Author(s): Fachner, Jörg

Title: Time is the key – Music and Altered States of Consciusness

Year: 2011

Version:

Please cite the original version:

Fachner, J. (2011). Time is the key – Music and Altered States of Consciusness. In E. Cardeña, & M. Winkelman (Eds.), Altering Consciousness: A multidisciplinary perspective. Volume 1: History, Culture and the Humanities (pp. 355-376). Praeger.

CHAPTER 16

Time Is the Key: Music and Altered States of Consciousness

Jörg C. Fachner

> Music and consciousness are things we do. . . . Achieving consciousness, from the Latin *con* (with) and *scire* (to know), is the central activity of human knowledge. At the heart of the word is a concept of mutuality, knowing with others. Our consciousness is a mutual activity; it is performed. (Aldridge, 2006, p. 10)

Introduction

In this chapter, I will summarize the literature on how music and altered states of consciousness (ASC) are connected. Essential aspects include induction and expression of emotions and rhythmic body movements to music and how an altered experience of music is connected to states of altered temporality. Winkelman (2000) stressed the human capacity for experiencing ASC as a fundamental biological function. Studies on brain functions of altered music experience and temporality (Fachner, 2006b, 2009; Shanon, 2001) convey the natural bases of these phenomena, which have been utilized in shamanistic practice for ages. As Rouget suggested:

> To shamanize, in other words to sing and dance, is as much a corporeal technique as a spiritual exercise. Insofar as he is at the same time singer, instrumentalist, and dancer, the shaman, among all practitioners of trance, should be seen as the one who by far makes the most complete use of music. (Rouget, 1985, p. 319)

Music and the Alteration of Consciousness

Music functions in many different contexts to alter consciousness, while the same music can be listened to without altering consciousness *per se* (Becker, 1994). Music can be fast, loud, and with a steady beat, as for example in gospel music, leading to religious rapture, or the music can be slow, solemn, and spherical to accompany contemplative worshiping (Söhngen, 1967). For Rouget (1985), music creates emotional conditions and structures time processes of symbolic events, especially in ceremonial settings in which it is intended to alter consciousness states for individual or group ritual purposes [see Ustinova, and Zarrilli, this volume].

Rouget's groundbreaking book *Music and Trance. A Theory of the Relations Between Music and Possession* differentiates between *trance* (from Latin *transire* for "passing through") and *ecstasy* (from Latin *exstasis* for "to be out or stand out of stasis"). For him, "trance is always associated with a greater or lesser degree of sensory overstimulation—noises, music, smells, agitation—ecstasy, on the contrary, is most often tied to sensorial deprivation—silence, fasting, darkness" (Rouget, 1985, p. 10) (see Table 16.1). The literature includes many different and partly contradictory definitions of the terms *trance* and *ecstasy* (also see Cardeña, 2009; Fachner, 2006a; Matussek, 2001; Meszaros, Szabo, & Csako, 2002; Pekala & Kumar, 2000; Winkelman, 1986). Rouget's concepts of trance and ecstasy are linked to the amount of body movement to music. Trance music in Rouget's terminology is connected to rhythmic body movements, to dance, excitement, and hyperarousal, and in certain rituals it may also lead to *possession trance*. Ecstasy,

Table 16.1 Differentiation of ecstasy and trance according to Rouget, 1985, 11.

Ecstasy	**Trance**
Immobility	Movement
Silence	Noise
Solitude	In company
No crisis	Crisis
Sensory deprivation	Sensory overstimulation
Recollection	Amnesia
Hallucination	No hallucination

meanwhile, happens in hypoarousal and immobility and seems to be more concerned with pure mental activity, like meditation, contemplation, and the like. A recent inquiry on out-of-body experiences has shown that such ASC occur more often in immobility, when lying down supine or sitting (Zingrone, Alvarado, & Cardeña, 2010), when the focus of attention can turn inward, and more afferent information is processed, a finding that corroborates Rouget's concept of ecstasy [see Winkelman, Volume 2].

Although the everyday connotation of the terms *trance* and *ecstasy* may have diametrical or similar meanings when connected to music (Hess, Fachner, & Rittner, 2009; Rittner, Fachner, & Hess, 2009), in the techno music genre, *trance* still stands for dance and excitation and *ecstasy* refers to a meditative "chill-out" music, representing the relaxation state after exhaustive dancing (Hutson, 2000; Penman & Becker, 2009; Weir, 1996) [see St John, this volume].

Trance Mechanics: How to Explain Trance?

Neher (1961, 1962) proposed that epilepsy-like phenomena witnessed in ceremonial drumming and healing rituals are based on the causal effects of a certain sound and tempo. Successive elements are: (1) a distinct frequency spectrum, dominated by low and loud bass frequencies of drums (Neher, 1962, pp. 152–153); (2) repetition of distinct rhythmic patterns ("monotonous drumming") to ensure that such frequency spectra occur; and (3) a certain tempo (beats per minute) of such drum beat sequences in order to entrain brainwave patterns.

This would explain the extreme cases of unusual behavior in ceremonies involving drumming. Neher proposed that this was the consequence of an *auditory driving effect* analogous to the epilepsy-inducing effect of *photic driving* (brain convulsions caused by rhythmic light emissions at a frequency of predominantly 10 Hz). He argued that the volume and energy of low-frequency sound information traveling bottom-up the afferent auditory pathways would induce sensory overstimulation and entrain other sensory modalities and trigger convulsions. The drumbeat frequency (beats per second) would synchronize EEG frequency measured in cycles per second. Neher (1961, p. 449) used strongly beaten drum beat frequencies performed at 3, 4, 6, and 8 Hz (beats per second), which in his homology would be analogue to the EEG's theta range (3–8 Hz), while photic driving was used in the range of alpha waves (8–13 Hz/flashes per second). The 8 to 13 beats per second are difficult to realize on drums by one player alone because of the extremely quick pulsating sequence (cf. Neher, 1961, p. 449;

1962, pp. 153–154). A group of players would be able to produce such pulsations by weaving their beats together. Nowadays, computer technology and appropriate music hardware (sampler, sequencer, sound modules, etc.) may permit such constant modes of play. Neher's ideas were taken up again in the rave culture in order to explain the altered states of consciousness occurring in the context of techno music and rave parties through sound (bass frequencies), repetition (loops and sequences), and tempo (bpm) of rhythmic patterns (Cousto, 1995; Hutson, 2000; Weir, 1996).

Rouget believed such experimental attempts to explain a universal "trance mechanism" with reference to constant low-pitch drumbeats alone to be incomplete, since the laboratory situation in Neher's experiment could not be compared to other settings. The auditory stimuli used in the lab, which were constant in form and intensity, have in practice very little in common with the constantly varying stimuli provided by drums played in possession events. Further, Rouget stressed that ritual leaders and musicians do not enter ASC unintentionally but willingly using known cultural techniques. "If Neher were right, half of Africa would be in a trance from the beginning of the year to the end" (Rouget, 1985, p. 175). The person must have a specific aim and must be intellectually prepared for the experience (Rouget, 1985, pp. 315–326). For example, the possessed individual must identify with the respective form of divine being pertinent to his or her culture and possibly attract the spirit through characteristic movements (pp. 35, 103, 105–108).

Neher's work on "auditory driving" has inspired a lot of discussions, critics, and enthusiasm (for a review, see Turow, 2005) and was a first experimental attempt to explore *entrainment* (a coupling of inner rhythms through external timers), a conformity of body movements, breath, heart beat, and nerve activity triggered and synchronized by rhythm. Although there is evidence that brainwaves entrain to external rhythmic stimulation (Becker, 1994; Fachner, 2006a; Maxfield, 1990; Turow, 2005; Wright, 1991), Neher's interpretation (gained visually—not quantitatively—from the ongoing EEG) that certain drumbeat tempo entrains equivalent EEG cycles still calls for sound replication.[1]

Music Therapy, Emotion and ASC

In one branch of music therapy theory discourse, the roots of music therapy are traced back to shamanic practices (Aigen, 1994; Crowe,

[1]A symposium on Brainwave Entrainment to External Rhythmic Stimuli organized by Turow in 2006 gathered researchers on this topic, but no explicit replication of Neher's results was presented (see http://stanford.edu/group/brainwaves/2006/index.html).

2004; Fachner, 1998, 2007; Hanser, 2009), the core of which are a variety of techniques such as drumming, dance, and music to alter consciousness. The question of how music induces ASC remains unsolved in discussions of the effect of music in music therapy and psychology (Ruud, 2001). The effects of music in settings with a goal-directed therapeutic intervention are based on models of modern music therapy (there are at least five major models) and accordingly are a reflection of practice-related issues (Aldridge, 1996). Whether the music itself has certain healing properties or whether the therapeutic relationship in music is effective is an ongoing discussion in music therapy research reflecting paradigmatic discourse of biomedical and social science approaches in medicine: Is it the medicine or the person that administers it that provides help (Fachner, 2007)? In our topic here, we may also ask if it is the music itself that has certain properties that *per se* induce ASC and healing or if music just accompanies rituals that intend to induce ASC [see Mishara & Schwartz, Volume 2].

Sound and ASC

In music therapy approaches using ASC (see Aldridge & Fachner, 2006; Bonny, 1980; Hess, Fachner, & Rittner, 2009; Rittner, Fachner, & Hess, 2009), the therapist strives for a "non conventional, healing state of consciousness" (Haerlin, 1998, p. 238) in single or group sessions with monochrome sound instruments such as sound bowls, gongs, and monochord, and pulsation instruments such as drums and rattles. Timmermann (2009) emphasizes the significance of a monotonous repetition of sounds as a core element of ASC induction. The duration of sounds appears to be important for the effects on the client. According to Arrién, "most individuals need 13 to 15 minutes in order to be influenced or carried away by drums" (Haerlin, 1998, p. 239). Haerlin writes that the main effect of ASC-inducing instruments is the "induction of an empty trance matrix that reduces the noise of thought and more or less suspends the normal and pathological frame of beliefs and references" (p. 240). Techniques that alter the focus of attention, and thereby consciousness, offer a way to empty the contents of memory (Dietrich, 2003), allowing for new information to enter (Matussek, 2001), safely guided by the therapist.

However, proposals that base ASC induction on the absorbing sounds of instruments alone overlook the influence of set and setting, the uniqueness of situation and context, and the personality and history of the receiving individual, as well as the specific sociocultural situation and attitudes of the persons involved in performance in the therapeutic process (Fachner, 2007). From a psychodynamic perspective, Strobel writes: "Strictly speaking, it is not only the sound, but the therapist via the sound who affects the client, and the client re-influences the therapist with his responses" (Strobel, 1988, p. 121).

Absorption, Imagery, and Musical Experiences

Listening to music as a sensual, aesthetic experience can completely absorb people and completely cut off other sensory input, but absorption seems to be linked to music preference, imagery, and hypnotizability. Snodgrass and Lynn (1989) looked for correlations between persons with high, medium, and low susceptibility to hypnosis (measured with the Harvard Group Scale of Hypnotic Susceptibility, Form A) and their degree of imaginative absorption while listening to highly and less imaginative music (imaginativeness of 12 pieces of classical music rated by 49 participants on a 7-point scale). Irrespective of imaginative qualities, highly hypnotizable persons reported markedly more absorption than persons with low susceptibility to hypnosis. All test participants clearly revealed higher imaginative performance with highly imaginative pieces compared to less imaginative ones. Differences in imaginative performance were found between persons with high hypnotic susceptibility while listening to highly imaginative music, but not with less imaginative music. Highly hypnotizable "fans" of classical music showed significant correlations between absorption and hypnotizability, a finding that was replicated by Kreutz and coworkers (2008), showing the influence of musical preferences on the intensity of emotions and absorption skills.

Music and Emotions in the Brain

Some very special pieces of music may send shivers down the spine; it is exactly these shivers or chills felt in listening to our favorite music that were used by Blood and Zatorre (2001) to demonstrate that musical information involves brain structures involved in conveying emotion. Listening to our favorite melody, we register changes not only in the activity of the autonomous nervous system, heart beat, muscle tension, skin resistance, and depth of breathing but particularly in the blood flow in brain structures involved in processing emotional stimuli. The activation pattern (blood flow) of brain regions (increased: ventral striatum, dorsomedial midbrain, insula, orbitofrontal cortex; decreased: amygdala, left hippocampus, ventromedial prefrontal cortex) shows a surprising similarity to activity patterns induced by drugs with a primarily euphoric effect similar to that of cocaine. This suggests that the perception of favorite music interacts directly with structures associated with emotions (Blood & Zatorre, 2001) [see Presti, Volume 2].

Menon and Levitin were able to show sequences of brain processes and their connectivity patterns involved when listening to music, that is, the succeeding time process of how and when the different centers of the brain become active when the "brain is on music" (Levitin, 2008). Menon and Levitin (2005) proposed that the nucleus accumbens, a part of the brain not easily visible in Blood and Zatorre's PET scans, initiates dopamine release in response to music [see Previc, Volume 2]. They found that, starting from the auditory centers, the cascade of activation initializes changes in parts of the frontal cortex, the mesolimbic reward centers, and finally the nucleus accumbens, releasing waves of dopamine. As expected, the cerebellum and the basal ganglia, regions of the brain involved in dopamine, motor, and timing processes analyzing rhythm and meter in music, became active as well. Phasic increases in dopamine release happen when meaningful objects are in the focus of attention; the higher the personal meaning and valence of the object in focus, the more dopamine is released (Yacubian & Büchel, 2009). A skilled musician (or shaman) may organize the sounds and rhythms played to culminate at a certain important point in the ritual and trigger endogenous processes (Katz & de Rios, 1971). Goldstein (1980) has already shown that the amount of "chills" can be diminished by administering opioid receptor antagonists such as naloxone to weaken the impact of the emotional experience of music. Opioid receptors with a high density in the brainstem region around the inferior collicolus "may mediate attachments we develop to certain beloved sounds" (Panksepp & Bernatzky, 2002, p. 137), enabling us to focus our emotions on certain beloved objects. An intense night in a club under the influence of certain club-specific music and drugs will be remembered and stored as such a beloved sound and will act later as a cue for seeking these intense events again. Panksepp has described the "generalized incentive-seeking system centered on mesolimbic and mesocortical dopamine circuits" (p. 135) that are activated when musical expectancies are coming into play and are important for the processing of time passages for rhythmic body movements.

A study on religious and deep listeners (people who have strong emotional reactions, like goosebumps or crying or are otherwise deeply moved when listening to their favorite music) in comparison to controls showed stronger responses in heart rate and galvanic skin response when listening to self-selected, preferred music (Penman & Becker, 2009). Deep listeners described their experiences in transcendent terms and responses occurred parallel to differing parts of the music that were of high subjective valence for the listeners. This occurrence was not locked to specific parts of the music; there was no straight connection of strong emotions to musical boundaries like returning chorus, a sudden change of musical registers, and so forth. This study illustrates how music functions as "a catalyst of strong emotions that may lead to trancing" (Penman & Becker, 2009, p. 64).

Physiological reactions (chills) are connected to reward circuits in the brain. They intensify the personal experience and mediate the meaning of the musical events, which are time-locked in their occurrence with specific moments inherent in the preferred or beloved music but are not necessarily locked to specific musical elements such as certain keys, harmonies, tempos, or loudness.

The Role of Music in Evolution and Information Transfer and Social Bonding

Matussek (2001) proposes that the cultural matrix and the physiological effects of music complement each other functionally to produce a state of amnesia and a willingness to assimilate new information. Freeman (2000) proposes that music and dance were related to the cultural evolution of human behavior and forms of social bonding. He saw connections in the cultural transmission of knowledge during ASC caused by chemical and behavioral forms of induction. Alterations of consciousness produced in this manner served to break through habits and beliefs about reality and increase alertness for new and more complex information. In times of primarily oral information transfer, memorization techniques were required to stimulate all senses for storing and processing that information. Musical abilities in particular seemed to be important for an effective transfer of knowledge.

Human musical expressive abilities evolved as a prelinguistic communication medium (Cross & Woodruff, 2009) and a framework prior to language that was utilized for communicating context-sensitive and complex emotional codings in an ongoing symbolic frame of reference in group interactions. Winkelman (2002, p. 78) stressed psychoemotional group bonding processes engaged by chanting, an affective vocalization and rhythmic medium that played a central role in human cognitive evolution through engaging biological competences that create empathy, group solidarity, and cohesion. Vocalizations communicate affective states and may mark territorial claims. Chanting provides a communication medium prior to speech, extending forms of affective vocalizations shared with other primates as well. The difference in musical expression in humans and animals involves referential symbolism and classification of musical elements whereby animal vocalizations of affective states are immediate expressions with nonsymbolic means, not planned nor integrated. Winkelman (2002) further stresses the advantage of music in strengthening group cohesion and identity. Rhythm in particular provides an external stimulation that coordinates and synchronizes group performances through a rhythmo-affective semantics and expression (2002, pp. 79, 80).

ASC, Music, and (Rhythmic) Body Movements

During drumming as well as dancing, the rhythmic movements of the body synchronize through the rhythm of the music. This occurs automatically during prolonged activity, without effort or control. This may give the impression that one becomes united or "one with the rhythm." For many rave dancers, this is a well-known experience (Hutson, 2000). Aaronson refers to the rave party as a "ritual space of rhythmic cohesion" in which rhythm, sound, and light effects evoke a bodily expression of figurative and abstract dances inscribing music into spaces "that go beyond the bounds of social class" (Aaronson, 1999, pp. 231, 232) in the sense of an embodied idealism (Rill, 2006).

> Rhythmic body movements are accompanied by recurrent shifts in body fluids, especially in the blood. In addition, respiration tends to synchronize with movements and induces the heart rate oscillations known as respiratory sinus arrhythmia. In this way, rhythmic movements may result in a respiratory–cardiovascular synchronization with increased blood pressure oscillations that stimulate the carotid baroreceptors. The effects of baroreceptor stimulation are not confined to a slowing of the heart rate; they also reduce cortical arousal and excitability, augment pain thresholds, reduce muscular reflexes, and increase theta activity, as has been shown in previous work. (Vaitl et al., 2005, p. 107)

It is a known fact from hypnosis research that there are personalities that are more hypnotizable and susceptible to hypnosis than others. Therefore, psychometric tools such as the Harvard Group Scale of Hypnotic Susceptibility (Shor & Orne, 1963) have been developed to preselect such individuals and to measure the depth of hypnosis reached (Meszaros et al., 2002). However, it seems that different personality traits and physiological constitutions may also have their root in genetic differences [see Cardeña & Alvarado, this volume; Granqvist, Reijman, & Cardeña, Volume 2].

The genetic bases concerning dance were reported by Bachner-Melman and collaborators (2005), who found that professional dancers (as compared to athletes and a control group) had greater facility for serotonin transport and vasopressin response (serotonin is a neurotransmitter that regulates blood pressure in the vessels [see Nichols & Chemel, Volume 2], and the arginine vasopressin receptor 1a regulates vasoconstriction/expansion due to specific amino acid activity). The different interplay of serotonin transporters and vasopressin receptors may enhance dancers' "social communication skills, courtship, and spiritual facets" (p. 394) as dancers compared to athletes and control group had higher scores on the Tellegen Absorption Scale and the Reward Dependence Factor of Cloninger's Tridimensional Personality Questionnaire. Serotonin activity in particular is linked to ASC, and

> Altered serotonin levels in carriers of the SLC6A4 promoter region allele might predispose such individuals to a greater ability for imagery and attention to stimuli (especially to musical stimuli) that we hypothesize may provide part of the "hard wiring" that talented and devoted individuals need to perform in an art form that combines a unique combination of both musical and physical skills. (p. 399)

Taking a closer look at brain processes involved in dancing, Park and coworkers (2002) reported changes in the EEG in the case of a male Salpuri dancer, a traditional dance formerly performed by shamans in Korea, comparing rest, listening to pop music, and remembering a previous dance. In mentally recalling an altered state (*sinmyung*, expressing spiritual cleansing or purification) of the dance, frontal and occipital low alpha (8–10 Hz) and theta frequencies increased, as compared to power values at rest. Theta increases were mostly obvious in the frontal midline, an increase that is normally seen in relaxed concentration and heightened awareness (Mitchell, McNaughton, Flanagan, & Kirk, 2008). Park supposes that the Salpuri dancer reaches the ASC "through suppression of frontal cortex functions and activation of subcortical functions" (Park et al., 2002, p. 961). This means that a state-dependent recall of ASC experiences seems to be characterized by the dominance of theta frequencies. Similar results were reported by Oohashi and collaborators (2002), who recorded the EEG of a participant who experienced *Kerauhan*, a possession trance that occurred during a dedicatory ritual drama called *Calonarang* in Bali. In the trance phase analysis, Oohashi and coworkers found a distinct power increase of EEG theta and alpha frequencies that differed clearly from patterns found in epileptic discharges and mental disorders.

There are very few musicological studies on the music that is played while being in or getting into ASC. Katz and De Rios (1971) transcribed songs whistled in the Peruvian ayahuasca ceremonies and explained the function of the songs as helpers for the shaman and their clients to control the visions evoked by the "perception of the speed of the healer's music" (p. 325). Music's function was compared to a "jungle gym," giving a structure to control ASC and provide "a series of paths and banisters to help them negotiate their way" (De Rios & Janiger 2003, p. 161) [see Mishor, McKenna, & Callaway, Volume 2].

Becker (1994) described the stages of the music used in a Rangda/Barong ritual in Pagoetan in Bali. Transcribing the music of a certain part of the ritual, Becker demonstrated that "short, loud temporal cycles with no melodic elaboration are used in Balinese gamelan music to indicate the presence of demons and fighting" (Becker, 1994, p. 48). Her transcription exemplifies how the pulsating rhythms of drums and cymbals, the sounds of gongs and gangsa, become "all rhythmically synchronized, become one with the rhythmic synchrony experienced throughout the central nervous system of the trancer" (p. 49). Becker interpreted the effect of music on ASC and discussed a coherent framework of rhythmic entrainment, connectionism, and neurotransmitter changes to explain the observations. But only Oohashi et al.'s EEG study (2002) correlated ASC-related brain changes over the time course of an authentic ritual performance.

Another musicological study correlated EEG, MIDI, and audio data of a 28-hour piano performance of Erik Satie's *Vexations* (Kohlmetz, Kopiez, & Altenmüller, 2003; Kopiez, Bangert, Goebl, & Altenmüller, 2003). Analyzing the music performance data (MIDI and audio recordings) during the ASC period (between the 15th and 18th hours of performing the piece), an increasing acceleration and disintegration of tempo and uncontrolled changes in loudness, which had previously remained stable over a period of 14 hours, was observed. Overall, however, the sensor-motor performance during the ASC remained remarkably stable. The pianist was still able to play the piano, but the way he played the piece was different before and after entering the state. Throughout the 28-hour performance, EEG frequency slowing was observed in the left posterior hemisphere, indicating less activity in the left parietal and more activity in right parietal lobes.

Summarizing, rhythmic body movements in dance may induce ASC by suppressing cortical and enhancing subcortical functions while slowing and increasing alpha and theta brainwaves. The serotonergic system may act differently in those experienced with dancing and ASC, leading to an increased imagery and attention for musical stimuli, while motor programs used for playing music function quite normally in altered states, but de- or acceleration of tempo and loudness may occur.

The connection of ASC and music is dependent upon the personal intention that is communicated with or attributed to preferred music. Whether music becomes meaningful and intense while experiencing or performing it depends on the situation or setting and the personal intention attached. Further, in the process of performing music, it may depend on personal kairological (see below) processes that evoke an immediate meaning and call for activity (as in Oohashi et al.'s work). Again, this stresses that the connection of music and ASC is connected to certain stations or stages in the time course of the ASC experienced.

ASC, Music, and Altered Temporality

Music is the art of time processes and requires time to be heard. Brown, Merker, and Wallin (2000, p. 17) discussed the neurobiology of metric timekeeping as a key evolutionary research question, as metrics are central for language and music. Alterations of time perception, whether induced by drugs, rhythmic body movements, intense emotions, absorption, or being hypnotized, change the focus of attention or meaningful sequences attached to it during rituals, which is crucial for the induction of ASC through music.

The drum has been central to discussions regarding timekeeping and entraining "movements to an external timekeeper, such as beating a drum" (Wallin, Merker, & Brown, 2000, p. 17). As Rouget (1985) and Eliade (1964) described, the shaman has to build his drum, sanctify it in a ritual according to his or her cosmology, and load it with the energy and tradition needed for the shamanic journey. It is played constantly during the treatment process, and the way it is played marks the stations on the shamanic journey. This stresses that ritual purposes and meaningful intentions are connected to the playing. Therefore, the main role of music seems to be to organize and synchronize time structures of group processes in which certain stations in the ritual and intensity stages of the process are phase-locked with specific content. The information units are encoded and symbolized in gestures, in mimesis (compare Winkelman 2002, p. 80), as reflected in rhythmic abilities and coherent movements of the body in drumming and dancing and its ritual-specific figurations that synchronize with the musical structure and the rhythms played. Rhythm and tempo organize the external entraining sequences of information to be transferred by ordering the sounds in their timely occurrence in rituals through rhythmo-affective semantics. Rhythm organizes the time structure of the musical events. This includes the beat intervals with varying accentuations, and interonset intervals of beats in the millisecond range (elaborated upon in Neher's research), the length of melody tones or vocalizations, and short phrasings in the second to minute range, and, when sharing a certain tempo, the group temporal process into a shared time structure. This seems to be more intense and effective when perception of time is altered, which is a common characteristic of ASC (Ludwig, 1966); but what about music makes changes in time perception from normal states of consciousness?

The research literature on timing reflects the debate on subjective timing effects, especially when time is estimated (memorized) after an event has happened. Pöppel (2000) has called it the *time paradoxon*—time periods with a dense event structure recalled in a narration are estimated as prolonged when a lot of interesting things happened, even when the duration in physical time is objectively short. It seems that "time judgments can distort, recalibrate, reverse, or have a range of resolutions depending on the stimulus and on the state of the viewer" (Eagleman et al., 2005, p. 10,370).

Tse has proposed a simple countermodel, arguing that the brain "has access to the approximate constant rate of its own information processing" (in Eagleman et al., 2005, p. 10,369). For example, if one bit of information processed is interpreted as one unit of objective time, then, in moments of shifted or increased attention, two or three bits of information would be counted again as one unit of objective time, "creating the illusion that time and motion had slowed down" (p. 10369). Our sense of subjective time fluctuates in relation to clock time according to the amount of information we receive per second. Only a specific, individually, and situation-relevant excerpt of sensory data is accessible to our consciousness (upper limit are around 15–20 bits/second).

> Determining what constitutes a bit of information in music is the crux of our problem. Basically, it depends on the individual, how well he knows the given musical style, his ability to codify musical events, and his ability to concentrate during the performance. Ostensibly, a note would be a bit of information. But in an extreme case—e.g., an exceptionally familiar recording—the first bar might be grasped as one gesture, which in turn would identify the entire piece, so it might be listened to in huge chunks (i.e., a minimal number of bits.) At the other extreme, one note might be heard as a composite of onset transients and sine tones with individual envelope shapes. More commonly, a chord, an arpeggio, or even an entire cadential gesture could be heard as one bit of information. Experience and training thus have a direct relation to the amount of "information" that can be grasped from a musical phrase. (Mountain, 1989, p. 4)

However, perception of time and music does not only depend on expectation, learning, attention, and memory functions in a dynamic process of chunking information units and their duration in the passage of time. As already outlined when discussing intense emotions above, a wide variety of endocrine and neurotransmitter activity changes in ASC interweave with these processes, enabling altered scaling of auditory events, such as loudness (Globus, Cohen, Kramer, Elliot, & Sharp, 1978). Studies that offer a physiological explanation are based on drug research and emphasize the role of various neurotransmitter processes, such as serotonergic (Wittmann et al., 2007), cannabinoid (Fachner, 2009; Mathew et al., 2002), dopamine, and cholinergic (Meck, 1996; Rammsayer, 1999) interactions with perception and action in an altered temporality (Shanon, 2001). Studies on patient populations and drugs indicate variations in scaling of musical events caused by de- and acceleration of internal clock speed and internal representation of perceived elements when reproducing or estimating time intervals in the millisecond-to-second and the second-to-minute range (Buhusi & Meck, 2005; Meck, 2005). Generally, task-related and activated neural networks (discussed are thalamo-cortico-striatal circuits, i.e., basal ganglia, supplementary motor cortex, prefrontal cortex, posterior parietal cortex) serve as a timekeeper and detect coincidences in synchronous brain activation and processing of different neural populations (Meck, 2005). Clock, memory, and decision stages can be separated. Clock speed (pacemaker) can be influenced by dopaminergic manipulations, whereas memory processes (representation of time durations) can be influenced by cholinergic manipulations. Meck illustrates this by a given oscillation of baseline clock-speed at 100 pulses, which are learned to have a chronological duration of 20 seconds. If clock speed is accelerated by pharmacological agents, the 100 pulses will be accumulated “earlier in physical time than during the baseline training” (Meck, 1996, p. 236), while decrease of clock speed will be accumulated later than physical time. Summarized, this means faster clock speed makes events last shorter while slower clock speed makes events last longer. This model of an internal clock may help to explain how state-dependent endogenous neurotransmitter activity in ASC alter the scaling of auditory units and mediate, for example, in- and decrease of tempo (and loudness[2]) reported in experimental performance studies sketched above [see Kokoszka & Wallace, Volume 2].

[2]Globus et al. (1978) and Iannone et al. (2006) have shown that loudness scaling is state dependent and can be pharmacologically altered.

To summarize, an altered temporality results in a different metric scaling of sensory events in the musical time-space and has an impact on perceptual and attentional processes (Fachner, 2000, 2009, 2011). Thus, we may expect that, if the information in the time course of music rituals becomes meaningful for the listener or performer, the brain will offer various strategies to zoom into specific parts of the music in order to process basic musical features, such as pitch, timbre, and pulse, as well as higher-level musical features, such as tonality, meter, and form, focused in a state of hypofrontality or enhanced sensory perception.

Dietrich (2003, 2004) describes the function of frontal cortex in ASC, proposing that hypofrontality (a reduction of frontal cortex activity) results in a flooding of information in the dorso-lateral prefrontal cortex. This results in a state of consciousness primarily concerned with reception and processing of sensory information, with less activity in the frontal and more activity in the posterior parts of the brain, namely in the temporal, parietal, and occipital areas. Further, in hypofrontal states, the perceptual, sensual bottom-up processing of the brain dominates the limited capacity of the working memory system located in the dorsolateral prefrontal cortex. From a perspective of hierarchically organized functional neuroanatonomy, this area involving working memory, temporal integration, and sustained and directed attention (Dietrich, 2004) is functionally changed during ASC in order to process an increased amount of sensual information, which may only be possible in an altered temporality and focus of attention. As the memory buffer reaches his limit, we may forget the ingredients of complexity experienced in ASC.

Aldridge (1989a) states that we are "patterned frequencies in a matrix of time" who improvise their identity out of a personal set found within the situational settings in which we are located. The experience of time is kairological (from the Greek *kairos*, a god of the right moment to decide), which signifies personal, individual time, and also a chronological structure oriented to the geophysical concept of time as conventional time by the clock. Kairological time emerges from personal perception of time and time intervals and signifies the right time for doing something, deciding, or acting in the here and now (Aldridge, 1996). Anticipation of what is coming up next and what is needed to be perceived is surely of vital interest for humans so that it is not only important in terms of "where to place attention, but also when" (Eagleman et al., 2005, p. 10,370).

Conclusion

Music and ASC are connected in various ways. One of the most determining influences seems to be the context, the personal set and socioecological setting, cultural beliefs, and the intentions of inducing ASC [see Whitehead, this volume]. Is music, then, only the soundtrack of a context in which participants aim to get into ASC, using music as a vehicle for their intentions? Well, participants project their intentions onto the music, but it needs to have the structure to serve them, such as: continuous intensifications, mainly of tempo and volume; the deliberate use of accelerando and crescendo (compare Rouget, 1985, pp. 82–86), but also extreme consistence and monotony in the case of ecstasy; long duration (hours); simple forms; minimal variations in many repetitions, Bordun, or ostinati; and no precise motifs, but steps, tonal variations, slow glissandi, and a narrow tonal range. Acoustic stimuli of trance are certain transitory developments and accentuations, for example, slowly and consistently growing and fading volume. Music therapy research stressed that there is no music that has a clear deterministic effect on physiology, but music can be used as a timeframe for communicative events (Aldridge, 1989b). Music has diverse therapeutic and also hedonistic meanings because the effects depend on processes of involvement, experience, and degree of information on the induction, references, meaning, and purpose of ASC in the specific context (Fachner, 2006a).

Music creates conditions and orders the time structure for intentions that favor the onset of ASC, that regulate form and development and make them more predictable and easier to control. The significance of ASC depends on the respective cultural context and symbolic expression. Each ASC induced in such contexts receives its power from music at the individual stages associated with the function and meaning of ASC in rituals and ceremonies. The function of music here is to create a special emotional atmosphere, to stimulate processes of identification within social groups, and to be either ASC inducing (invocation) or ASC accompanying or guiding. This depends on cultural beliefs, and therefore there are as many different combinations of music and ASC as there are cultural beliefs and music that express their interests.

The individually different degree of hypnotizability seems to be an important factor determining the personal onset time, quality, and depth of ASC. In hypnosis and suggestion, music may serve as a contextualizing factor, helping focus on the music-related induction that absorbs and denies external objects. Induction-specific vigilance changes combined with the intensified, narrowed, or broadened focus of attention might result in a different emotional profile of meaning experienced with music and its symbolic, metaphoric, and physical content. Electrophysiological studies have revealed theta changes as indicative for ASC (Fachner, 2006a, 2006b; Park et al., 2002; Winkelman, 2000). Chemically induced ASC, together with music, can be studied as psychophysiological models of ASC and altered temporality and might help to understand ASC processes in vivo.

Cognitive processing of music changes its modes of awareness on musical elements during ASC. Rhythm, pitch, loudness, and timbre and their sound staging in the perceptive field of a person seem to culminate in a certain sound which, corresponding to the cultural cognitive matrix, induces ASC (Fachner, 2006a). Rouget (1985) proposed that music features such as repetition, long duration, monotony, volume, and density do not provide clear causal explanations for ASC induction, but the connection of time and space perception alteration resulting from music is important (Christensen, 1996). Therefore, rhythm remains the target of discussion for music-related ASC induction.

References

Aaronson, B. (1999). Dancing our way out of class through funk, techno or rave. *Peace Review, 11*, 231–236.

Aigen, K. (1994). *The roots of music therapy: Towards an indigenous research paradigm*. UMI Dissertation Services, Ann Arbor, MI.

Aldridge, D. (1989a). A phenomenological comparison of the organisation of music and the self. *Arts in Psychotherapy, 16*(2), 91–97.

Aldridge, D. (1989b). Music, communication and medicine: Discussion paper. *Journal of the Royal Society of Medicine, 82*, 743–746.

Aldridge, D. (1996). *Music therapy and research in medicine: From out of the silence*. London: Jessica Kingsley.

Aldridge, D. (2006). Music, consciousness and altered states. In D. Aldridge & J. Fachner (Eds.), *Music and altered states: Consciousnes, transcendence, therapy and addictions* (pp. 9–14). London: Jessica Kingsley.

Aldridge, D., & Fachner, J. (Eds.). (2006). *Music and altered states: Consciousness, transcendence, therapy and addictions*. London: Jessica Kingsley.

Bachner-Melman, R., Dina, C., Zohar, A. H., Constantini, N., Lerer, E., Hoch, S., et al. (2005). AVPR1a and SLC6A4 gene polymorphisms are associated with creative dance performance. *Public Library of Science Genetics, 1*, 394–403.

Becker, J. (1994). Music and trance. *Leonardo Music Journal, 4*, 41–51.

Blood, A. J., & Zatorre, R. J. (2001). Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion. *Proceedings of the National Academy of Science of the United States of America, 98*, 11,818–11,823.

Bonny, H. (1980). *GIM Therapy: Past, present and future implications* (GIM Monograph Vol. 3). Salina, KS: Bonny Foundation.

Brown, S., Merker, B., & Wallin, N. L. (2000). An introduction to evolutionary musicology. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The origins of music* (pp. 3–24). Cambridge, MA: MIT Press.

Buhusi, C. V., & Meck, W. H. (2005). What makes us tick? Functional and neural mechanisms of interval timing. *Nature Reviews Neuroscience, 6*, 755–765.

Cardeña, E. (2009). Beyond Plato? Toward a science of alterations of consciousness. In C. A. Roe, W. Kramer, & L. Coly (Eds.), *Utrecht II: Charting the future of parapsychology* (pp. 305–322). New York: Parapsychology Foundation.

Christensen, E. (1996). *The musical timespace. A theory of music listening*. Aalborg, Denmark: Aalborg University Press.

Cousto, H. (1995). *Vom Urkult zur Kultur: Drogen und Techno* [From ancient cult to culture—Drugs and techno] (1st ed.). Solothurn, Switzerland: Nachtschatten.

Cross, I., & Woodruff, G. E. (2009). Music as a communicative medium. In R. Botha & C. Knight (Eds.), *The prehistory of language* (pp. 113–144). Oxford: Oxford University Press.

Crowe, B. J. (2004). *Music and soulmaking: Toward a new theory of music therapy*. Lanham, MD: Scarecrow.

De Rios, M. D., & Janiger, O. (2003). *LSD, spirituality, and the creative process*. Rochester, VT: Park Street.

Dietrich, A. (2003). Functional neuroanatomy of altered states of consciousness: The transient hypofrontality hypothesis. *Consciousness and Cognition, 12*, 231–256.

Dietrich, A. (2004). Neurocognitive mechanisms underlying the experience of flow. *Consciousness and Cognition, 13*, 746–761.

Eagleman, D. M., Tse, P. U., Buonomano, D., Janssen, P., Nobre, A. C., & Holcombe, A. O. (2005). Time and the brain: How subjective time relates to neural time. *Journal of Neuroscience, 25*, 10369–10371.

Eliade, M. (1964). *Shamanism: Archaic techniques of ecstasy* (Rev. and enl. ed.). New York: Bollingen Foundation.

Fachner, J. (1998). A look at the basics of communication from the stance of music therapy. In C. E. Gottschalk-Battschkus & C. Rätsch (Eds.), *Ethnotherapies* (1st ed., Vol. 14, pp. 209–214). Berlin: Verlag für Wissenschaft und Bildung Amand Aglaster Berlin.

Fachner, J. (2000). *Cannabis, Musik und ein veränderter metrischer Bezugsrahmen* [Cannabis, music and a changed metric frame of reference]. In H. Rösing & T. Phleps (Eds.), *Populäre Musik im kulturwissenschaftlichen Diskurs* [Popular music in the discourse of cultural studies] (Vol. 25/26, pp. 107–122). Karben, Germany: CODA.

Fachner, J. (2006a). Music and altered states of consciousness: An overview. In D. Aldridge & J. Fachner (Eds.), *Music and altered states: Consciousness, transcendence, therapy and addictions* (pp. 15–37). London: Jessica Kingsley.

Fachner, J. (2006b). Music and drug induced altered states. In D. Aldridge & J. Fachner (Eds.), *Music and altered states: Consciousness, transcendence, therapy and addictions* (pp. 82–96). London: Jessica Kingsley.

Fachner, J. (2007). Wanderer between worlds—Anthropological perspectives on healing rituals and music. *Music Therapy Today, 8*, 166–195. Retrieved 11th January 2011 from http://www.musictherapytoday.com.

Fachner, J. (2009). *Out of time? Music, consciousness states and neuropharmacological mechanisms of an altered temporality*. Paper presented at the 7th Triennial Conference of European Society for the Cognitive Sciences of Music, 16-20 August at University of Jyväskylä, Finland . Retrieved 11th January 2011 from http://urn.fi/URN:NBN:fi:jyu-2009411245

Fachner, J. (2011). Drugs, altered states, and musical consciousness: Reframing time and space. In E. Clarke & D. Clarke (Eds.), *Music and consciousness* (in Press). Oxford: Oxford University Press.

Freeman, W. (2000). A neurobiological role of music in social bonding. In N. L. Wallin, B. Merker & S. Brown (Eds.), *The origins of music* (pp. 411–424). Cambridge, MA: MIT Press.

Globus, G. G., Cohen, H. B., Kramer, J. C., Elliot, H. W., & Sharp, R. (1978). Effects of marihuana induced altered state of consciousness on auditory perception. *Journal of Psychedelic Drugs, 10*, 71–76.

Goldstein, A. (1980). Thrills in response to music and other stimuli. *Physiological Psychology, 8*, 126–129.

Haerlin, P. (1998). The use of music instruments in psychotherapy in order to alter states of consciousness. *Psychotherapeut, 43*, 238–242.

Hanser, S. B. (2009). From ancient to integrative medicine: Models for music therapy. *Music and Medicine, 1*, 87–96.

Hess, P., Fachner, J., & Rittner, S. (2009). Verändertes Wachbewusstsein [Altered Waking Consciousness]. In H. H. Decker-Voigt, P. Knill, & E. Weymann (Eds.), *Lexikon Musiktherapie* (pp. 550–557). Göttingen, Germany: Hogrefe.

Hutson, S. R. (2000). The rave: Spiritual healing in modern western subcultures. *Anthropology Quarterly, 73*, 35–49.

Iannone, M., Bulotta, S., Paolino, D., Zito, M., Gratteri, S., Costanzo, F., et al. (2006). Electrocortical effects of MDMA are potentiated by acoustic stimulation in rats. *BMC Neuroscience, 7*(1), 13.

Katz, R., & De Rios, M. D. (1971). Whisteling in Peruvian ayahuasca healing sessions. *Journal of American Folklore, 84*, 320–327.

Kohlmetz, C., Kopiez, R., & Altenmüller, E. (2003). Stability of motor programs during a state of meditation: Electrocortical activity in a pianist playing "Vexations" by Erik Satie continuously for 28 hours. *Psychology of Music, 31*(2), 173–186.

Kopiez, R., Bangert, M., Goebl, W., & Altenmüller, E. (2003). Tempo and loudness analysis of a continuous 28-hour performance of Erik Satie's composition "Vexations." *Journal for New Music Research, 32*, 243–258.

Kreutz, G., Ott, U., Teichmann, D., Osawa, P., & Vaitl, D. (2008). Using music to induce emotions: Influences of musical preference and absorption. *Psychology of Music, 36*, 101–126.

Levitin, D. (2008). *This is your brain on music*. London: Atlantic Books.

Ludwig, A. M. (1966). Altered states of consciousness. *Archives of General Psychiatry, 15*, 225–234.

Mathew, R. J., Wilson, W. H., Turkington, T. G., Hawk, T. C., Coleman, R. E., DeGrado, T. R., et al. (2002). Time course of tetrahydrocannabinol-induced changes in regional cerebral blood flow measured with positron emission tomography. *Psychiatric Research: Neuroimaging, 116*, 173–185.

Matussek, P. (2001). Berauschende Geräusche. Akustische Trancetechniken im Medienwechsel [Intoxicating (rushing) sounds. Acoustic trance techniques in changing mediums]. In A. Hiepko & K. Stopka (Eds.), *Rauschen. Seine Phänomenologie zwischen Sinn und Störung* [Rushing. Its phenomenology between sense and distortion] (pp. 225–240). Würzburg, Germany: Königshausen & Neumann.

Maxfield, M. C. (1990). *The journey of the drum. Effects of rhythmic drumming on EEG and subjective experience*. Unpublished Ph.D. thesis, Institute of Transpersonal Psychology, Menlo Park, CA.

Meck, W. H. (1996). Neuropharmacology of timing and time perception. *Cognitive Brain Research, 3*(3–4), 227–242.

Meck, W. H. (2005). Neuropsychology of timing and time perception. *Brain and Cognition, 58*, 1–8.

Menon, V., & Levitin, D. J. (2005). The rewards of music listening: Response and physiological connectivity of the mesolimbic system. *Neuroimage, 28*(1), 175–184.

Meszaros, I., Szabo, C., & Csako, R. I. (2002). Hypnotic susceptibility and alterations in subjective experiences. *Acta Biologica Hungarica, 53*, 499–514.

Mitchell, D. J., McNaughton, N., Flanagan, D., & Kirk, I. J. (2008). Frontal-midline theta from the perspective of hippocampal "theta." *Progress in Neurobiology, 86*(3), 156–185.

Mountain, R. S. (1989, November 10–13). Factors that influence our perception of time in music. *Convergence, conference of the Canadian Electroacoustic Society*. Retrieved June, 22, 2010, from http://www.armchair-researcher.com/writings/articles/time89.pdf.

Neher, A. (1961). Auditory driving observed with scalp electrodes in normal subjects. *Electroencephalography and Clinical Neurophysiology, 13*, 449–451.

Neher, A. (1962). A physiological explanation of unusual behavior in ceremonies involving drums. *Human Biology, 34*, 151–160.

Oohashi, T., Kawai, N., Honda, M., Nakamura, S., Morimoto, M., Nishina, E., et al. (2002). Electroencephalographic measurement of possession trance in the field. *Clinical Neurophysiology, 113*, 435–445.

Panksepp, J., & Bernatzky, G. (2002). Emotional sounds and the brain: The neuro-affective foundations of musical appreciation. *Behavioural Processes, 60*(2), 133–155.

Park, J. R., Yagyu, T., Saito, N., Kinoshita, T., & Hirai, T. (2002). Dynamics of brain electric field during recall of Salpuri dance performance. *Perceptual and Motor Skills, 95*, 955–962.

Pekala, R. J., & Kumar, V. K. (2000). Operationalizing "trance" I: Rationale and research using a psychophenomenological approach. *American Journal of Clinical Hypnosis, 43*, 107–135.

Penman, J., & Becker, J. (2009). Religious ecstatics, "deep listeners," and musical emotion. *Empirical Musicology Review, 4*(2), 49–70.

Pöppel, E. (2000). *Grenzen des Bewusstseins. Wie kommen wir zur Zeit und wie entsteht Wirklichkeit?* [Limits of consciousness. How do we get to time and how is reality contructed?] Frankfurt a. Main: Insel.

Rammsayer, T. H. (1999). Neuropharmacological evidence for different timing mechanisms in humans. *Quarterly Journal of Experimental Psychology, 52B*(3), 273–286.

Rill, B. (2006). Rave, communitas, and embodied idealism. *Music Therapy Today, 7*(3), 648–661. Retrieved 11th January 2011 from http://www.musictherapytoday.com

Rittner, S., Fachner, J., & Hess, P. (2009). Trance. In H. H. Decker-Voigt, P. Knill, & E. Weymann (Eds.), *Lexikon Musiktherapie* (pp. 538–541). Göttingen, Germany: Hogrefe.

Rouget, G. (1985). *Music and trance. A theory of the relations between music and possession*. Chicago: The University of Chicago Press.

Ruud, E. (2001). Music therapy—History and cultural contexts. *Voices,* 1(3). Retrieved 11th January 2011 from https://normt.uib.no/index.php/voices/article/view/66/53

Shanon, B. (2001). Altered temporality. *Journal of Consciousness Studies, 8*, 35–58.

Shor, R. E., & Orne, E. C. (1963). Norms on the Harvard Group Scale of Hypnotic Susceptibility, Form A. *International Journal of Clinical and Experimental Hypnosis, 11*, 39–47.

Snodgrass, M., & Lynn, S. J. (1989). Music absorption and hypnotizability. *International Journal of Clinical and Experimental Hypnosis, 37*, 41–54.

Söhngen, O. (1967). *Theologie der Musik* [Theology of music]. Kassel, Germany: Stauda.

Strobel, W. (1988). Sound—Trance—Healing. *Musiktherapeutische Umschau, 9*, 119–139.

Timmermann, T. (2009). Ethnologische Aspekte in der Musiktherapie [Ethnological aspects of music therapy]. In H. H. Decker-Voigt & E. Weymann (Eds.), *Lexikon Musiktherapie* (2nd ed., pp. 123–126). Göttingen, Germany: Hogrefe.

Turow, G. (2005). *Auditory driving as a ritual technology: A review and analysis*. Unpublished Religious Studies Honors Thesis, Stanford University, Stanford, CA.

Vaitl, D., Birbaumer, N., Gruzelier, J., Jamieson, G. A., Kotchoubey, B., Kübler, A., et al. (2005). Psychobiology of altered states of consciousness. *Psychological Bulletin, 131*, 98–127.

Wallin, N. L., Merker, B., & Brown, S. (2000). *The origins of music*. Cambridge, MA: MIT Press.

Weir, D. (1996). *Trance: From magic to technology*. Ann Arbor, MI: Trans Media.

Winkelman, M. (2000). *Shamanism: The neuroecology of consciousness and healing*. Westport, CT: Bergin & Garvey.

Winkelman, M. (2002). Shamanism and cognitive evolution. *Cambridge Archeological Journal, 12*, 71–101.

Winkelman, M. J. (1986). Trance states: A theoretical model and cross-cultural analysis. *Ethos, 14*, 174–203.

Wittmann, M., Carter, O., Hasler, F., Cahn, B. R., Grimberg, U., Spring, P., et al. (2007). Effects of psilocybin on time perception and temporal control of behaviour in humans. *Journal of Psychopharmacology, 21*, 50–64.
Wright, P. (1991). Rhythmic drumming in contemporary shamanism and its relationship to auditory driving and risk of seizure precipitation in epileptics. *Anthropology of Consciousness* 2(3–4): 7–14.
Yacubian, J., & Büchel, C. (2009). The genetic basis of individual differences in reward processing and the link to addictive behavior. In J.-C. Dreher & L. Tremblay (Eds.), *Handbook of reward and decision making* (pp. 345–360). Burlington, VT: Academic Press.
Zingrone, N. L., Alvarado, C. S., & Cardeña, E. (2010). Out-of-body experiences and physical body activity and posture: Responses from a survey conducted in Scotland. *Journal of Mental and Nervous Disease, 198*, 163–165.