signals was altered. Results showed that the kinematic components of the NDEr's sense of self-location correlated with a specific emotional state and field of view within a specific phase of the NDE sequence and trajectory (e.g., self-location motions at extreme speeds associated with a *reduced* field of view and achromatic textures; self-location motion at standstill associated with an *expanded* field of view and light textures). During a specific NDE phase, different phenomenal structures and textures occurred together, which we identified as a set of spatio-temporal configurations or "Archi-Textures" for that phase. We identified three distinct Archi-Textures as well as out-of-body experience perceptual patterns.

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KEYWORDS: near-death experience, mental representation, out-of-body experience, kinematics of self-location, affective embodiment, body image.

In this article, we will make extensive use of specialized terminology. For that reason, we begin with a glossary of technical terms describing a near-death experiencer's (NDEr's) phenomenological context.

Kinematics: the study of subjective self-location trajectories, including the motion velocities and accelerations between an initial location and a displaced location over time.

Parasomatic: relating to the out-of-body specific visuo-spatial perspective, which gives the impression of being realized from a perspective point of view outside the physical body location.

Self-location: specific spatial impressions of subjective self-localization and motion in near-death experiences (NDEs); these impressions are related to the peculiar sense of embodiment experienced in virtual reality immersive environments, which induce sensations of dissociation between one's physical body location and one's virtual spatial sensations of location.

Topography: the map realized by NDErs of the representations of their physical body and their self-location subjective position in space during NDEs.

Vection: the phenomenal sensation of self-location motion in the absence of physical movement through space. This phenomenon results from interactions of visuo-vestibular and somatosensory signals and typically occurs in virtual environments and in aviation.

We propose that vection phenomena are responsible for the self-location impression of motion in NDEs.

Archi-Textures: the set of spatio-temporal configurations of phenomenal elements—self-location, field of view, motion, and emotional state—for a specific NDE phase. Each set of phenomenal elements has a distinct shape of field of view, light textures, self-location velocity profile, and affective qualities. On the basis of the perceptual descriptors, we have identified three Archi-Textures sets. For example, the third Archi-Textures set has a standstill self-location, a boundless field of view, and achromatic light textures of extreme intensity, experienced as paroxysmal feelings such as joy and/or wellbeing.

NDEs are deep transcendental mental experiences typically following a life-threatening situation, such as cardiac arrest (French, 2005; Parnia et al., 2001; van Lommel et al., 2001); respiratory arrest, coma, traumatic brain injury (Hou et al., 2013); or states of shock (Greyson, 2015), but also associated with circumstances that do not jeopardize life (Charland-Verville et al., 2014). NDE accounts typically focus on written narratives, leaving unexplored the NDEr's mental representation. Earlier analyses of NDErs' phenomenal experiences used NDEr narratives and qualitative NDEr interviews, chiefly regarding the qualities of visual perceptions of the physical realm from an out-of-body perspective. Researchers variously characterized the differences in NDE perceptions from ordinary visual perceptions as "transcendental awareness" (Ring & Cooper, 1997); "hyperdimensional perception" (Brumblay, 2003); and "global perception," "360° spherical perception," and "perception by transparency" (Jourdan, 2001, 2011; Jourdan & Smythies, 2019).

The ineffability of these experiences seems to justify the development of an alternative approach to describe more precisely and re-enact the NDEr's subjective mental representations. Collecting the NDEr's detailed descriptions of mental representations allows the resurgence of memories linked to peculiar spatio-temporal impressions of self-location, including the NDEr's changed and changing visual multi-dimensional perspectives. This process provides more comprehensive reporting and also psychological integration for the NDEr. The process also enables better characterization of the affective dimension—its content and intensity—during an individual's NDE chronology. This study was designed to explore a new way of reading NDEs to discover whether it might offer wider and complementary insights to the conventional narrative approach.

The purpose of the study was to identify the spaces people are moving through during NDEs according to the qualitative perceptual features of these spaces and the mapping of their physical body and their self-location positions with their affective correlates. In that sense, the approach somewhat replicates that of Victor Egger (1848-1909), a French epistemologist and psychologist who, in an effort to understand the vivid sense of self reported by drowning survivors and other survivors of near-fatal events, examined their visual descriptions in his book *I of the Dying* (Egger, 1896). The specific research question we addressed was: What might be learned by using experiencers' mental representations of the kinematics of the physical body and perceived self-location, associated with the field of view and affective state of different spatio-temporal configurations, during specific NDE sequences?

Method

Because this study was exploratory in nature, we employed a qualitative approach. In order to overcome the idiosyncratic elements of NDEs and analyze the data to establish certain objective generic patterns, we combined the grounded theory hypothetico-deductive methods of Glaser and Strauss (1967) with a Husserlian phenomenological approach using Michel Bitbol's (2014) and Liliana Albertazzi's (2010, 2013, 2018) experimental and scientific phenomenological principles. This method of analysis is suited to the structural perceptual and intentional components of NDEs, which rely predominantly on retentional (memory-based) and protentional (anticipatory) dynamics. We focused on using the NDErs' sensorimotor and affective impressions to map the remembered location of their physical body and self-location point of view; the visual field shapes, textures, and boundaries; as well as the location of the mental imagery within the visual field. These elements are further described below.

Participants

Participants were 15 volunteers recruited from a pool of 300 volunteers from a larger research study on the retrospective analysis of NDEs conducted in collaboration with the Coma Science Group (GIGA-Consciousness, University of Liège, and University Hospital of Liège, Belgium). All 300 participants had an NDE as measured by the NDE Scale (Greyson, 1983) and the Weighted Core Experience Index (WCEI; Ring, 1980) and were over the age of 18 to give legal informed consent. Because NDEs have been shown to have universal core elements largely unaffected by demographic factors such as sex, race, and education level, we did not consider those factors. Because the study was conducted in French, fluency in both written and oral French was required for the understanding of protocol task instructions. Criteria of exclusion were physical hand impairments and/or vision disabilities, which could have prevented the execution of the graphic task.

The sample comprised 8 men (M) and 7 women (W), ranging in age from 40 to 82 years at the time of the study, with a mean age of 61. All participants were White.

Regarding their total NDEs, 11 (6 M, 5 W) had one NDE, and 4 (2 M, 2 W; Subjects 3, 5, 8, 9) had two, resulting in a total of 19 NDEs. At the time of their NDEs, the youngest was 12 years old, and the oldest was 57, with NDEs by sex and decade fairly evenly distributed. The interval between occurrence of the NDE and reporting them for this study ranged from 3 to 51 years.

Regarding NDE circumstances, seven (3M, 4W) were associated with traumatic injury, another seven were associated with disease (3M, 4W), and one experience (M) that scored on both scales as an NDE occurred during a meditation session in the apparent absence of injury or disease. The remaining four participants (3M, 1W) did not specify the circumstances of their NDEs.

Instruments

The NDE Scale (Greyson, 1983) measures the depth of an individual's NDE according to 16 multiple-choice items divided into 4 subscales: cognitive, affective, paranormal, and transcendental. Each item is rated 0 = not present, 1 = mildly or ambiguously present, or 2 = definitely present (Greyson, 1983; Lange et al., 2004). A total score is then calculated by summing all item responses, yielding a possible range from 0 to 32. A total score of 7 or higher constitutes the criterion for an NDE and was the criterion for participant inclusion in our study. Since its development, the scale's reliability and validity have been well established, having been used in hundreds of studies worldwide and translated into 20 languages (Greyson, 2021, p. 55).

The WCEI measures the phenomenological and depth variety of NDEs. It comprises a 10-point questionnaire of features of NDE phenomenology with each item receiving a weighted score such that total score ranges from 0 to 29. A score of 5 or below is considered to indicate a superficial NDE, 6-9 a basic NDE, and 10 or above a profound NDE. To be recruited for our study, participants had to score 6 or above.

Procedure

After securing written informed consent, we scheduled two confidential, one-on-one, semi-structured interviews with participants, which we conducted in person or via Skype Internet conference between 04/29/2014 and 07/20/2014. All interviews were audio-recorded via Zoom Q3HD, Facetime, or Sansa clip.

During the first, in person interview, participants performed a supervised drawing task. Participants were furnished with an A4-sized transparent sleeve, containing from bottom to top an A4-sized sheet of white paper, an A4 carbon copy sheet, and an A4-sized sheet of black paper. The black paper was used to “blind” the participants to what they were drawing to reduce self-consciousness and self-criticism regarding formal aesthetic representation criteria and to roughly simulate the NDEr’s visual inner space. To reduce friction with the paper surface, participants drew using a Pilot G-Tec-C4 rollerball pen on the transparent sleeve surface.

We asked participants to use the storytelling mode that most appealed to them to talk about the sequence of their NDE in phases—for example, a movie sequence, book chapter, or theatre play-act. For each sequence, we provided a transparent sleeve containing the different sheets of paper described above. For instance, if the participant had divided the experience into six phases, they received six transparent sleeves, positioned on a table in front of them and numbered in the order they had defined.

For each phase of participants’ experience they had defined, we asked them to draw the shape of the surrounding environment using basic two- and three-dimensional geometrical shapes—for example, ellipse, sphere, rectangle, square, or triangle—as they remembered it and to state or draw the dimension of their boundaries and the appearances of what they saw within those boundaries, such as the degree of light exposure, hue, temperature, saturation, contrast, opacity/transparency, and sharpness/blurriness. We then asked them to indicate by a mark, such as a dot or cross, in their order of appearance: the spatial position of their physical body and/or the position of their self-location (subjective point of view) and an outline of the field of view experienced from the perspective of each of those locations. We further invited them to specify any other sensory modalities they were experiencing from these respective viewpoints, such as light, sound, taste, touch, temperature, pressure, smell, and/or pain.

Next, we asked them to draw arrows indicating the direction of the self-location(s), if moving, and describe their sense of that motion in terms of acceleration/deceleration and velocity, such as extremely fast, fast, slow, or stationary. We asked them to name the emotions and sensory impressions they felt at each stationary position of the body and/or subjective point of view and to rate their intensity using a scale 0 (low)–10 (high). Last, we asked them to map the location of any mental imagery, such as people, entities, objects, and/or any other representational phenomena that emerged from the location of the body and the subjective self-location.

We then conducted a second interview via Skype or phone calls to clarify some of the visual descriptions and graphic elements collected during the first interview and to answer a questionnaire regarding what they considered to be the better mode of expression—oral versus non-oral form—for reporting their NDE.

Analysis of Data

At the end of the graphic recording, we kept only the white sheet as raw material for subsequent analysis and modeling. Using Adobe Photoshop CS6 (version 13.0 x64), the principal investigator (Lerner) anonymized the representations and erased the participants' hand-written comments. She also translated into English the audio recordings and graphic elements. At a later stage, the researchers added additional symbols, such as dots, arrow, and/or zones, to highlight or clarify some elements in the drawings, thus facilitating the visualization of their structural and perceptual components.

The steps involved in working with the data were: (a) categorizing descriptors, which consisted of collecting the descriptors used by participants into common groupings across their graphic reports, according to three forms of organization: forms of grouping, forms of shape, and forms of meaning; (b) increasing generalization, which consisted of grouping the descriptor categories to show their similarities, differences, or hierarchical relationships to distinguish generic NDE structures; and (c) extracting the invariant NDE structures, which would allow them to be objectified.

We applied these steps as follows. First we made an inventory of all the representational elements to enable their naming. This labeling and coding enabled us to extract invariant structures and certain groupings of elements according to their connectivity and predictability. Then we examined the graphic representations for reciprocal and hierarchical relations among their spatiotemporal features and their specific self-location kinematics. To interpret the data of the self-location positioning in an NDEr's experienced spaces, we employed the retinoid-supported model of egocentric space (Trehub, 2007, 2013). To interpret shapes and mental imagery formation and patterns in the NDEs, we used elements of neurogeometry of the functional architecture of vision (Petitot, 2017) and the physiology of action-perception (Berthoz, 2013; Berthoz & Jorland, 2004; Berthoz & Petit, 2006), as well as the biophysical picture representation theory (Bókkon 2008; Bókkon & D'Angiulli, 2009; Bókkon & Salari, 2012; Bókkon et al., 2011, 2013). Finally, we conceptualized the distinct categories of the NDE experiences to build a model while preserving the multidimensionality of the experience.

Results

An overview of our findings is presented in Table 1. Each column is explained and detailed in the following sections.

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Table 1

Overview of Participants' NDE Phases

Subject # /	Out-of-Body Experience		Archi-Textures I Phase		Archi-Textures II Phase	Archi-Textures III Phase	
NDE #	Dissociative	Associative	Outward	Inward	Ellipse/Sphere/Round	Outside	Within
S1/NDE1	x		x				
S2/NDE1	x		x	x	x	x	
S3/NDE1		x					
/NDE2				x	x		x
S4/NDE1			x		x	x	
S5/NDE1	x		x	x			
/NDE2	x				x		x
S6/NDE1		x		x	x		x
S7/NDE1	x		x			x	
S8/NDE1					x	1	2
/NDE2						x	
S9/NDE1			x	x			x
/NDE2					x		x
S10/NDE1			x	x		x	
S11/NDE1	x	x	x	x			x
S12/NDE1	x	x	x		x	alternating	
S13/NDE1			x			x	
S14/NDE1			x			1	2
S15/NDE1		x	x				

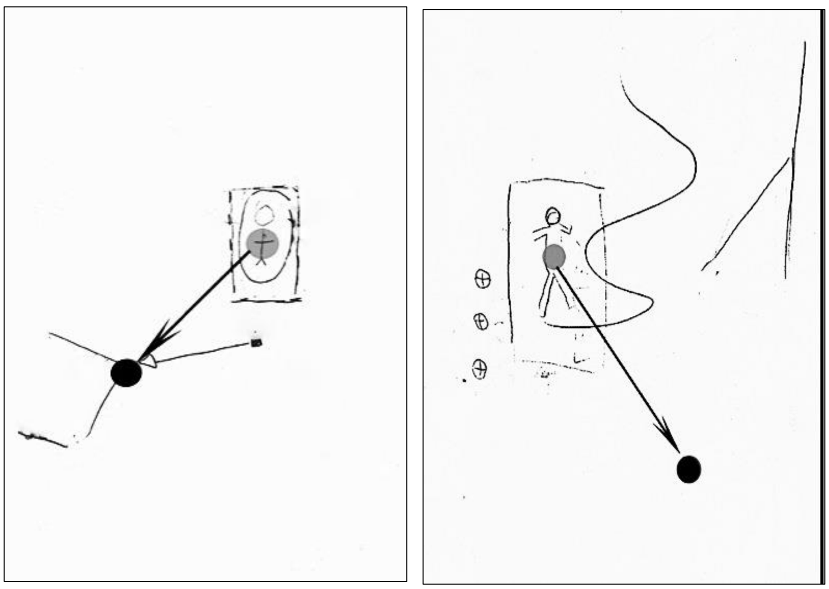
Out-of-Body Experience Perceptual Pattern

The first pattern we identified involved an out-of-body experience (OBE), which we define as a subjective spatial impression of leaving (dissociative phase) and/or reentering (associative phase) the physical body and seeing the physical body from a parasomatic (external from the physical body) point-of-view. Based on the 15 participants' drawings and narratives, 12 of their 19 NDEs included an OBE. Five participants (3M, 2W) reported only a dissociative phase (for sample drawings, see Figure 1), five participants (2M, 3W) reported only an associative phase (for sample drawings, see Figure 2), and two participants (1M, 1W) reported both dissociative and associative phases.

Figure 1

Two Examples of Participants' Drawings of Dissociative Phase of OBE

Subject 2, NDE 1 Subject 5, NDE 1

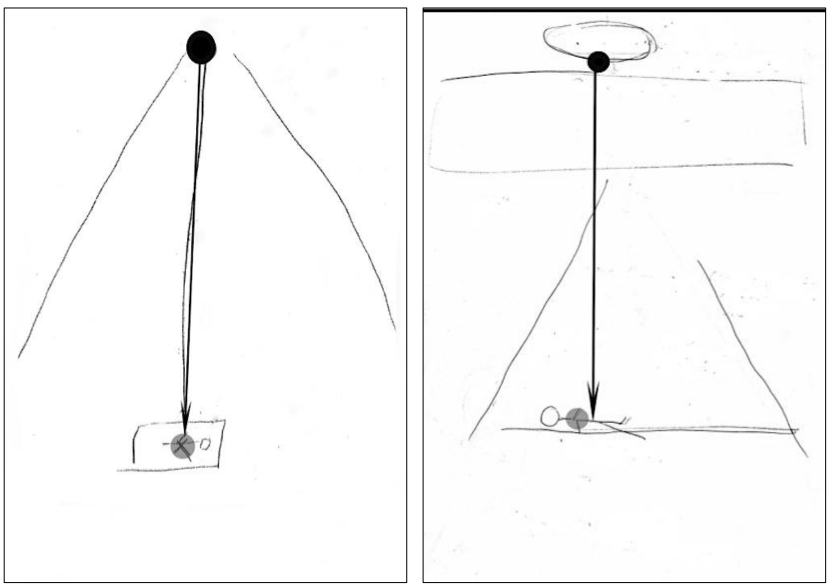


Note. Gray dot indicates physical body location, black dot indicates parasomatic point of view, and black arrow indicates upward motion from the physical body to a parasomatic point of view of the physical body location.

Figure 2

Two Examples of Participants' Drawings of Associative Phase of OBE

Subject 3, NDE 2 Subject 6, NDE 1



Note. Black dot indicates parasomatic point of view, gray dot indicates physical body location, and black arrow indicates downward motion from the parasomatic point of view to the physical body location.

Compiled data for the 7 dissociative and 5 associative NDEs—including physical body position, parasomatic point-of-view direction of motion, perceptual modality(s), and associated affect(s)—appear in Table 1. In all instances, participants reported visual perception. In all but one of the dissociative NDE phases, the motion of the parasomatic point of view was upward and oblique at an angle varying between 30° to 45°. By contrast, in all of the associative NDE phases, the motion of the parasomatic point of view was downward at 90° or, if the angle was not specified, was described as vertical or, in one case, vertical at a slight angle.

Table 1

Participants' Reported Dissociative and/or Associative OBE Phases, Including Physical-Body Position and Parasomatic Point-of-View Direction of Motion, Perceptual Modality(s), and Affect(s)

Category	Subject # / NDE #	Physical body position	Parasomatic point-of-view direction of motion	Perceptual modality(s)	Affect(s)
Dissociative	S1/NDE1	Supine	Upward motion left oblique.	Visual	Indifference.
	S2/NDE1	Supine	Upward motion; 3.5 m height at 45°.	Auditory and visual	Surprise, weightless, floating body.
	S5/NDE1	Supine	Upward motion; 5 m and 6 m height at 45°.	Visual ability to see through my own body—	
	S5/NDE2	Standing	Upward motion at a 12 o'clock position in clockwise rotation.	Visual	Awareness of dying. Fatalism, disgust, nausea.
	S7/NDE1	Supine	Upward motion, ceiling height at 30° followed by a 180° rotation.	Visual	Total acceptance, renunciation vertigo. At beginning of

					ascent, experience is very distressing, negative, and endless.
	S11/NDE1	Sitting	Upward oblique motion, height between 80-100 cm.	Visual	Fear, worry, terror, panic.
	S12/NDE1	Supine	Upward motion followed by followed by a 180° rotation.	Visual: I can see myself.	Consciousness of being dead; I am not surprised.

Associative	S3/NDE2	Supine	Downward motion; ceiling height at 90°.	Visual	Astonishment with no surprise, extreme negativity.
	S6/NDE1	Supine	Downward motion, vertical at a slight angle.	Visual	Amazement, sadness, joy, love.
	S11/NDE1	Sitting	Downward motion at 90°.	Visual	Sensation of being human, of having returned, of my whole body being here.
	S12/NDE1	Prone	Downward vertically.	Visual	Slightly afraid, we have no choice. It is a free fall. Sadness. Refusal to come back.
	S15/NDE1	Supine	Downward motion at 90°.	Auditory and visual	Failure, anxiety, fear, anger, physically heavy.

Archi-Textures Perceptual Patterns

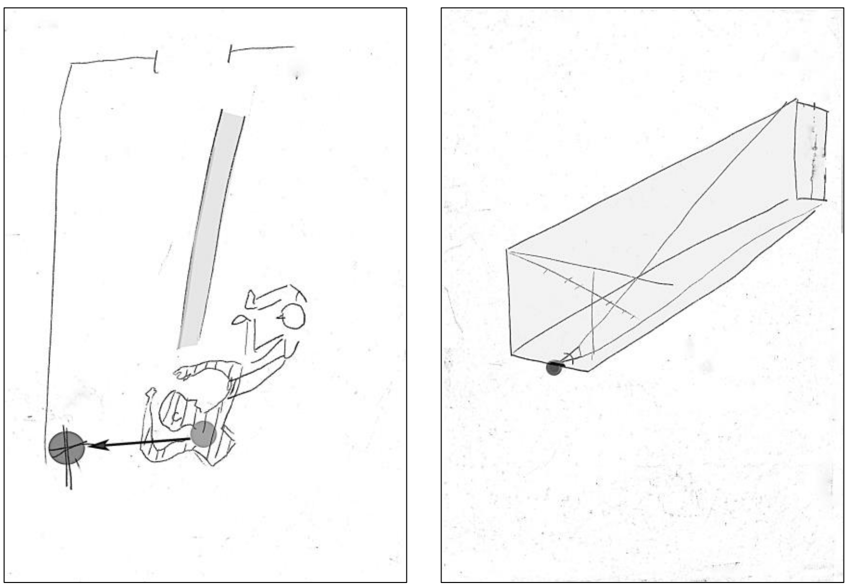
We identified three additional NDE phases that we labeled Archi-Textures. Each of these phases involved (a) a specific field of vision, characterized by a shape and texture; (b) a specific self-location movement in relationship to that field; and (c) specific associated affect(s). Archi-Textures I is distinguished by a convergent, vergent, or divergent field of vision; Archi-Textures II by an elliptical, spherical, or round field of vision; and Archi-Textures III by self-location with regard to the intense light that most NDErs perceived.

Before we detail each of the three Archi-Textures, we present an example that illustrates a transition from an out-of-body phase to a visually embodied self-location in Archi-Textures I; see Figure 3. The left drawing shows the visual field (gray column) projected from the physical body. As subjective self-location leaves the body (gray dot moving in direction of arrow from physical body to location of black dot), the projected source of the visual field "follows" the subjective self-location, resulting in the visual field projected from the new parasomatic self-location (right drawing).

Figure 3

Example of a Transition From a Dissociative OBE Phase to an Archi-Textures I Outward Trajectory

Subject 2 , NDE 1



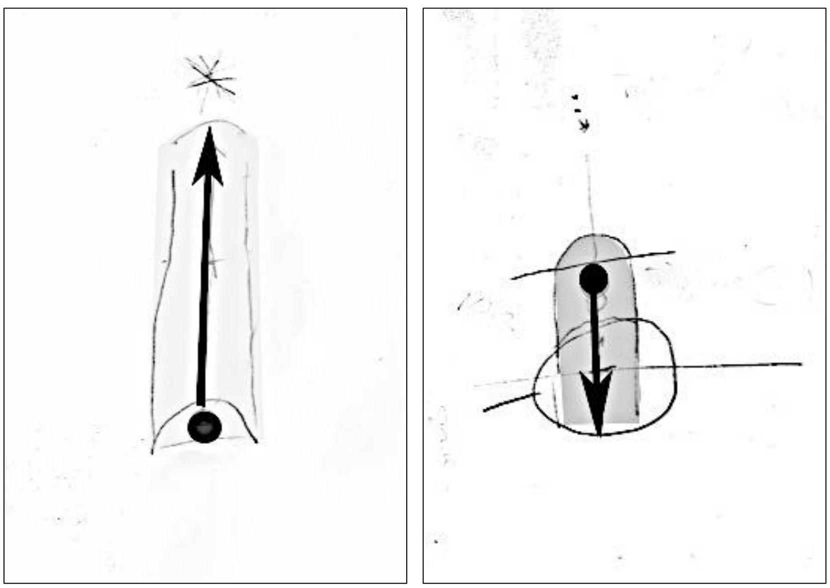
Archi-Textures I: Convergent/Vergent/Divergent Visual Field and Associated Motion(s) and Affect(s)

Out of our participants' 19 NDEs, 14 reflected a pattern we identified as Archi-Textures I. In Archi-Textures I, shapes of the perceptual boundaries of the experiencer's exteroceptive visual field involved either convergence (narrowing down), vergence (parallel), or divergence (widening out) of the visual field, and texture was either chromatic (presence of color) or achromatic (absence of color, with shades ranging from white through increasingly darker grays to black). Archi-Textures I self-location motions involved outward trajectory (away from initial location), inward trajectory (return toward initial location), or both, with directions of the self-location motions described in terms of the six cardinal field-of-gaze directions: upward (superior rectus), downward (inferior rectus), inward (medial rectus), outward (lateral rectus), downward-and-outward (superior oblique), and upward-and-outward (inferior oblique). A complete Archi-Textures I round-trip included an outward and inward trajectory; examples of three round-trip participants' drawings appear in Figure 4 A, B, and C.

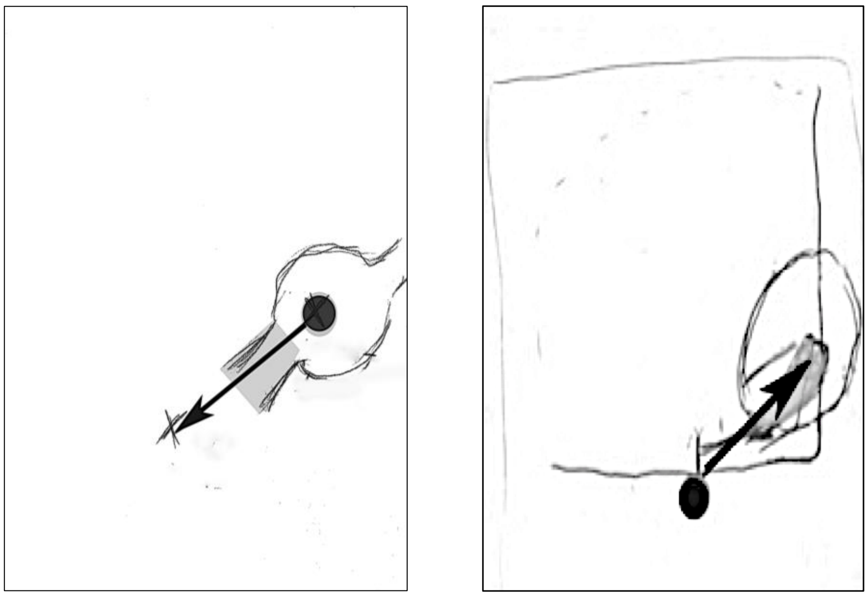
Figure 4 (A, B, C)

Examples of Three Participants' Drawings of Archi-Textures I Visual Field Perceptual Boundary and the Outward and Inward Motion Trajectories of Self-Location

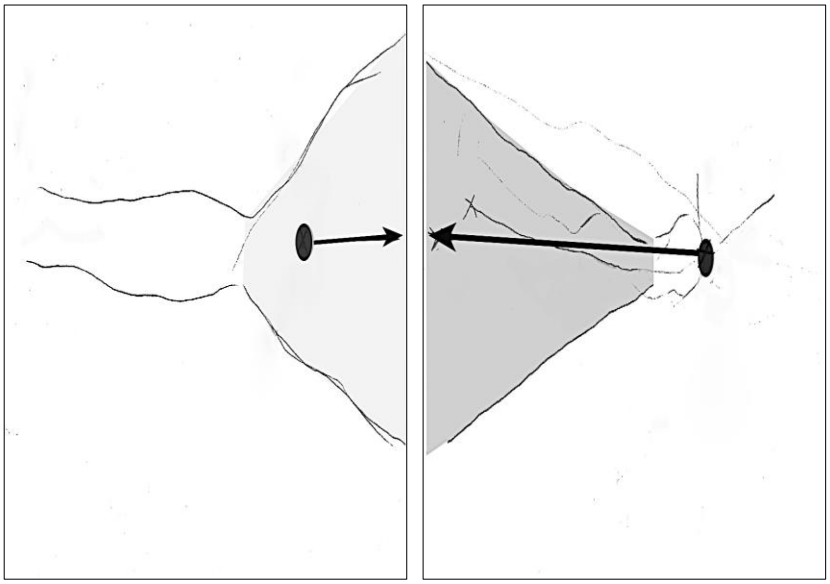
A - Subject 2, NDE 1. Left drawing: outward trajectory, vergent visual field, upward movement. Right drawing: inward trajectory, vergent visual field, downward movement.



B - Subject 11, NDE 1. Left drawing: outward trajectory, divergent visual field, downward-and-outward movement. Right drawing: inward trajectory, convergent visual field, upward-and-outward movement.



C - Subject 9, NDE 1. Left drawing: outward trajectory, divergent visual field, outward movement. Right drawing: inward trajectory, divergent visual field, inward movement.



Note. Black dot indicates self-location position; black arrow indicates trajectory direction; and gray area indicates visual field.

Compiled data for the 14 NDEs with features reflecting Archi-Textures I appears in Table 2. Outward and inward trajectories varied with regard to convergent/vergent/divergent shape of visual field. The *outward* trajectories of the self-location motions were expressed in an upward (Figure 4 A left drawing), forward oblique (Figure 4 B left drawing), or forward horizontal (Figure 4 C left drawing) motion. By contrast, the *inward* trajectories of the self-location motions were expressed in a downward (Figure 4 A right drawing), backward oblique (Figure 4 B right drawing), or backward horizontal (Figure 4 C right drawing) motion. When the experiencers reported their self-location moving along *both* outward and inward trajectories, the inward trajectories appeared to be mirror representations of the outward trajectories. In these cases, the self-location during inward trajectory headed in the *opposite* direction of the outward trajectory. Texture in all cases except one outward trajectory was achromatic, and affect across cases was varied.

[Insert Table 2 about here. Note to typesetter: Please place Table 2 on left page and Table 2 (continued) on right page, aligning S/NDEs [for example, S1/NDE1 aligned in Table 2 and Table 2 (continued)]

Archi-Textures II: Elliptical/Spherical/Round Visual Field and Associated Motion(s) and Affect(s)

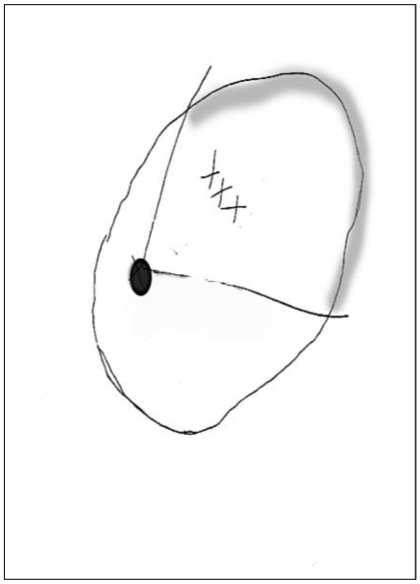
For Archi-Textures II, characterized by eight of our 15 participants' 19 NDEs, experiencers described a rounded field of vision: six ellipses, including one ellipse in 3D; one 3D sphere; and one round space. For sample drawings, see Figure 5 A, B, C, D, and E.

Figure 5 (A, B, C, D, E)

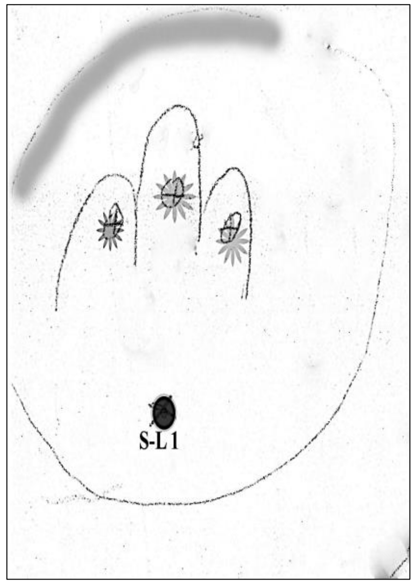
Five Examples of Participants' Drawings of Archi-Textures II Visual Field Perceptual Boundary and the Motion Trajectories of Self-Location

A - Subject 9, NDE 2

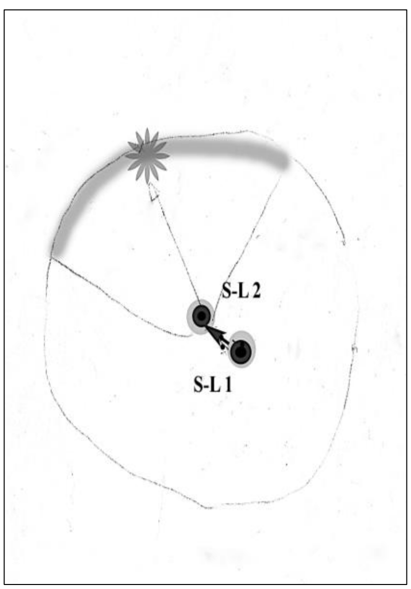
B - Subject 5, NDE 2



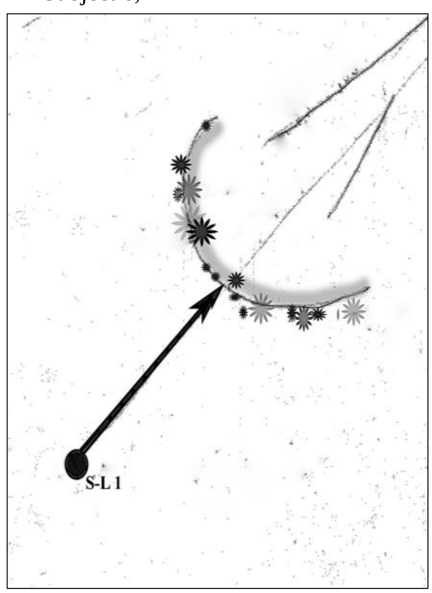
C - Subject 8, NDE 1

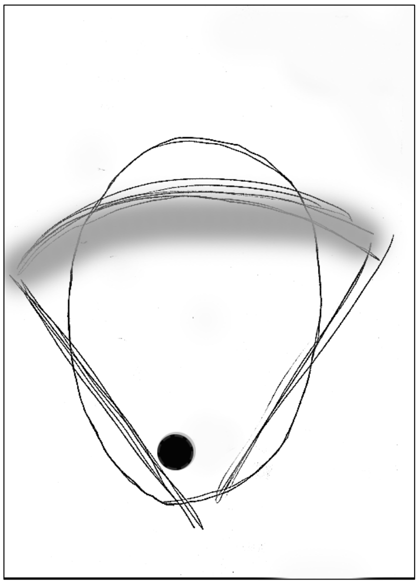


D - Subject 6, NDE 1



E - Subject 12, NDE 1





Note. Black dot indicates self-location position; black arrow indicates trajectory direction. "S-L" stands for self-location positions, numbered according to their motion's chronology (i.e., S-L 1, 2, 3…). Gray line outlines the Archi-Textures II field-of-vision boundary shape; gray star indicates location of emergence of mental representations.

Compiled data for the eight NDEs with features pertaining to Archi-Textures II appear in Table 3. In all eight cases, the Archi-Textures II texture was chromatic, motion trajectory was forward and/or standstill, and affect was varied.

Table 3

Participants' Reported Archi-Textures II Phase Features, Including Self-Location Elliptical/Spherical/Round Visual Field and Associated Motion(s) and Affect(s)

Subject # / NDE #	Visual Field		Motion Direction & Velocity	Affect(s) with Likert 0 (absent) – 10 (max intensity)
	Shape/Size	Texture		
S2/NDE1	≅ 0.75 of an ellipse	Chromatic	1. Forward motion 2. Forward motion 3. Standstill	1. Surprise (8) 2. Joy (10) 3. Joy (10)
S3/NDE2	≅ 0.25 of an ellipse	Chromatic	10 to 0 forward motions	Feeling of bliss (10) gradually decreasing as we move along the position 9 to 0
S4/NDE1	≅ 0.5 of an ellipse on subject's right-hand side at a 3-3.5 m height	Chromatic	Forward motion at walking pace	Joy and well-being (8-9)
S5/NDE2	≅ 0.5 of a 3D ellipse with a field of vision opening at 90-100°	Chromatic	Standstill position with a bird's eye view at an angle between 50-60°	Fear (3), fatalism, inexorability, no joy, sadness (8), joy, desire, total happiness
S6/NDE1	≅ 0.5 of a 3D sphere	Chromatic	Forward motion	Love (10), joy (10)
S8/NDE1	≅ 1/3 of a round space	Chromatic	Forward motions: 1. Lying 2. Sitting 3. Standing	1. Incomprehension (3), fear (10) 2. Stupefaction (10), curiosity (2) 3. Sorrow (9)
S9/NDE2	≅ 1/3 of an ellipse	Chromatic	One standstill position	Joy (10), reunion, love (10)
S12/NDE1	≅ 0.25 of an ellipse	Chromatic	Alternately: forward motion and 6 standstill positions	Joy (10), telepathy

Note. *n* = 8 NDErs, each reporting on one NDE.

Archi-Textures III: Position With Regard to the Light and Associated Motion(s) and Affect(s)

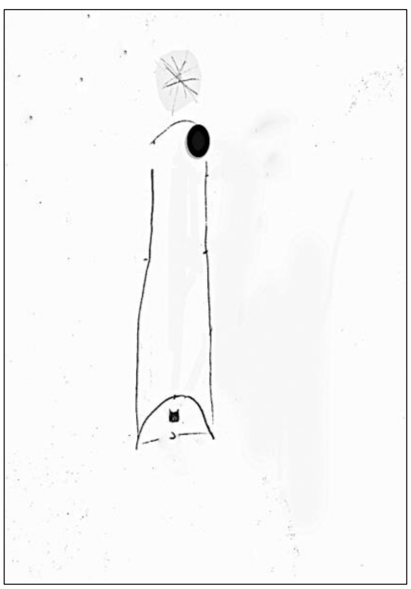
Of our 15 participants' 19 NDEs, 13 participants in 15 NDEs reported perceiving an intense light. We distinguished two types of Archi-Textures III self-locations with regard to the light: either *positioned outside* it or *embodied within* it; an NDE could include either one or both. For sample drawings, see Figure 6 A, B, and C.

Figure 6 (A, B, C)

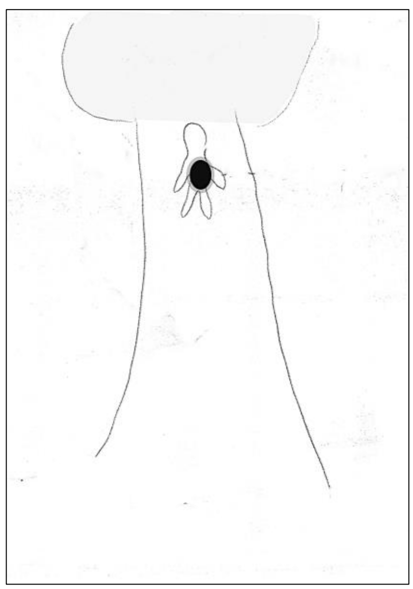
Twelve Examples of Participants' Drawings of Archi-Textures III Visual Field Perceptual Boundary and Motion Trajectories of Self-Location

A - *Five Examples of Self-Location Outside the Light*

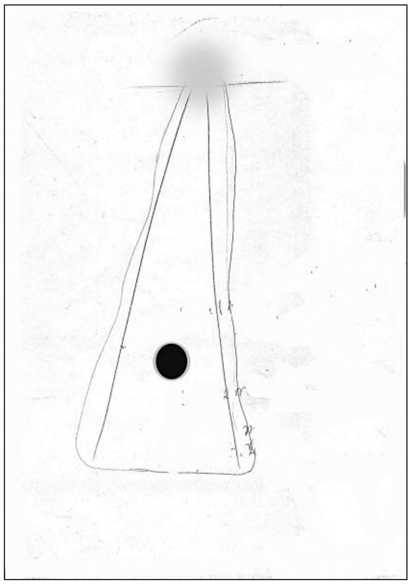
Subject 2, NDE 1



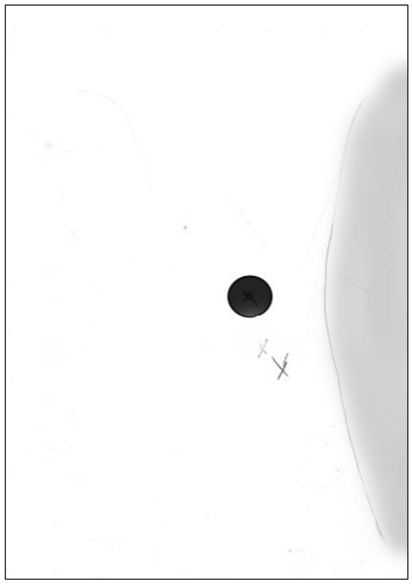
Subject 4, NDE 1



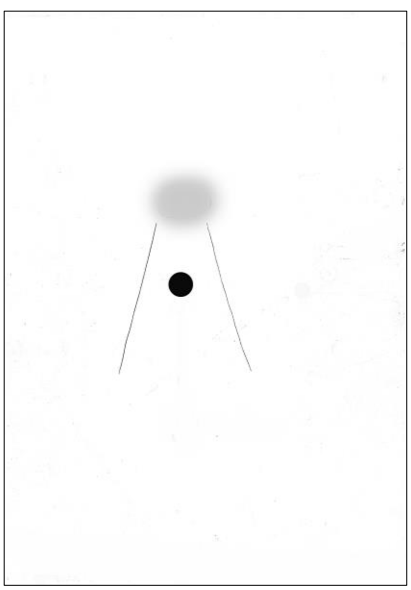
Subject 7, NDE 1



Subject 10, NDE 1

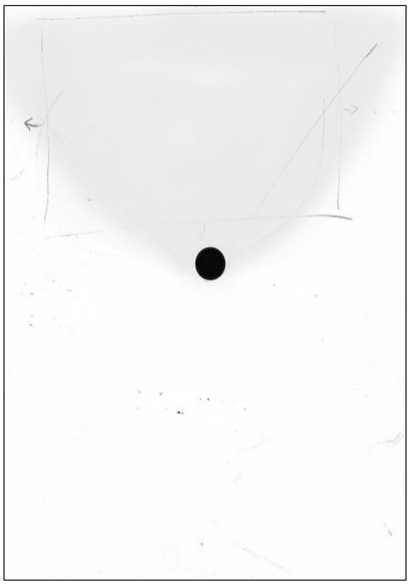


Subject 13, NDE 1

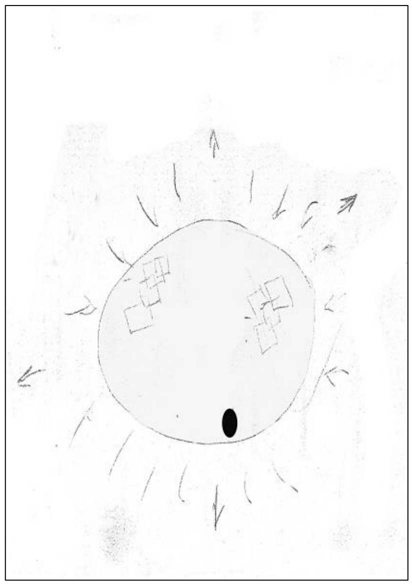


B - *Six Examples of Self-Location Within the Light*

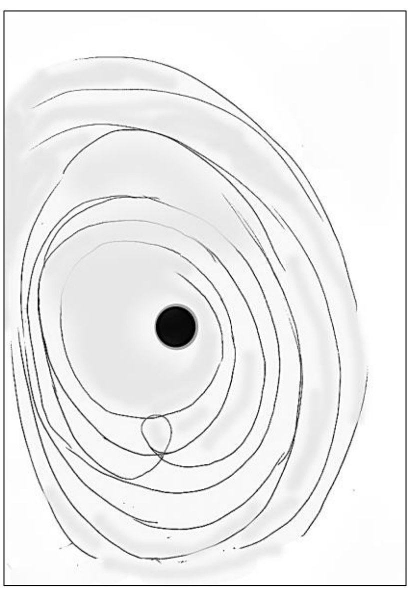
Subject 3, NDE 2



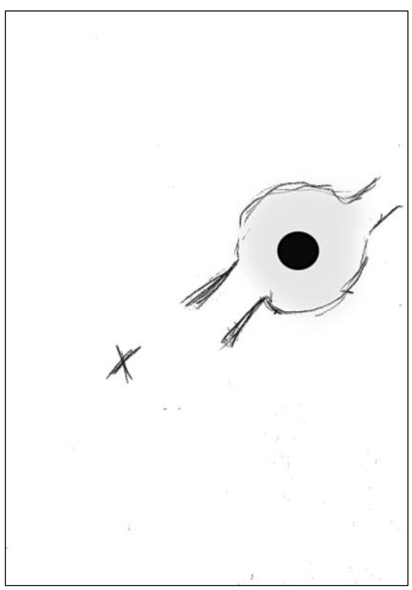
Subject 5, NDE 2



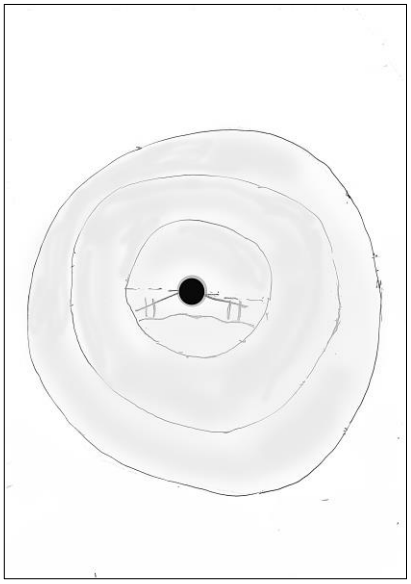
Subject 6, NDE 1



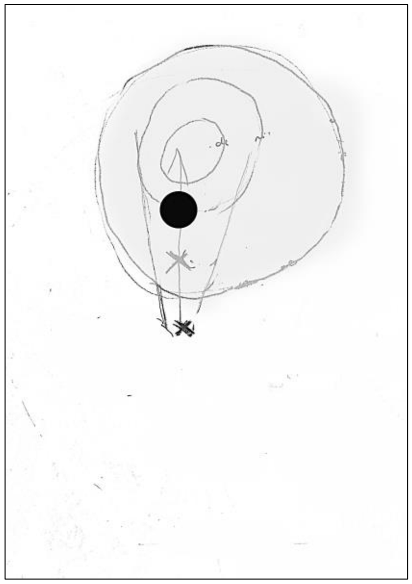
Subject 9, NDE 1



Subject 11, NDE 1

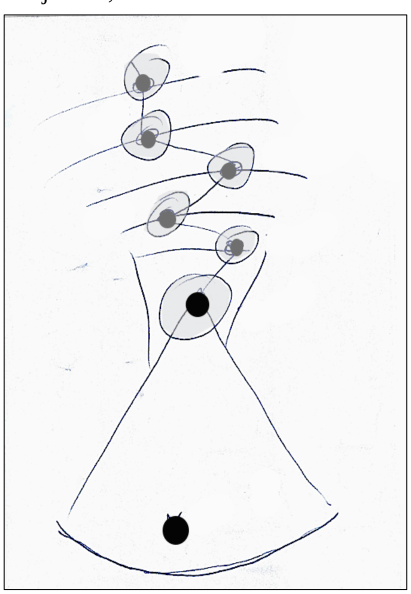


Subject 14, NDE 1



C - *One Example of Self-Location Experienced Alternately Outside and Within the Light*

Subject 12, NDE 1



Note. Black dot represents self-location position, gray area represents the light, lines represent boundaries of field of vision, and arrow represents perceived motion.

Compiled data for the 15 NDEs with features pertaining to Archi-Textures III appear in Table 4. Regarding self-location relative to the light, five NDEs reportedly involved only one self-location outside, and another NDE involved two self-locations outside; six NDEs involved only one self-location within; and three NDEs involved self-location both outside and within. Shape of visual field varied as a function of self-location relative to it. When self-location was *outside* the light (Figure 6 A), it was described as a point or a circle of light. When self-location was *within* the light (Figure 6 B), it was described as an infinite wall of light or a 3D oval, more or less spherical. When self-location was experienced alternately *outside* and *within* the light (Figure 6 B), it was described as a point of light and a 3D shape more or less spherical. Regarding texture, in all 15 NDEs the field of vision was achromatic. Regarding motion, 12 NDEs included only one standstill position, one involved forward movement, and two involved a combination of movement and standstill. Affects were varied.

[See Table 4 in separate document.]

Discussion

OBE Perceptual Pattern

Throughout NDE and OBE literature, authors have emphasized the *dissociative* phase of the OBE (Blanke et al., 2004; Blanke et al., 2016). However, in the graphical data we collected, the *associative* phase was an equally frqsequent component of the OBE (see Table 1). Hence, the general term OBE seems to lack accuracy, and it might be beneficial for future case reports of

OBE phenomena to clarify whether reference is being made to a dissociative or an associative OBE phase.

The OBE dissociative phase in NDEs might result in the failure of multisensory integration processing, which seems to create a mismatch between the physical body and its visuospatial perspective. In the OBE dissociative phase (see Table 1), the experiencer has a parasomatic visuospatial perspective of their physical body (Blanke, 2005; Greenlee et al., 2016), which leads to the disintegration of the subject's personal and extra-personal space.

In contrast, the OBE associative phase might signify the *reintegration* of the subject's personal and extra-personal space. Furthermore, in the OBE associative phase (see Figure 1), the multisensory resynchronization and, with it, the reactivation of the somatosensory and proprioceptive dynamic map would enable the reappearance of the physical body image representations. These physical body image representations seem to provide crucial visual support for the subject's mental process of understanding and integrating their experience in their daily lives (Maack, & Mullen, 1983; Nizzi et al., 2012; Perruchoud et al., 2016; Ramachandran & Altschuler, 2009). Indeed, the absence of physical body image representations in the OBE associative phase can be experienced as a rupture, which can make an experiencer's return to ordinary life more difficult. For instance, we observed that subjects who saw their physical body image representation but who did not report an OBE associative phase expressed difficulty with their physical bodily reintegration:

> S4/NDE1: *"Yes, and then clack! Finished. [...] I did not feel I returned to my body afterward. So, I do not have an explanation [...]. I do not have the impression either of*

a return to myself [...]. And then maybe I took a year or two to recover: but it's weird, I'm not crazy …"

S9/NDE2: *"There I found myself directly on the ground, there is a break there because here I do not know what happened!"*

Archi-Textures

From the empirical observations of the graphic representations produced by the experiencers, three primary topological configurations seem to emerge between the dissociative and associative OBE phases of NDEs, namely the *"*Archi-Textures*"* I, II, and III, which we consider to be determined by the neurogeometry of the functional architecture of vision and its retinoid system. The *"Archi's"* describe the perceptual appearances of the visual and retinal field *dynamic structures*, and the *"Textures"* relate to the visual and retinal field *perceptual composition*. Thus, we identified the "Archi" structural and textural patterns on the basis of (a) the chronological position they occupy within an NDE, (b) the specific perceptual appearances of the visual and retinal field shapes and textures, as well as (c) the self-location kinematic and affective components, which seem to be induced by some particular positioning and embodiment within these Archi-Textures.

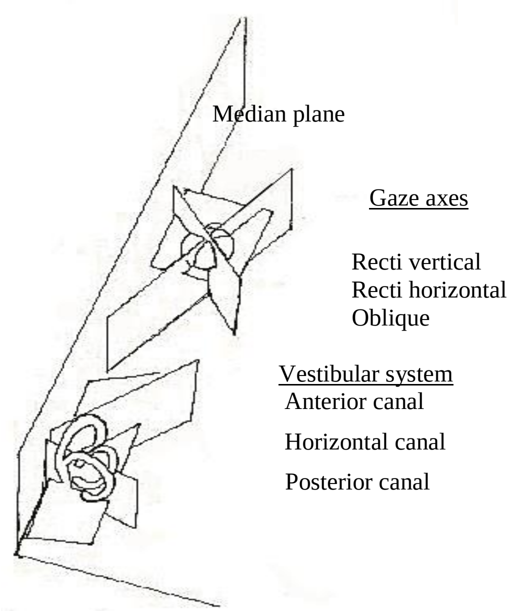
We will now present and discuss, in chronological order of emergence, each of the Archi-Textures' structural features and properties, which we derived from the observation of the graphic representations and the oral descriptions of the 15 experiencers. These three generic Archi-Textures paradigms could serve, in future NDE research, as an epistemological tool to decipher experiencers' visual and affective mental representations.

Throughout the duration of an NDE, the Archi-Textures constituted the visuo-spatial environments in which the self-location trajectories occurred. We interpret the self-location directional motions and velocities to be the result of visuo-vestibular interactions between the optic flow and the 3D orientation plane of the vestibular system's semi-circular canals, as well as somatosensory perceptions and multisensory graviceptive (gravity detecting) signals. The schemas in Figure 7 show the 3D orientation of the planes of the semi-circular vestibular canals and the action planes of the extra-ocular muscles in an animal with frontal eyes (Ezure & Graf, 1984, p.89).

Commenté [JH3]: Do you mean that the person's physical eyes are moving in a correlated way with what they are visualizing, or that NDE visualization seems to conform to the same rules/laws as physical vision, or -- ??

Figure 7

Gaze Axes and Vestibular System Schemas in Animals With Frontal Eyes



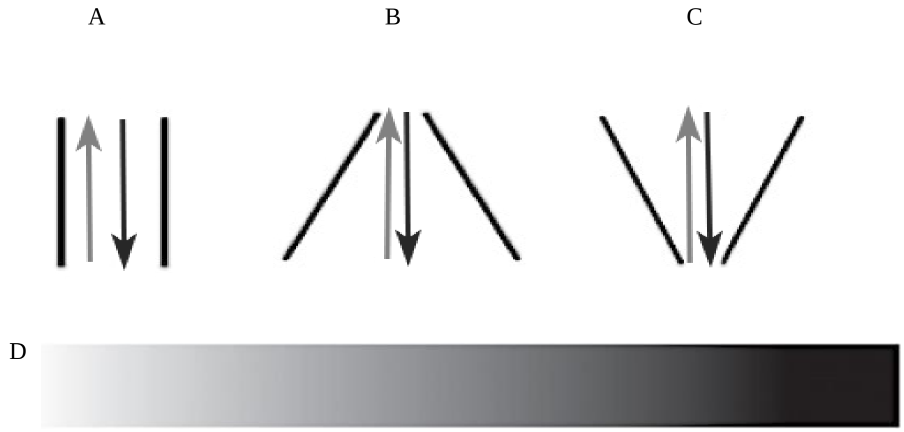
Archi-Textures I Model

We consider the Archi-Textures I visual field shapes to be rooted in the proto-geometry of the visual system, which relies on the rotation axes of the eyeballs (adduction, abduction, intorsion, extorsion, elevation, depression), the parallax, and the six cardinal fields of gaze direction influenced by Donders and Listing's laws of the three-dimensional orientation of the eye and its axes of rotation together with the body and head position. The shapes of Archi-Textures I are the perceptual boundaries of a reduced exteroceptive (external) visual field known as tunnel vision. This tunnel vision from which only the visual central field has been preserved due to the loss of peripheral vision is probably caused by retinal ischemia (Blackmore, 1996), though this explanation has been debated (Holden, 2015). In experiencers' representations, in which the visual field appears framed by two boundaries, we have observed that these exteroceptive-reduced visual fields can also sometimes be seen tilted to various degrees of angle. The outlines could be vergent (see Figure 4 A), convergent (see Figure 4 B), or divergent (see Figure 4 C) and are expressed in the six cardinal fields of gaze direction (see Table 2).

Based on participants' descriptions of the visual field perceptual boundary shapes and textures, as well as the perceived self-location motion velocities and directionalities (see Table 5) and representations (for examples, see Figure 4 A, B, C), we devised the Archi-Textures I model depicted in Figure 8.

Figure 8

Archi-Textures I Model: Visual Field Boundary Shapes (A, B, C) and Textures (D) and the Types of Self-Location Trajectories Within the Visual Field



Note. In A, B, and C diagrams, dark lines indicate the boundaries of the visual field, and arrows indicate self-location trajectories within the visual field, with gray arrow indicating outward (away from initial location) and upward trajectory and black arrow inward (toward initial location) and downward trajectory.

Each schema can express one of the six potential fields of gaze direction, which can also be affected by the parallax angle of the line of sight. Consequently, variable angles of vergence, convergence, and divergence of the visual field can be expected. For the Archi-Textures I model, we chose to use as an example the vertical orientation with an upward or downward gaze-direction motion, although the Archi-Textures I orientation could also be horizontal with a lateral outward or inward gaze-direction motion, or an oblique orientation with an oblique superior outward or inferior downward gaze-direction motion. To summarize, the Archi-Textures I visual field can have three orientations: vertical, horizontal, or oblique, with an outward or inward direction for each orientation, as well as a field of gaze, with variable angles of vergence, convergence, and divergence.

Fourteen of 15 subjects recalled trajectories of the self-location motions within Archi-Textures I, out of which 7 NDEs involved only outward trajectory, two only inward, and 5 both (see Table 6). In the experiencers' representations, they described the shapes of Archi-Textures I in these terms for their outward trajectories:

S1/NDE1; S2/NDE1; S13/NDE1 "a tunnel"

S15/NDE1: "A tunnel . . . a nozzle pipes."

S4/NDE1: "A really straight path . . . smooth. Path width between 4 m to 5 m . . . path length 400 m with an opening at a 180° angle."

S5/NDE1: "A funnel . . . tunnel slightly up hill 30°, the tunnel is larger at the entrance and becomes a normal corridor at the end."

S7/NDE1: "A cone . . . a funnel . . . A corridor."

S9/NDE1: "A basket."

S10/NDE1: "A corridor . . . A kind of gut."

S11/NDE1: "A funnel."

S12/NDE1: "An inverted glass."

S14/NDE1: "Triangle . . . Funnel . . . A cone that is shrinking."

Experiencers described the shapes of Archi-Textures I in these terms for their inward trajectories:

S2/NDE1: “A tunnel”

S3/NDE2: “A tunnel, a cylindrical tube.”

S5/NDE1: “Virtual tube . . . imaginary tube, it is an abstract tube.”

S6/NDE1: “A path . . . A funnel that is a little flared.”

S10/NDE1; S11/NDE1: A “funnel.”

Furthermore, when the subjects, in their representations, exhibited *both* Archi-Textures I outward and inward trajectories, the shapes of the inward trajectory were a mirror image of the outward trajectory (see Figures 4 A, B, C). In these cases, not only were Archi-Textures I shapes mirrored but also the self-location replicated these schemas and the inward trajectories were a mirror image of the outward trajectories. For instance, in the representations of S2/NDE1 (see Figure 4 A), the outward trajectory was seen in an upward direction, whereas the inward trajectory was in a downward direction. The same was true with the representation of S11/NDE1 (see Figure 4 B), where the outward trajectory was in a backward direction, whereas the inward trajectory was in a forward direction, and with S9/NDE1 (see Figure 4 C). These mirrored trajectories of the self-location appear in the subjects’ verbal reports:

S11/NDE1: “Like in the beginning when I had this suction.”

S10/NDE1: “I am transported back the other way in the same corridor at full speed.”

S9/NDE1: “I took the way backward very, very downright quickly, too.”

S6/NDE1: “It’s like I’m on a trip and I’m back on my steps.”

The Archi-Textures I *affects* were described as predominantly negative for both outward and inward trajectories, with a slight improvement in the outward trajectory (see Table 6**)**. However, for two subjects who had experienced both outward and inward Archi-Textures I trajectories, namely S2/NDE1 and S9/NDE1**,** not only they did experience moving in opposite trajectories within the Archi-Textures I mirrored shapes, but they also experienced *opposite affects*. These two subjects reported positive affects during the outward trajectories and negatives affects during the inward ones. However, for S11/NDE1, affects were negative during both the outward and inward trajectories.

In addition, the self-location motions in Archi-Textures I were felt as linear and continuous, with a velocity ranging from fast to extremely fast. As a consequence, these motions had no stationary self-location position.

S1/NDE1 and S14/NDE1 did not experience any self-location motion. This absence of visual motion perception might be related with visual phenomena known as akinetopic vision (motion blindness). More specifically in the case of S1/NDE: a monocular akinetopic vision and S14/NDE1 case: a binocular akinetopic vision. For the other subjects, the self-location motions were described as fast to extremely fast. The experiencers described their self-location outward and inward motions in Archi-Textures I in these terms:

S3/NDE2: “Very fast sliding motion, a fraction of a second . . . Feeling in a state of rapid movement.”

S6/NDE1: “The fastest that I can imagine . . . A fall from a cliff without the feeling of fear . . . Very, very short time, almost immediate.”

S9/NDE1: “The impression that I am pushed backward very fast . . . the movement was continuous.”

S10/NDE1: “At full speed, like on a train.”

S15/NDE1: “Upward suction, so fast.”

S12/NDE1: “ . . . fast, accelerating, forward motion.”

S4/NDE1: “For 4 to 5 sec.”

S5/NDE1: “I have left: direction time-space.”

As was the case with the Archi-Textures I model, the self-location directional motions can potentially head in six directions, which correspond to the interactions between the primary positions of the eyeball (vertical: inferior/superior; horizontal: nasal/temporal; oblique: left/right, anterior/posterior) and the 3D orientation plan of the semi-circular canals of the vestibular system. Although these directions are influenced by the graviception information and the semi-circular canal difference in sensitivities of the “utricular maculae (transduces horizontal accelerations) and the saccular maculae (transduces vertical accelerations) in the otolithic system” (Giannopulu et al., 2016), they could be additionally affected by the body’s physical position during the OBE phases (see Table 5: Physical body position). For instance, “in the supine position, when the head is no longer gravity-aligned, the weight of otolith cues decreases” (Lopez & Blanke, 2010), and sometimes, as a result, floating impressions or nauseous feelings can be experienced. These sensations are often a distinctive trait associated with OBE episodes

(Anzellotti et al., 2011; Blanke, 2005). Nevertheless, we have noticed that these sensations can still be persistent within the Archi-Textures I, as some experiencers' descriptions attested:

S7/NDE1: "Floating motion."

S5/NDE1 and S9/NDE1: "Nausea, disgust."

In particular, some oral reports gave us a better understanding of the chronological sequence occurring between the OBE floating sensation and the extreme self-location velocity experienced in Archi-Textures I. One participant described it in these terms:

S9/NDE1:"Floating, then moving backward at a vertiginous speed."

In fact, the subjects who remembered and represented their OBE dissociative phase~~,~~ helped us trace the genesis of changes in their corporeal awareness by examining the way the visual field of the physical body is captured at a specific point in time and space and is tilted as by a graviceptive vestibular tone imbalance, as in the tilted room illusion (Brandt, 2003; Kirsch et al., 2017). For instance, in one participant's oral report, the Archi-Textures I tilted visual field seemed to have induced a sideways self-location motion:

S11/NDE1: "Linear continuous, really fast upward and then sideway suction into a funnel shape".

And in a second case, the Archi-Textures I tilted visual field appeared to be at an angle of 25° to 30°:

S5/NDE1: “it is an abstract tube . . . two parallel with a tilt of between 25° to 30°.”

In the dissociative phase, the visual field was represented with an angle of tilt to a maximum of 45° (see Table 5 and Figure 1). In the associative phase, the visual field was represented with an angle of tilt to a maximum of 90° in an upside-down direction (see Table 5 and Figure 2).

To better grasp how the transition between the OBE dissociative phase and Archi-Textures I is realized, we looked at one edifying example of OBE dissociative phase. In Figure 3 A (on the left), the representation of Subject 2’s OBE dissociative phase, it can be clearly seen that the peripheral visual field (colored in pale gray) has been reduced, and in Figure 3 B (on the right), the central visual field (colored in pale grey) has been tilted and internalized as a retentional mental representation. This central and tilted visual field, as in the Brandt tilted room illusion, has been captured and internalized as a mental image to become one of the potential structural shapes of the visual field which we have identified as Archi-Textures I (see Figure 2 A). The transition from Figure 3 A to Figure 3 B highlighted the process of transformation of the parasomatic viewpoint into a self-location position. In Figure 3 B, the self-location spatio-temporal position adopted the parasomatic angle of view of the OBE dissociative phase in Figure 3 A. The corporeal awareness that was felt in the OBE from a parasomatic viewpoint is from that moment transferred to a self-location, which will henceforth embody the experiencer’s corporeal awareness during the entire NDE. An explanation of these phenomena of esthesiologic (sensory) transfers of corporeal awareness might be that in non-sentient and unmoving bodies, like NDE bodies, “the absence of perceptions seems to shift the underlying mechanism of corporeal awareness to the preserved visual and vestibular systems” (Lucci & Pazzaglia, 2015).

Concerning Archi-Textures I textures, which we have previously modeled in the Archi-Textures I model (Figure 8 D), they were predominantly achromatic within the black and white achromatic value scale, and their hues were modulated by different degrees of brightness and saturation. Participants described these textures in these terms:

S2/NDE1: “Very black, opaque.”

S3/NDE2: “Black and light in the meantime.”

S4/NDE1: “a little light grey”

S5/NDE1: “It is light . . . off-white.”

S6/NDE1: “grey.”

S7/NDE1: “Absolute black.”

S9/NDE1: “Black, moonlight.”

S10/NDE1: “Black with little windows of some sort all around.”

S14/NDE1: “Black and white . . . grey frequencies, but soft, very soft.”

S15/NDE1: “Opaque, slightly grey-black.”

Only one participant’s description represented an exception to the above pattern of achromaticity:

S1/NDE1: "Fixed vision from left to right of a yellow tunnel changing from clear to dark. […] Towards a blue door three-quarters open, behind which it is black, opaque without depth."

On the other hand, this participant also did not feel any self-location motion in Archi-Textures I; this absence of perceived motion may be due to the effects of a monocular akinetopic vision (motion blindness) which might have created some retentional afterimage phenomena.

Hypothetically, the location of these textures could be in the magnocellular layer, which is populated with ganglions cells insensitive to color and which responds only to the perception of movement. This hypothesis might help explain experiencers' achromatic texture descriptions, as well as the rapid self-location motion they report having experienced in Archi-Textures I.

Archi-Textures II Model

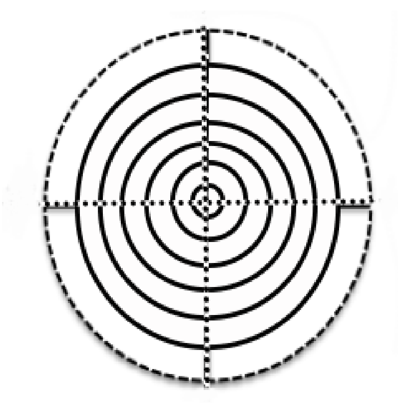
Compared to Archi-Textures I, Archi-Textures II and III show a switch from an exteroceptive visual field to an internal retinal field of vision. In comparison to Archi-Textures I's narrow visual field and linear perspective related to Euclid's geometrical optics, Archi-Textures II exhibits an enlarged field of vision of variable curvature concavity, which we have identified as the distinctive phenomenological component of Archi-Textures II (see Table 7 and Figures 5 A, B, C, D, E).

We conceptualized both Archi-Textures II and Archi-Textures III boundary shapes as originating in the perceptual appearances of the ellipsoidal plane of the retina. The perceptual appearances of the internal field of vision of the retina are determined by the mathematical properties of the concept of fiber bundles and *contact geometry* which deals with the connectivity between the various neural hypercolumns of the visual cortex's functional architecture in the V1 visual area (Petitot, 2017). To estimate the type of shapes of the internal field of vision we encountered in the subjects' representations, we adopted the classical division of the retina into 4 quadrants (superior temporal, superior nasal, inferior temporal, inferior nasal) for the modeling of potential Archi-Textures II field-of-vision boundary shapes. Within the field of vision of Archi-Textures II, the self-location retinotopic positions at various distances from the fovea center determines the perceptual appearances of the Archi-Textures II textures.

The model of Archi-Textures II depicted in Figure 9 was derived from the descriptions of the experiencers' visual field boundary shapes and the self-motion impressions (see Table 7) and the experiencers' representations (for examples, see Figures 5 A, B, C, D, E).

Figure 9

Archi-Textures II Model: Field-of-Vision Boundary Shapes



We subdivided the macula into 6 circles starting from the outside to the inside: 1 - perifovea area, 2 – parafovea, 3 – fovea, 4 - foveal avascular zone (FAZ), 5 – foveola, and 6- umbo (the center of the foveola). Circles 1 and 2 are in the peripheral region of the fovea; circles 3, 4, and 5 are within the fovea; and circle 6, the umbo, is at the center. Using this model, we translated the perceptual retinal field-of-vision boundary shapes in experiencers' reports into segments of various length of a circle, an ellipse, or a sphere (see Table 7), which were equivalent to one to two, and more rarely three quadrants of the internal retinal field perceptual boundary shapes, with the self-location retinotopically positioned at variable distances from their centers (see Figures 5 A, B, C, D, E). For instance, Archi-Textures II boundary shapes were perceived by S14/NDE1 as a 3D sphere from which he was located "at a distance of approximately 4-5 meters until 10 meters from the center of the 3D sphere," and for S12/NDE1, the Archi-Textures II boundary was the equivalent of a quarter of a quadrant of the perceptual retinal field of vision which he described in these terms: *"What I see is really like a quarter of a pie*" (see Figure 5 E).

We consider the Archi-Textures II textural perceptual appearances to rely on the spectral sensitivity of the cones and rods of the eye's retina. The pattern and the perceptual appearances of the textures were experienced differently depending on the distances of the self-location retinotopic positions from the umbo. Participants described the Archi-Textures II internal retinal field-of-vision textures as chromatic (see Table 7) within the color range of the optical spectrum, probably as a result of its location in the parvocellular layer specialized in color detection realized by a different class of cones. According to Hagop Sazdjian (2012-2013), a French nuclear physicist, optical wavelengths are tridimensional with a spherical propagation, the center of which generally corresponds to the position of the point source that created them. In Archi-Textures II, the degree of eccentricity from the fovea centralis center determines the qualities of the visual resolution of the chromatic phenomena emerging within this Archi-Textures set. For instance, the textures described by experiencers as extremely sharp, with an increased 3D depth effect, vivid color, and quasi-perceptual sensations, hypothetically might have been experienced from a retinotopic self-location closer to the umbo than the textures whose perceptual appearances were blurry and with pastel hues, which could have been located at a self-location retinotopically farther away from the umbo, more likely in the peripheral zone of the fovea, in the perifoveal and parafoveal areas, as represented in the Archi-Textures II model.

Eight of 15 experiencers recalled having had self-location motion trajectories within Archi-Textures II. According to their descriptions, in comparison to Archi-Textures I and III, Archi-Textures II exhibited the richest variety of visual phenomena such as entoptic phenomena (within the eye itself), such as halos and biophotonic phosphenes with internal clockwise or anti-clockwise rotational motions (Chen et al., 2009; Bókkon & D'Angiulli, 2009; Bókkon & Salari, 2012; Bókkon et al., 2013; Császár et al., 2016), as well as holographic representations stored as engrams or mnesic traces in the hippocampus. We interpret these textures to be the phenomenal chromatic content used to shape the various idealized representations (Husserl, 1898-1925), experienced as quasi-perception, which emerged in Archi-Textures II's retinal field of vision as foveal hallucinations. Furthermore, these visual phenomena enhanced the creation of the mental representations, generated from data formed in memory over the experiencer's life span, as well as from the experiencer's imagination in the brain's attempt to fill in the visual gaps (Hubbard, 2010).

In our view, the Archi-Textures II visual textures act as visual primes for the creation of analogizing apperceptions (mental operations) in a manner similar to that of the *projective method* in the Rorschach test. The projective brain makes assumptions about the world to make sense of what is seen, as in the case of S6/NDE1 for whom the arising phosphenes in his field of vision were interpreted as "spots that meet like a multitude of little clouds."

Similarly, the mental representations seem to have undergone a process of *idealization*. For instance, garden scenery was turned into an Eden-like scene as described by S2/NDE1, "at the exit of the tunnel . . . Garden of Eden: flowers, blue sky, and animals," or the Eden and hellish-like mixed scenery described by S5/NDE1, "three beings . . . a magnificent landscape with beautiful little houses, beautiful meadows, and beautiful hills, woods . . . and that's the hell." The same idealization process applied to image representations of people who were remembered appearing in their prime, as with S2/NDE1 who experienced "meeting with [my] deceased loved ones (in their most physically beautiful form)."

A variety of other types of representations, such as entities and objects, came to light exclusively in Archi-Textures II. These representational phenomena seem to have also provided personal guidance to the experiencers, which helped enhance their sense of security and comfort:

> S8/NDE1: "A woman, she is sitting, and she is dressed in ample fabrics. She has a stole . . . She has a face, but it is something you cannot describe because it fades. She is in the same alignment as me, she is in front of me."
>
> S3/NDE2: " . . . two, three, four etheric figures. It vibrates; maybe one is absorbed by the others . . . Look like guardian angels . . . it is a very transparent yellow color, canary yellow."
>
> S14/NDE1: "the entities are of pastel colors . . . Oval elongated . . . a little like a capsule of medicine . . . with fuzzy ethereal edges and an aura of light . . . four or five, but sometimes at different places . . . smaller than human . . . They are surrounding me, so at my level but around . . . Moving in a counter-clockwise direction."

> S4/NDE1: “two tanks progressing side by side . . . Two tanks of the IDF army in the desert.”

Hence, these idealized representations could well be the origin of archetypal representations.

The foveal hallucinations of chromatic textures appeared multi-colored, as the rainbow spectrum, which participants described in these terms:

> S6/NDE1: “like a rainbow quite soft”
>
> S8/NDE1: “aurora borealis”
>
> S14/NDE1: “Very light tint of blue, water vapour . . . It goes from pink, red to blue and green.”
>
> S12/NDE1: “in the blue-green.”
>
> S4/NDE1: “ . . . yellow color with a bit of khaki. Yellow color slightly orange, . . . really yellow sand.”

The chromatic textures also had a variable degree of definition that ranged from higher to lower resolutions:

> S6/NDE1:“I would say, intense but in pastel colors, rather towards ochre, a little moiré, a little iridescent.”

Sometimes, the sharpest perceptual resolution of the textures appeared with an increased 3D depth effect or as a hologram rendering:

> S9/NDE1: "my two maternal grandparents and an uncle who was still alive at that time . . . I saw them in the totality of their aspects. They were bright and I saw them in all dimensions . . . It was better than a picture since they were actually like a hologram."

We observed that the perceptual colors of Archi-Textures II and III textures resulted from the self-location retinotopic distance from the umbo and were experienced as different wavelengths, according to the color experienced. Some participants associated color with affective qualities:

> S14/NDE1: "Colors are the emotion's reflection: warm hues: well-being, love . . . cold hues are a form of indifference and detachment."

Whereas participants described the *velocity* of self-location motion in Archi-Textures I as extremely fast, they described it in Archi-Textures II as slower paced (see Table 7). This decrease in self-location velocity might also have facilitated the creative process of mental representation reconstruction.

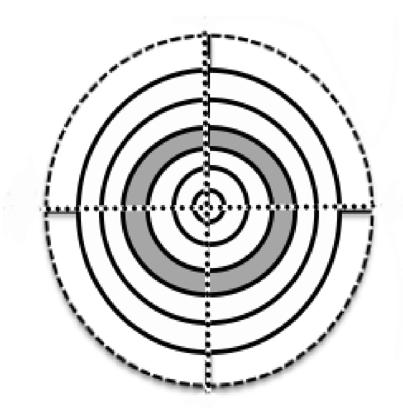
Concerning the *affects* reported in Archi-Textures II, they are tightly linked to Archi-Textures III experiences, which, as we will discuss, were the manifest core and driving force of the self-location motions in the participants' NDEs. Therefore, the order in which Archi-Textures III textures appeared within the NDE chronology was crucial for understanding the influence exercised by the Archi-Textures III phase on Archi-Textures II affects. Hence, when the self-location motions were heading toward the Archi-Textures III phase, the affects were felt as increasingly positive. In contrast, when the self-location moved away from the Archi-Textures III phase, the affects were felt as increasingly negative.

Archi-Textures III Model

The third NDE Archi-Textures model we have identified still relies on the ellipsoidal perceptual appearance of the retina internal field of vision, like the Archi-Textures II model whose boundary shapes are segmental parts of Archi-Textures III. As we did for the Archi-Textures II model, for Archi-Textures III modeling, we divided the internal field of vision of the retina into 4 quadrants (superior temporal, superior nasal, inferior temporal, inferior nasal). The model of Archi-Textures III in the schemas in Figure 10 has been derived from the descriptions of the visual field boundary shapes and the experiencers' self-location positioning within Archi-Textures III (see Table 9) and the experiencers' representations (for examples, see Figures 6 A, B, C).

Figure 10

Archi-Textures III Model: Vision Boundary Shapes Experienced by Self-Location as Located Either Outside a Field of Vision or Within an Embodied Visual Space



Archi-Textures III perceptual field-of-vision boundary shapes either outside or within an intense light were of variable curvature concavity, with a length generally of 4 quadrants of the perceptual boundary shapes in the internal retinal field of vision, experienced by the self-location at various retinotopic distances from the umbo. We subdivided the macula in the same way as with Archi-Textures II. Thirteen of 15 experiencers recalled self-location positioning within Archi-Textures III.

We distinguished two types of Archi-Textures III experiencing, which produced specific phenomenology of self-location positioning (see Table 8). In the first type of experiencing, the Archi-Textures III boundary shape was experienced as a visual horizon whereby the self-location retinotopic position~~s~~ was located *outside* the perceptual boundaries of the field of vision (see Figure 6 A). In the second type of experiencing, the Archi-Textures III boundary shapes, and the self-location retinotopic position were located *within* the perceptual boundaries of the field of vision (see Figure 6 B**).** In experiencing both Archi-Textures III categories, the textures were experienced as achromatic with extreme intensities of light textures, and the self-location was at a single standstill position.

According to our hypothesis, based on participants' depiction of the textural light intensities, Archi-Textures III could be located in an area without blood vessels, known as the foveal avascular zone (FAZ) and represented by the gray ring in the Archi-Textures III model (Figure 10). In point of fact, the FAZ allows light to be sensed without dispersion or loss. Therefore, the outcome of the light retention in the FAZ might be a valid hypothesis to explain *both* the texture of extreme light intensities perceived by experiencers within Archi-Textures III - Outside *and* the texture of paroxysmal intensity in Archi-Textures III - Within.

Up to now, the hypotheses others have raised to explain these paroxysmal intensities of light were: electromagnetic radiation (Slawinski, 1987), randomly firing neurons (Blackmore & Troscianko, 1989), optic radiation (Owens et al., 1990) and, more recently, the emission of bioluminescent photons (Bókkon & Salari, 2012). This last hypothesis would also be compatible with the location we propose within the FAZ.

During an NDE, the perceptual light operates as a powerful heliotropic motor agent (turning toward light), which determines the rate of change of the self-location retinotopic position and, consequently, the self-location's velocity, which also regulates the valences and intensities of the experiencer's affects.

In experiencers' descriptions, Archi-Textures III perceptual light textures and shapes varied as one went through the NDE. In fact, Archi-Textures III's strength of attraction constituted the motor agent responsible for the self-location motions and for affects modulation:

S12/NDE1: *"It acts as a magnet."*

S13/NDE1: *"The movement is as if I were sucked; your whole body moves at the same time as if there was a force that draws you forward . . . you have a completely linear movement . . . as if you were transported without moving . . . as if you were in the same position and all your body was moving calmly toward the light."*

S7/NDE1: *"I saw the light and I am directed toward it."*

Consequently, Archi-Textures III field-of-vision's boundary shapes, sizes, and light textures were experienced differently according to the self-location retinotopic closeness or remoteness from the Archi-Textures III center—which we have hypothetically located in the FAZ~~)~~.

From a self-location perspective situated in Archi-Textures I, participants reported the Archi-Textures III field-of-vision boundary shapes, sizes, and intensity of the light textures to be a distant visual horizon, which they described in these terms:

S7/NDE1: *"A black corridor with a point like a pinhead that is blinding, as it is indescribably white."*

S12/NDE1: *"An inverted glass* . . . *smaller towards the top, really a needle tips* . . . *Very luminous in front."*

S11/NDE1: *"A funnel with the beam of the sun at the end."*

S14/NDE1: *"A cone heading toward the light."*

S1/NDE1: *"the tunnel* . . . *Black with a light at the end* . . . *Light reflection* . . . *This tunnel has a physical aspect."*

S1/NDE1: *"Bright light at a distance* . . . *I only see the sparkling light at the end of the tunnel* . . . *The great light is in the bottom of a Garden of Eden."*

S4/NDE1: *"This light that is at the bottom."*

From a self-location perspective situated in Archi-Textures II (see Figures 5 A, B, C, D, E) and in Archi-Textures III (S) (see Figures 6 A)**,** participants reported the Archi-Textures III field-of-vision's boundary shapes, sizes, and intensity of the light textures to be a near (close-by) visual horizon, which they described in these terms:

S4/NDE1: *"A great light, like a fire; space, a big circle."*

S8/NDE2: *"A huge light . . . Like a sun. For me it's as bright as a sun, at the same time I could look at it . . . It's hot and it's white . . . it must be animated . . . variations, I-we will say pulsations."*

S10/NDE1: *"An immense light, and I am a little flea here . . . there is a very soft heat, a pleasant heat . . . I am on the threshold of melting with the light."*

S14/NDE1: *"First, the vision of this light . . . it is both very white but without dazzling me. I call it love . . . It is hot . . . The light is at an angle of 30° . . . I am in front . . . I have it in full face . . . a limited radiation . . . a circle, a beautiful circle. The light in the middle at 10, at the edge I would say 4."*

The distance of the self-location retinotopic positions from the Archi-Textures III center seemed, therefore, to have regulated the velocity of the self-location motions as well as the intensities of their affects. We noticed that the closer the light was from the self-location retinotopic positions, the more positive were the affects, and, conversely, the farther the light was from the self-location positions, the more negative were the affects (see Table 6, 7, 9). In Archi-Textures III, the strength of attraction seems to reach its limit when the self-location retinotopic motions reach the perceptual limits of the field of vision. In this case, the self-location seems to freeze in its position, having reached a physical limit:

S4/NDE1: *"I am x meters from this flame, maybe 100 m and then it's over, I am stopped . . ."*

Hence, when participants experienced Archi-Textures III's field of vision as a physical spatial limit, they also phenomenologically experienced it as a mental frontier, a turning point for decision making:

S2/NDE1: *"Voice telling me 'It's too early for you, go home!'"*

S4/NDE1: *"when I agree to leave."*

S7/NDE1: *"I stop a few meters from the entrance because my grandmother cries Stop!"*

S10/NDE1: *"At some point in my run toward the light, there is a stop, that's all . . . I turn around"*

S3/NDE2: *"I ran into something impalpable: a wall of light of something that was in front of me . . . It felt like there was a border that told me that I could not go further . . . There I was thrown back."*

S2/NDE1: *"I agree to go back to restart a life. It's over."*

S6/NDE1: *"Just after the thought about my husband I say to myself, I must return. In fact, I turned . . . I pivoted . . . This space, once I turned it disappeared."*

S9/NDE1: *" . . . the thought of my children . . . Then I came back directly."*

Finally, participants described Archi-Textures III – Within phenomenology in these terms:

S3/NDE2: *"We see and we are in the scene at the same time, there is no form, we take the form of the light . . . It is a particle of light . . . A space of vision."*

S5/NDE2: *"The space is very bright, very clear, the atmosphere is white. Light, only light . . . I am the entire space . . . we do not have a proper existence yet we are."*

S6/NDE1: *"I was in that light . . . it was strong from the start, it was global. It was like a huge cocoon of light, there was no change in color or intensity."*

S8/NDE1: *"Something that really passed thorough me, that really got into all my fibers . . . and it stays in me, as if it's something that has mingled with all the fibers of what I am . . .The impression of being bathed fiber by fiber."*

S9/NDE1: *"I enter the light. I am absolutely united in the light . . . one becomes that of the light . . . it is very bright white and yellow . . . I am in the light, surrounded by all sides, I am immersed."*

S11/NDE1: *"Blinding light . . . spherical . . . I am in a bubble, like a deep-sea diver. The space is always a bubble."*

S13/NDE2: *"The body, the space, everything . . . I cannot delimit . . . I was immersed in the light . . . I felt like I came home, to be back home."*

S14/NDE1: *"Such light should have dazzled me . . . it is welcoming . . . it is not overwhelming; it is comprehensive . . . very, very white yellow . . . 360° vision all around us . . . as if we were in the middle of a single sphere and we see the top, the bottom, left, right; it's a panoramic view in 3D . . . The sphere is not limited . . . one is in the light . . .. 'I-we' is really bathed and it is especially this notion of love with a big 'L'. At most, it is intense. At most, this feeling of being loved is important."*

S6/NDE1: *"There was no outline; it was like a totality of light . . . You could say that the air was the light, it was always clear, . . . it was in 3D."*

In comparison to Archi-Textures II, mental representations in both forms of Archi-Textures III were totally absent from experiencers' descriptions and were replaced by light textures of extreme intensities. In the case of Archi-Textures III – Within, a visual embodiment of the light by the self-location gave rise to phenomena of *fusion* or a state of *"enlightenment"* which, in Husserlian (2012) terminology, could be defined as an act of *"intellection."* Participants described this phenomenon in these terms:

S9/NDE1: *"There is a uniformity between me and the part of the other . . . I am absolutely united in the light. We are this, we become this light."*

S3/NDE2: *"There is no form; we take the form of light."*

Moreover, the self-location's paroxysmal visuo-affective embodiment, experienced as a state of fusion, was further described in these terms:

S9/NDE1: *"A feeling of unconditional love. An apogee of love and well-being."*

S3/NDE2: *"In this light, this light is everywhere . . . Love at ten . . . And in each cell, we feel this state of absolute love . . . it's like this state of bliss. This emotion I felt throughout my body, my whole structure . . . it made me burst . . ."*

In Archi-Textures III – Within, the failure of the body schematization seemed to have triggered a sense of the *disintegration* of the body and, with it, generated an experience of *ego dissolution* in which consciousness was conscious only of itself. Participants described this impression thus:

S3/NDE2: *"I do not sense any more, yet I am."*

S14/NDE1: *"We are only consciousness . . . Infinite knowledge."*

The Archi-Textures III – Within phase could be envisaged as a multi-layered structure of perceptions and apperceptions (mental operations), in which one can experience one's own otherness as "we" (Riva, 2017), making Archi-Textures III– Within the place where *"the localization of the zero point of my living body and that of others"* (Levinas, 1949) share the same origin. Thus, in Archi-Textures III – Within, the absence of one's own body image representation and proprioceptive sensations might have erased individual peripersonal boundaries and, with them, the feeling of having to defend one's own skin, which in turn might facilitate the occurrence of intersubjective episodes.

Moreover, such intersubjective experiences might help explain the predisposition to empathy that develops after an NDE. Indeed, according to (Atwater, 1998), the major psychological aftereffects of NDEs are a greater emotional sensitivity to others and expansive concepts of love. Based on this study, those empathic feelings, suggestive of Husserl's (2012) intropathy (*Einfühlung*), might be partly induced by NDErs' peculiar interoceptive experiences, which could effectively be correlated to empathy ontogenesis. To test this hypothesis, Archi-

Textures III – Within could be investigated for its effect on the ontogenesis of empathy (Berthoz & Jorland, 2004).

Recently, the implication of active interoceptive inference in the emotional brain has been raised (Seth & Friston, 2016). This inference, especially the one related to the visceromotor areas (VMAs), might play a key role in NDE self-location kinematic and affect dynamics, which would be worth investigating in future NDE studies.

Regarding Archi-Textures III – Within , aschematia (Bonnier, 1905) is an affliction that causes certain parts of oneself to cease to fit in with the notion that one has a body. As a result, these deficient body schema representations produce an inadequate mapping of spaces. In Archi-Textures III – Within, aschematia increased the induction of an *extreme sense of self*, which was correlated with paroxysmal affects, sometimes described by NDE subjects as the *"true home of the self"* (S9/NDE2; S12/NDE1).

In the Archi-Textures III – Within, the absence of body image might have been experienced as a meta-representation related to an interoceptive processing. The enhanced feeling of the self, deprived of any body image, might be the result of the re-presentation of interoceptive cortical activity in the right anterior insula and homeostatic processing associated with emotional awareness and the paroxysmal sense of self (Cameron, 2001; Craig, 2003, 2009, 2013; Ceunen et al., 2016; Droit-Volet & Gil, 2009). This state might create some temporal distortion (Di Lernia et al., 2018).

Although some Archi-Textures III – Outside participants reported paroxysmal affects from their *external* standstill self-location position *as a field of vision*, most paroxysmal affects were reported by Archi-Textures III – Within participants who described *an embodied space* at a standstill self-location position (see **Table 4** **& Figure 6 B**). In that sense, Archi-Textures III –

Within can be considered as the transcendental core of NDEs, which is anchored on a very specific type of self-location embodied position (Lerner, 2016), namely, a self-location fully embodied visually and affectively by paroxysmal light textures from an egocentric and standstill position within the Archi-Textures III – Within spatio-temporal, and often 3D, configuration. The perception of the self-location standstill together with the perception of time-suspension "*epoché"* (Husserl, 1917-1918, 1893-1917) was experienced by the NDErs as a *transcendental reduction*. This experience gave a sense of an irreversible and transformative nature to the NDEs.

We noticed that whether the self-location retinotopic positions were *outside* or *insid*e Archi-Textures III, the self-location was felt at standstill positions (see Figures 6 A & B), and the textures were perceived achromatically, with extreme intensities of light textures**.** In the case of Archi-Textures III – Within, the effect of the light's interoceptive quality (Damasio & Carvalho, 2013), combined with the self-location's standstill during immersion, altered the experiencers' time perception. The absence of motion created a sense of eternal, timeless perception.

To our knowledge, the *affective culmination* of Archi-Textures III – Within could be considered the deepest level of experience during an NDE. We have identified this affective culmination as the spatio-temporal point in which the self-location is embodied from a retinotopic egocentric position in the Archi-Textures III – Within kinesio-optic 3D structure (see Figure 6 B), as in the egocentric 3D space retinoid model (Trehub, 2007).

Among the 13 participants~~,~~ who experienced one of the two forms of Archi-Textures III S12/NDE 1 presented an atypical case, as he experienced alternately and with several occurrences *both* Archi-Textures III – Outside and – Within (see Figure 6 C). The visual accommodation focus-mechanism seemed to have acted as the motor agent responsible for the self-location switching between motion and stillness, which he described in these terms:

S12/NDE1: *"It's very mobile. We go where we want as soon as we look at a point or a star, it's as if all the space is reduced to this point and it is dilated again and then we are . . . it is always forward. These are accelerations, successive like a zoom effect, you accelerate and when you're there, there is a small effect of hindsight . . . I can see everywhere around me . . . Whenever we arrive at a place, this little bubble in which we see everywhere . . . I can see everywhere around me."*

By dint of Subject 12's graphic representations, the transitions between the two types of Archi-Textures III phenomenological experiences,– Outside and – Within, were made visible. The shifts between the two forms of Archi-Textures III were produced by what the experiencer referred to as *"de-zooming and zooming."* When he reported *"de-zooming-in,"* his self-location was moving toward the Archi-Textures III center, and when he reported "*zoomin*g," his self-location was in the middle of a sphere. Archi-Textures III was experienced alternately *from the outside* and *from within* that is to say, once as the self-location field of vision with a horizon, which created a *contextual setting,* and once as an immersive space visuo-affectively embodied by the egocentric standstill self-location. The vections of the self-location motions leading to Archi-Textures III were linear in a forward direction and inhibited the previous self-location. In Subject 12's words: "There is no recoil sensation, it is always forward." This phenomenon has been called inhibition of return and has been referred to as "a curious mechanism—when we look at a scene by successive jumps of saccadic gaze and never return immediately to the same point" (Berthoz & Petit, 2006).

We offer a final note regarding our development of NDE Archi-Textures models I, II, III. We developed them based on our participants' oral and graphic representations. These models may be subject to exceptions as a result of temporal delays, which might create certain visual retentional phenomena, such as visual trailing and afterimages. Thus, the contents of other "Archi's" or "Textures" which had visual retention might arise within other "Archi's" or "Textures," producing visual effects of inclusion, superposition, interpenetration, collision, or juxtaposition. Such variations would reveal the inherent porosity and distinctive temporalities of each of the *Archi-Textures*. The phenomenon of visual trailing can sometimes be caused by akinetoptic vision (motion blindness), which prevents the perception of visual motion (Zeki, 1991). Nevertheless, these retentional incursions show the porosity and the interconnectedness existing between the different Archi-Textures' spatiotemporal features and phenomena. Moreover, these phenomena can affect the NDErs' visual perceptual content, as well as the affective and cognitive contents.

Commenté [JH4]: I don't understand the rest of this paragraph. Let's discuss when we meet via Zoom.

Conclusion

During the trajectories of NDEs, the self-location kinematics and affects appear to rely on the embodiment of visuo-vestibular inputs as motor agents related to the perceived self-location motions and positions. Thus, across the NDE trajectories, the vestibular signals are degrading until their total extinction while the visual signals all along the NDE are continuously influencing the velocities and the self-location positioning on specific points of the retina (perifoveal, parafoveal, foveal or foveal avascular zone).

Across the three Archi-Textures models we reviewed, we identified transitions occurring between an *external* visual exteroceptive field and an *internal* retinal field of vision, which corresponded to geometrical modifications of the field of view, as well as distinctive retinotopic self-location positioning within these fields.

The field-of-view *geometrical transformation* started from (a) a visual exteroceptive field, which was reduced and sometimes tilted, which hosted fast self-location motions in Archi-Textures I; then (b) an internal retinal field of vision, which was perceived as enlarged, which hosted slow-paced self-location motions in Archi-Textures II; followed by (c) a further expanded internal retinal field of vision, which hosted standstill *self-location positions* in Archi-Textures III – Outside; to finally reach (d) an egocentric *embodiment* by standstill self-locations within the internal retinal field of vision in Archi-Textures III – Within.

The expansion of the field of view went hand in hand with an increased sense of the light reception by the self-location, which created an *expanded sense of self* in Archi-Textures III – Outside and, in Archi-Textures III - Within, an *ego dissolution*. In our view, Archi-Textures III - Within constitutes the paradigmatic model of an NDE's transcendental and transpersonal space. Its presence can help classify and predict the *intensity* of a person's perceptual, cognitive, and affective experience during their NDE.

Although we expected to observe a strong correlation between the highest velocity of self-location and paroxysmal affects, in fact we observed the opposite. Indeed, we demonstrated that the *absence* of the self-location's perceived motion produced a visuo-affective embodiment of Archi-Textures III's *intense light textures*, which induced perceptions of spatio-temporal *infinity* and *eternity*, visuo-affectively embodied in a fusion. The essence of an NDE journey, as an esthesiologic (sensory) transfer of corporeal awareness, was remarkably summarized by S3/NDE2, who said it started from *"I go where I see"* and ended up with *"I am what I see."*

In this study, based on the graphical drawings and oral descriptions of the mental representations of NDErs' phenomenal affective, perceptual, and cognitive components, we have developed an alternative tool that complements current analysis of NDEs, to specify in greater detail the chronological emergence of the affect types and valences that are generated by the NDE's self-location-specific kinematic features. Moreover, this experimental method naturalizes the perceptual phenomena in NDEs using first-person graphic representations and descriptions~~,~~ without, however, reducing the NDE's phenomenal features to merely stimuli. This method of graphical drawings and oral descriptions may prove to be a more appropriate tool for the systematic and detailed expression of NDE contents.

To date, the phenomenological chronology of the affective components related to the various positions of the physical body, as well as the self-location positions and trajectories within NDE spaces, has not been captured in the conventional scales used to validate NDEs—the NDE Scale (Greyson, 1983) and the Weighted Core Experience Index (Ring, 1980). It now seems clear that such affects are essential indicators that should be taken into consideration.

References

Albertazzi, L. (2010). The perceptual roots of metaphor. In L. Albertazzi, G. J. van Tonder, & D. Vishwanath (Eds.), *Perception beyond inference: The information content of visual processes* (pp. 345–390). MIT Press.

Albertazzi, L. (2013). *Handbook of experimental phenomenology: Visual perception of shape, space, and appearance*. John Wiley & Sons.

Albertazzi, L. (2018). Naturalizing phenomenology: A must have? *Frontiers in Psychology*, *9* Article 1933, 1–11. https://doi.org/10.3389/fpsyg.2018.01933

Anzellotti, F., Onofrj, V., Maruotti, V., Ricciardi, L., Franciotti, R., Bonanni, L., & Onofrj, M. (2011). Autoscopic phenomena: Case report and review of literature. *Behavioral and Brain Functions*, *7*(1), 1–11. https://doi.org/10.1186/1744-9081-7-2

Atwater, P. M. H. (1998). *Aftereffects of near-death states: When the near-death experience is over, it isn't over* [Brochure of the International Association for Near-Death Studies (IANDS)]. Retrieved from https://www.iands.org/images/stories/pdf_downloads/aftereffects.pdf

Berthoz, A. (2013). *Vicariance (La): Le cerveau créateur de mondes*. Odile Jacob.

Berthoz, A., & Jorland, G. (2004). *L'empathie*. Odile Jacob.

Berthoz, A., & Petit, J. L. (2006). Phénoménologie et physiologie de l'action. Odile Jacob.

Bitbol, M. (2014). La conscience a-t-elle une origine. *Des neurosciences à la pleine conscience: Une nouvelle approche de l'esprit.* Flammarion.

Blackmore, S. J. (1996). Near-death experiences. *Journal of the Royal Society of Medicine*, *89*(2), 73–76. https://doi.org/10.1177%2F014107689608900204

Blackmore, S. J., & Troscianko, T. S. (1989). The physiology of the tunnel. *Journal of Near-Death Studies*, *8*(1), 15–28. https://doi.org/10.17514/JNDS-1989-8-1-p15-28.

Blanke, O. (2005). Perception and experience of the self in autoscopic phenomena and self-portraiture. *Swiss Archives of Neurology Psychiatry and psychotherapy 156*:173–188. https://doi.org/10.4414/sanp.2005.01602

Blanke, O., Faivre, N., & Dieguez, S. (2016). Leaving body and life behind: Out-of-body and near-death experience. In S. Laureys, O. Gosseries, & G. Tononi (Eds.), *The neurology of* consciousness (2nd ed., pp. 323–347). Academic Press Elsevier.

Blanke, O., Landis, T., Spinelli, L., & Seeck, M. (2004). Out-of-body experience and autoscopy of neurological origin. *Brain*, *127*(2), 243–258. https://doi.org/10.1093/brain/awh040

Bókkon, I. (2008). Phosphene phenomenon: A new concept. *BioSystems*, *92*(2), 168–174. https://doi.org/10.1016/j.biosystems.2008.02.002

Bókkon, I., & D'Angiulli, A. (2009). Emergence and transmission of visual awareness through optical coding in the brain: A redox molecular hypothesis on visual mental imagery. *Bioscience Hypotheses*, *2*(4), 226–232. https://doi.org/10.1016/j.bihy.2009.01.009

Bókkon, I., Mallick, B. N., & Tuszynski, J. A. (2013). Near death experiences: A multidisciplinary hypothesis. *Frontiers in Human Neuroscience*, *7*, 533. https://doi.org/10.3389/fnhum.2013.00533

Bókkon, I., & Salari, V. (2012). Hypothesis about brilliant lights by bioluminescent photons in near-death experiences. *Medical Hypotheses*, *79*(1), 47–49. https://doi.org/10.1016/j.mehy.2012.03.028

Bókkon, I., Salari, V., & Tuszynski, J. A. (2011). Emergence of intrinsic representations of images by feedforward and feedback processes and bioluminescent photons in early retinotopic areas. *Journal of integrative neuroscience*, *10*(01), 47–64. https://doi.org/10.1142/S0219635211002610

Bonnier, P. (1905). Aschematia. *Revue Neurologique*, *13*, 606–609. https://doi.org/10.1016/j.yebeh.2009.09.020

Brandt, T. (2003). Vestibular cortex: Its locations, functions, and disorders. In *Vertigo: Its multisensory syndromes* (2nd, ed., pp. 219–231). Springer. Science & Business Media. https://doi.org/10.1007/978-1-4757-3801-8_13

Brumblay, R. J. (2003). Hyperdimensional perspectives in out-of-body and near-death experiences. *Journal of Near-Death Studies*, *21*(4), 201–221. https://doi.org/10.17514/JNDS-2003-21-4-p201-221.

Cameron, O. G. (2001). *Visceral sensory neuroscience: Interoception*. Oxford University Press.

Ceunen, E., Vlaeyen, J. W., & Van Diest, I. (2016). On the origin of interoception. *Frontiers in Psychology*, *7*(743), 1–17. https://doi.org/10.3389/fpsyg.2016.00743

Charland-Verville, V., Jourdan, J.-P., Thonnard, M., Ledoux, D., Donneau, A. F., Quertemont, E., & Laureys, S. (2014). Near-death experiences in non-life-threatening events and coma of different etiologies. *Frontiers in human neuroscience*, *8*, 203. https://doi.org/10.3389/fnhum.2014.00203

Chen, S. C., Suaning, G. J., Morley, J. W., & Lovell, N. H. (2009). Simulating prosthetic vision: I. Visual models of phosphenes. *Vision research*, *49*(12), 1493–1506.

Craig, A. D. (2003). Interoception: The sense of the physiological condition of the body. *Current Opinion in Neurobiology*, *13*(4), 500–505. https://doi.org/10.1016/S0959-4388(03)00090-4

Craig, A. D. (2009). Emotional moments across time: A possible neural basis for time perception in the anterior insula. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, *364*(1525), 1933–1942. https://doi.org/10.1098/rstb.2009.0008

Craig, A. D. (2013). An interoceptive neuroanatomical perspective on feelings, energy, and effort. *Behavioral and Brain Sciences*, *36*(6), 685–686. https://doi.org/10.1017/S0140525 X13001489

Császár, N., Scholkmann, F., Salari, V., Szőke, H., & Bókkon, I. (2016). Phosphene perception is due to the ultra-weak photon emission produced in various parts of the visual system: Glutamate in the focus. *Reviews in the Neurosciences*, *27*(3), 291–299. https://doi.org/10.1515/revneuro-2015-0039

Damasio, A., & Carvalho, G. B. (2013). The nature of feelings: Evolutionary and neurobiological origins. *Nature Reviews Neuroscience*, *14*(2), 143. https://doi.org/10.1038/nrn3403

Di Lernia, D., Serino, S., Pezzulo, G., Pedroli, E., Cipresso, P., & Riva, G. (2018). Feel the time. Time perception as a function of interoceptive processing. *Frontiers in Human Neuroscience*, *12*(74), 1–17. https://doi.org/10.3389/fnhum.2018.00074

Droit-Volet, S., & Gil, S. (2009). The time-emotion paradox. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *364*(1525), 1943–1953. https://doi.org/10.1098/rstb.2009.0013

Egger, V. (1896). Le moi des mourants. *Revue Philosophique de la France et de l'Étranger*, *41*, 26–38. Retrieved from http://www.jstor.org/stable/41079702

Ezure, K., & Graf, W. (1984). A quantitative analysis of the spatial organization of the vestibulo-ocular reflexes in lateral-and frontal-eyed animals—I. Orientation of semicircular canals and extraocular muscles. *Neuroscience*, *12*(1), 85–93.

French, C. C. (2005). Near-death experiences in cardiac arrest survivors. *Progress in Brain Research*, *150*, 351–367. https://doi.org/10.1016/S0079-6123 (05)50025-6

Giannopulu, I., Leboucher, P., Rautureau, G., Israël, I., & Jouvent, R. (2016). Visuo-vestibular contributions to vertical self-motion perception in healthy adults. In H. Bleuler, M. Bouri, F. Mondada, D. Pisla, A. Rodić, & P. Helmer (Eds.), *New trends in medical and service robots* (pp. 101–112). Springer International. https://doi.org/10.1007/978-3-319-23832-6_20

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Aldine.

Greenlee, M. W., Frank, S. M., Kaliuzhna, M., Blanke, O., Bremmer, F., Churan, J & Smith, A. T. (2016). Multisensory integration in self-motion perception. *Multisensory Research*, *29*(6–7), 525–556. https://doi.org/10.1163/22134808-00002527

Greyson, B. (1983). The Near-Death Experience Scale. *Journal of Nervous and Mental Disease*, *171*(6), 369–375.

Greyson, B. (2015). Western scientific approaches to near-death experiences. *Humanities, 4*, 775–796.https://doi.org/10.3390/h4040775

Holden, J. M., & Loseu, S. (2015). Shedding Light on the Tunnel and Light in Near-Death Experiences: A Case Study. *Journal of Near-Death Studies, 34*, 1.

Hou, Y., Huang, Q., Prakash, R., & Chaudhury, S. (2013). Infrequent near-death experiences in severe brain injury survivors: A quantitative and qualitative study. *Annals of Indian Academy of Neurology*, *16*(1), 75–81. https://doi.org/10.4103/0972-2327.107715

Hubbard, T. L. (2010). Extending *Prägnanz*: Dynamic aspects of mental representation and Gestalt principles. In L. Albertazzi, G. J. van Tonder, & D. Vishwanath (Eds.), *Perception beyond inference: The information content of visual processes.* (pp. 75–108). MIT Press.

Husserl, E. (2002). *Phantasia, conscience d'image, souvenir*. Jérôme Millon.

Husserl, E. (2003). *Sur la phénoménologie de la conscience intime du temps: 1893–1917*. Editions Jérôme Millon, collection Krisis.

Husserl, E. (2012). *On the phenomenology of the consciousness of internal time (1893–1917).* Kluwer Academic Publishers.

Jourdan, J.-P. (2001). Les dimensions de la conscience. *Les Cahiers scientifique de IANDS-France*, *7*. Retrieved from http://dr.jp.jourdan.pagesperso-orange.fr/Les Dimensions de la Conscience.pdf

Jourdan, J.-P. (2011). Near death experiences and the 5th dimensional spatio-temporal perspective. *Journal of Cosmology*, *14*. Retrieved from http://cosmology.com/Consciousness152.html

Jourdan, J.-P., & Smythies, J. (2019). An exploratory study of perceptual and cognitive features in near-death experiences: A proposed model and research recommendations. *Journal of Near-Death Studies*, *37*(2), 65–97. https://doi.org/10.17514/JNDS-2019-37-2-p65-97.

Kirsch, V., Keeser, D., Becker-Bense, S., Karali, T., Ertl-Wagner, B., Brandt, T., & Dieterich, M. (2017). Vestibular and visual cortex activity during room tilt illusion. *Journal of Neurology*, *264*(1), 70–73.

Lange, R., Greyson, B., & Houran, J. (2004). A Rasch scaling validation of a 'core' near-death experience. *British Journal of Psychology, 95*(2), 161–177. https://doi.org/10.1348/000712604773952403

Lerner, F. (2016). *Matière des déplacements des états de mort imminente (e-motion, création, réparation)* (Doctoral dissertation). UCL-Université Catholique de Louvain.

Levinas, E. (1949). *En découvrant l'existence avec Husserl et Heidegger*. Librairie philosophique J. Vrin.

Lopez, C., & Blanke, O. (2010). How body position influences the perception and conscious experience of corporeal and extrapersonal space. *Revue de Neuropsychologie*, *2*(3), 195–202.

Lucci, G., & Pazzaglia, M. (2015). Towards multiple interactions of inner and outer sensations in corporeal awareness. *Frontiers in Human Neuroscience*, *9*, Article 163, 1–7. https://doi.org/10.3389/fnhum.2015.001 63

Maack, L. H., & Mullen, P. E. (1983). The doppelgänger, disintegration and death: A case report. *Psychological Medicine*, *13*(3), 651–654. https://doi.org/10.1017/S0033291700048066

Nizzi, M. C., Demertzi, A., Gosseries, O., Bruno, M. A., Jouen, F., & Laureys, S. (2012). From armchair to wheelchair: How patients with a locked-in syndrome integrate bodily changes in experienced identity. *Consciousness and Cognition*, *21*(1), 431–437. https://doi.org/10.1016/j.concog.2011.10.010

Owens, J., Cook, E. W., & Stevenson, I. (1990). Features of "near-death experience" in relation to whether or not patients were near death. *The Lancet*, *336*(8724), 1175–1177.

Parnia, S., Waller, D. G., Yeates, R., & Fenwick, P. (2001). A qualitative and quantitative study of the incidence, features and aetiology of near death experiences in cardiac arrest survivors. *Resuscitation*, *48*(2), 149–156. https://doi.org/10.1016/S0300-9572 (00)00328-2

Perruchoud, D., Michels, L., Piccirelli, M., Gassert, R., & Ionta, S. (2016). Differential neural encoding of sensorimotor and visual body representations. *Scientific Reports*, *6*, 37259. https://doi.org/10.1038/srep20144

Petitot, J. (2017). *Elements of neurogeometry: Functional architectures of vision*. Springer.

Ramachandran, V. S., & Altschuler, E. L. (2009). The use of visual feedback, in particular mirror visual feedback, in restoring brain function. *Brain*, *132*(7), 1693–1710. https://doi.org/10.1093/brain/awp135

Ring, K. (1980). *Life at death: A scientific investigation of the near-death experience*. Coward McCann.

Ring, K., & Cooper, S. (1997). Near-death and out-of-body experiences in the blind: A study of apparent eyeless vision. *Journal of Near-Death Studies, 16*(2), 101–147. https://doi.org/10.17514/JNDS-1997-16-2-p101-147.

Riva, G. (2017). The neuroscience of body memory: From the self through the space to the others. *Cortex*, *104*, 241–260. https://doi.org/10.1016/j.cortex.2017.07.013

Sazdjian, H. (2012-2013). Cordes vibrantes, ondes sonores, ondes optiques. Universite Paris-Sud. Retrieved from http://ipnwww.in2p3.fr/IMG/pdf/th-sazdjian-poly1.pdf

Seth, A. K., & Friston, K. J. (2016). Active interoceptive inference and the emotional brain. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*(1708), 1–10. https://doi.org/10.1098/rstb.2016.0007

Slawinski, J. (1987). Electromagnetic radiation and the afterlife. *Journal of Near-Death Studies,* *6*(2), 79–94. https://doi.org/10.17514/JNDS-1987-6-2-p79-94.

Trehub, A. (2007). Space, self, and the theater of consciousness. *Consciousness and cognition*, *16* (2), 310–330. https://doi.org/10.1016/j.concog.2006.06.004

Trehub, A. (2013). Where Am I? Redux. *Journal of Consciousness Studies*, *20*(1–2), 207–225. Imprint Academic.

van Lommel, P., van Wees, R., Meyers, V., & Elfferich, I. (2001). Near-death experience in survivors of cardiac arrest: A prospective study in the Netherlands. *The Lancet*, *358*(9298), 2039–2045. https://doi.org/10.1016/S0140-6736 (01)07100-8