

# Mystical Experience in the Lab

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## Abstract

We review previous attempts to study mystical experience and point to problems inherent to certain methodologies. Focusing on studies that use controlled environments we advocate taking an experimental approach to mysticism. To demonstrate the viability of this approach, we report findings from a new study that probes the potential for eliciting mystical experiences in the laboratory. We find that our experimental paradigm is indeed enough to elicit mystical experiences. Based on subjective ratings of experience, rich descriptions from interviews, and data obtained three months after the study, our data indicate that the experiences reported by the participants had a high degree of authenticity and had lasting effects in terms of memory and attribution. These findings demonstrate that at least some forms of mystical experience can be studied in a controlled environment. Prospects and limitations for the experimental approach to mysticism are discussed.

## Keywords

mystical experience – mysticism – perception – sensory deprivation – suggestibility

## 1 Introduction

The academic study of mystical experience is in trouble. Opposing definitions and speculative theories are threatening to dissolve mysticism as a useful scientific construct, and the nature of evidence complicates investigations into the psychological underpinnings of mystical experience. Here we argue that taking an experimental approach to this fascinating phenomenon may be necessary if the ambition is to answer some of the most central questions in the study of mysticism; How much of the content in mystical experiences can

be explained by actual sensory perception? To which degree should mystical experiences be understood as mere interpretations of experiences that depend on social constructions? To what extent are those who report mystical experiences to be considered special talents, frauds, pious frauds, or even schizoid? Are there specific personality traits, behavioral and contextual components that seem to systematically increase the probability of believers reporting mystical experiences? And if so, how do they operate to facilitate such experiences? In this paper we probe the potential for studying such problems in controlled environments using a particular experimental paradigm designed to elicit mystical experience.

### 1.1 *Theories on Mysticism*

Mysticism research is crowded with different and often opposing views. Generally, the field is operating along a continuum with two distinct poles: *perennialism* and *particularism* (for a review see; Almond, 1982; Wulff 2002; Hammersholt 201b). The perennialist position holds the essentialist view that mystical experiences are universal in content and occurrence, and that religious techniques and practices elicit similar experiences at all times and in all cultures (Stace 1960; Smart 1965). At the other end of the spectrum, the particularist position holds the constructivist view that there exists no unmediated experiences, and that all experiences are shaped by the cultural concepts and expectations, which the individual brings to the experience (Katz 1978). As we shall see, one of the main reasons for this diversity of theories is that it is incredibly hard to test specific hypotheses on mysticism, because a range of methodologies suffers from inherent problems when faced the challenge to investigate mysticism as a psychological phenomena.

### 1.2 *Methodological Challenges in the Field*

A major problem within mysticism research pertains to the nature of evidence. Historical evidence consists of written sources that are more often than not confounded by several layers of editing which prioritize educational, dogmatic, idealized agendas over accurate descriptions of the psychological content of experience (Keller 1978; Geertz 1990; Taves 2009). Because of this extremely complex relationship between text and experience, it is arguably impossible to determine if written accounts reflect actual experiences; a retrospective interpretation of an experience influenced by cultural schemas; or if the report is simply a fabricated piece of literature designed for other purposes. Nevertheless, prominent scholars from both the perennialist and particularistic camp have still attempted to “get behind” the written accounts of mystical experiences in order to reach the “actual experience” of the mystic.

Indeed, in his pioneering work Walther T. Stace (1960) argues that all reports of mystical experiences around the world are in fact the same experience of “pure consciousness” with seven distinct characteristics. Stace reaches this conclusion by a unique method specifically designed to distinguish actual experiences from retrospective interpretations of such. The method works by differentiating reports with so-called “low interpretation” from reports with “high interpretation”:

If a man says, “I see a red colour,” this is a low-level interpretation, since it involves nothing except simple classificatory concepts. But a physicist’s wave theory of colours is a very high-level interpretation. Analogously, if a mystic speaks of the experience of “an undifferentiated distinctionless unity,” this mere report or description using only classificatory words may be regarded as a low-level interpretation. But this is being more fussily precise than is usually necessary, since for all intents and purposes it is just a description. If a mystic says that he experiences a “mystical union with the Creator of the universe,” this is a high-level interpretation since it includes far more intellectual addition than a mere descriptive report. (Stace 1960: 37)

However, the method Stace applies is highly problematic because it, in advance, rules out the possibility that religious individuals can actually experience a union with God, since the concept of God will always constitute a high level interpretation according to Stace. In other words, Stace’s method is specifically tailored to promote the idea of pure consciousness, and thus does not constitute an ideal method for the study of mysticism as a psychological phenomenon (Hammersholt 201b). Furthermore, Stace specifically excludes visions from the category of mystical experiences, without providing empirical support for this exclusion. Similarly, at the particularistic end of the spectrum, Steven Katz argues that all mystical experiences are different and that phenomena such as visions should be included within the category. Katz departs from the assumption that the human epistemology allows for no unmediated experiences, although Katz does not provide empirical support for this assumption. The assumption, however, has natural consequences for his position on mysticism:

[T]he experience itself as well as the form in which it is reported is shaped by concepts which the mystic brings to, and which shape his experience. (...) [F]or example, the Hindu mystic does not have an experience of x which he then describes in the, to him, familiar language and symbols of

Hinduism, but rather he has a Hindu experience, i.e., his experience is not an unmediated experience of *x* but is itself the, at least partially, preformed anticipated Hindu experience of Brahman (Katz 1972: 26).

However, while Katz may be right that no two mystical experiences are the same, his argument is circular. According to Katz, the human epistemology explains the plurality of the written accounts of mystical experience, but his method for interpreting these accounts already presumes this difference. Furthermore, Katz implicitly assumes that a written account of a mystical experience always directly reflects an actual experience (Hammersholt 2011a, 2011b). Hence, although the richest accounts of mystical experience are historical, this kind of material makes it notoriously difficult to extract reliable data for scientific examination, especially if the goal is to test hypotheses on the psychological nature of mystical experience.

Another valuable source of material designed by psychologists derives from survey studies, some of which use psychological scales of mysticism to explore the nature and frequency of experience in various populations (for a review see; Spilka et al. 2003). The most widely distributed and recognized of these scales is the Mysticism-scale (M-scale) developed by Ralph Hood (Hood 1975). While this scale has led to important insights into the phenomenon of mysticism, it is limited in its scope because it is based on predefined phenomenological construct, namely, Stace's idea of "Pure Consciousness." This makes the scale useful only insofar that the assumptions and theoretical layouts from Stace are true, which remains a non-trivial claim. Hence, while the M-scale has made scholars reach fascinating insights, the field should not limit itself by administering this scale alone. Instead, different approaches, measures and definitions should still be applied. On a more general level, survey studies have brought interesting insights on various kinds of experience (Borque 1969; Greeley 1974) but survey studies typically do not afford a rich description of the phenomenon, and, more importantly, they do not provide a basis for analyzing mystical experiences in their immediate contexts. Indeed, in a sample of 1,468 participants Greeley (1974) found that that 35% of the respondents answered "yes" to the question: "Have you ever felt as though you were close to a powerful spiritual force that seemed to lift you out of yourself." In a later study by Thomas and Cooper (1978) the scholars also found that approximately a third of 302 participants answered "yes" to the same question. In a subsequent content-analysis however, responses revealed that only 2% of the respondents' experiences could be categorized as mystical experiences according to the categories of Stace.

A third major source of material comes from anthropologists who study mystical experiences in their immediate and natural context, which potentially allows for rich descriptions through observation and interviews (Luhrmann 2012; Luhrmann, Nusbaum & Thisted 2010). Anthropological material has many advantages over historical evidence and survey studies, but it too suffers from problems inherent to its methodology. Field observations typically lack control of relevant variables, and they are often constrained by a limited number of informants. These limitations make it difficult, if not impossible, to systematically investigate the psychological, behavioral and contextual components associated with mystical experience. If the aim is to confidently identify, isolate, and analyze components in practices that affect the probability of believers reporting mystical experience, none of these methods appear to be optimal candidates.

Considering these limitations, it is perhaps not surprising that mysticism as a field attracts speculative theories and wild definitions. It is incredibly difficult to weed out wrong assumptions and to test and reject improbable theories. This is why the experimental approach seems attractive. This approach enables scholars to study mystical experiences in a setting where components like personality traits, behavior and context could be analyzed and controlled for; where physiological and perceptual processes could be measured; and where socially constructed aspects could be identified and analyzed. Although the approach is challenged by problems of authenticity and ecological validity, we believe its advantages outweigh its limitations, not as a stand-alone approach to mysticism, but as a supplement to historical, psychological, and anthropological approaches.

### 1.3 *Previous Attempts to Study Mysticism in Controlled Environments*

Recently neuroscientists have attempted to investigate mystical experience in a controlled environment using imaging technologies like fMRI, PET, and SPECT to measure the neural correlates of mystical experience (Newberg et al. 2001; Beauregard & Paquette 2006). Unfortunately this exciting new field suffers from considerable methodological and theoretical issues. It is for example surprising that none of these studies use models of perception to analyze the phenomenon. Instead they use poorly supported and highly speculative models of higher order cognition for interpreting their results (for a critical review, Schjoedt 2009a; 2009b; Bulbulia & Schjoedt 2012). Moreover, these studies are heavily constrained by the experimental setting. Participants are typically instructed not to move, and often they have their heads fixed to avoid movement artifacts in the data. While lying in the scanner, participants often

receive stimuli and instructions through headphones or on a screen, while being asked to have mystical experiences on command. These procedures are likely to obstruct any attempt to measure authentic and spontaneous mystical experiences. Indeed, in a study by Beauregard & Paquette (2006) 15 nuns were asked only to think about a mystical experience they have had, after the nuns had expressed that “God can’t be summoned at will.” Hence, while studying powerful mystical experiences in believers in a controlled environment would enable researchers to identify, isolate and analyze central aspects of the phenomenon, we need an experimental setting with the power to actually elicit spontaneous mystical experiences.

The idea of eliciting and studying mystical experience in the lab is not new (Pahnke & Richards 1966; Pahnke 1967; Deikman 1963; Hood & Morris 1981).<sup>1</sup> Most previous studies however, were carried out more than thirty years ago. Perhaps it was ethical issues that ended this fascinating line of research, as some of these studies used hallucinogenic substances to induce mystical experiences in their subjects (Pahnke & Richards 1966; Pahnke 1967). Recently however, a fascinating line of studies conducted by Griffith and colleagues have revitalized the idea of experimentally inducing mystical experiences by administering hallucinogens (Griffith et al. 2006; Griffith et al. 2008; Griffith et al. 2011; MacLean et al. 2011; MacLean et al. 2012). In their studies, Griffith and colleagues induced mystical-type experiences in hallucinogen-naïve adult participants, reporting regular participation in religious or spiritual activities, by administering a high dose of psilocybin in each participant. In these rigorous double-blinded studies, Griffith and colleagues find that psilocybin produce perceptual changes, unstable moods, subjective experiences, and increased measures of mystical experience in the participants (Griffith et al. 2006). In line with Griffith and colleagues, we also believe the time has come to revitalize the idea of eliciting mystical experience in the lab to systematically study them. In contrast to Griffith and colleagues, however, we wish to approach the eliciting of mystical experiences from the perspective of perceptual manipulation without the use of hallucinogens. The cognitive brain sciences today provide robust models of perception that allows us to design specific contexts to elicit mystical experiences in participants without raising ethical concerns. This approach has two major advantages. First, it provides researchers with an easier access to study mystical experiences in their immediate context.

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1 In a series of studies, Michael Persinger has claimed that it is possible to induce religious and mystical experiences by means of an electromagnetic helmet (Persinger 1997, 2002; Hill & Persinger 2003). These studies will be reviewed later in this article.

Second, as the approach is based on a manipulation of the sensory system, it may yield more ecological validity when compared with the vast range of religious practices that does not include substance usage.

## 2 Theoretical Framework

Despite the vast number of diverging theories on mysticism, most scholars generally agree that reports of mystical experience are characterized by unusual perceptual changes that deviate from everyday perceptions and experience. Yet, few attempts have been made to explain mystical experience in terms of perceptual principles (Wulff 2002). This is unfortunate because recent neurocognitive research on perception offers robust models for understanding unusual sensory experiences. In the study we present in this article, we focus on the perceptual aspects of mystical experience as we import a general prediction model of perception as our theoretical framework. This model has recently established itself as the dominant paradigm for understanding perception and cognition in the brain sciences (Friston 2005; Frith 2007; Friston & Kiebel 2009; Bar 2009a). According to the prediction model, the brain generates top-down predictive models of events in the world based on prior experience. From this perspective, human perception is not just based on sensory input. Based on prior experience and learning, the brain predicts what *ought* to happen in the world (Frith 2007: 132; Bar 2009b). Importantly, the brain constantly monitors and compares its own predictions (internal models) with external input from the sensory apparatus (external models). If the brain detects a mismatch, this elicits a prediction error signal, which normally causes the brain to correct and update its internal models (Frith 2007: 216-7; Friston & Kiebel 2009).

Under normal circumstances sensory information is given more weight than the brain's predictions. If you predict or expect something to be in a room but your senses tell you otherwise, your subjective experience usually agrees with the sensed reality. This, however, is not always the case. In some situations, rather than being informed by sensory information, internal models of the world appear to dominate experience. This phenomenon has been thoroughly studied in perception research (Frith 2007). For example participants with strong expectations to see the letter "A" on a screen have been shown to experience the letter "A" even though they are actually shown the letter "B" (Jack 1998). Moreover, hypnosis and placebo research have demonstrated how strong expectations induced in suggestive contexts can elicit quite remarkable effects in individuals' sensory experiences (Kirsch 1985, 1990; Braffman & Kirsch 1999). Such experiences can be categorized within the same category of

unusual sensory experiences as mystical experiences, because they seem to be dominated by expectations rather than by sensory input.

The prediction model explains how the induction of strong expectations may increase the weight of the brain's own predictions to the extent that sensory information that conflicts with these predictions is ignored. It follows from this model that unusual perceptions are more likely to occur in contexts where expectations are high and access to conflicting stimuli is reduced. Sensory deprivation is an illustrative example of the latter because it effectively reduces access to sensory input. Sensory deprivation therefore obstructs the brain's attempt to monitor the situation for potential prediction errors. Simply put, it is easier to mistake a tree for a man in darkness, especially, if a man is expected, because darkness prevents successful error monitoring. From the perspective of the prediction model, it is not surprising that mystical experiences are associated with religious practices where participants expect that such experiences may occur, and where participants are subject to different types of sensory deprivation that reduce their ability to monitor for information that conflicts with these expectations (La Barre 1972). Such contexts seem to maximize the probability of eliciting unusual experiences in which individual expectations dominate over sensory input. Likewise, it is not surprising, that mystical experiences are often preceded by large amounts of contemplative and meditative training, since prior perceptual experiences have a significant impact on how the brain creates future predictions. Hence, according to the model, whereas sensory deprivation and expectations creates an optimum condition for top-down processing, like hallucinations, the repetitive elicitation of such representations should further enhance the probability of such processes taking place in the future. For instance, a spiritist who is used to having experiences of seeing spirits while meditating will have a higher probability of seeing spirits in a sensory deprived environment than an inexperienced individual.

Following our theoretical framework we define mystical experience within a broader category of unusual sensory experiences reported by individuals in which the reported perceptual content cannot be fully explained by a direct stimulation of the sensory apparatus. Hence, we understand mystical experience as examples of such unusual sensory experiences in which the unusual perceptual content is embedded in a religious or spiritual framework. Using the terminology of the prediction model then, we define *mystical experiences as perceptions embedded in a religious or spiritual framework, which are caused by a dominance of the brains internal models*. In a more pragmatic sense, this definition seeks to capture phenomena such as visions, epiphanies, holistic experiences, and the sensed presence of supernatural beings or entities.



The prediction model of perception has already proven to be an effective framework for analyzing other religious phenomena (Schjoedt et al. 2013a), e.g. ritualized behavior (Nielbo & Sørensen 2011; Nielbo et al. 2013), interpersonal prayer (Schjoedt et al. 2011), and participation in collective rituals (Schjoedt et al. 2013b). In the present study we use a controlled environment, which according to the prediction model should increase the probability of eliciting mystical experience in participants. Briefly, we expose participants to a highly suggestive context to increase their expectations of having a mystical experience, combined with a sensory deprived context to prevent them from successful error monitoring.

### 3 The Study

To elicit mystical experience in our participants we used an experimental design inspired by a famous study in which participants are stimulated with complex magnetic fields over the temporal lobes while sitting in a sensory deprived room. Intriguingly, Michael Persinger has claimed that this setup enables him to induce mystical experiences in up to 80% of his participants. The electromagnetic device, the so-called God helmet, he claims, affects a particular network in the brain, which results in the perception of another sentient being in the room (Persinger 1997, 2002; Hill & Persinger 2003). Persinger's God helmet studies, however, are controversial for a number of methodological and theoretical reasons (Granqvist et al. 2005; Schjoedt 2009a). First, the magnetic fields used by Persinger are approximately one million times weaker than the fields normally applied with Transcranial Magnetic Stimulation (TMS). This makes it theoretically implausible for the device to induce currents strong enough to depolarize neurons through the skull (Ruohonen 1998), although it has been suggested that the specific waveform of the field is crucial (Persinger in Granqvist et al 2005). Second, in an attempt to replicate the findings from Persinger, Granqvist and colleagues did a randomized double-blinded study to test the effect of the magnetic stimulus. The research team employed two conditions in which participants were either stimulated with complex magnetic fields or not, and they found no effect of the magnetic stimulus (Granqvist et al. 2005).

Granqvist, however, did find that participants reported unusual and mystical experiences, but that these were evenly distributed between target and control groups. Granqvist therefore argues that Persinger's findings might result from expectancy effects caused by a lack of double-blindness and a proper randomization. Without these expectancy effects, the added effect of the magnetic

stimulus was non-existent. Moreover, the experiences reported seemed to be predicted by the participant's level of suggestibility (measured on Tellegen's Absorption Scale). This observation corresponds with insights from hypnosis research that individual expectations and suggestibility are important for eliciting unusual sensory experiences during hypnotic sessions (Orne 1959; Sheehan 1971; Kirsch 1985, 1990). Granqvist also found that participants' level of religiosity (measured by Level of Religiousness Scale) predicted if reported experiences were interpreted within a religious framework or not (Granqvist & Larsson 2006). This suggests that cultural background, prior beliefs, and personal expectations to the situation are all important predictors of whether participants report mystical and unusual sensory experiences.

Persinger's and Granqvist's studies teach us two valuable lessons: Whereas the magnetic stimulus used does not seem to have effects on perception, the suggestiveness of the context, including suggestions about the magnetic stimulus of the temporal lobes, do appear to effectively increase the probability of participants reporting mystical experiences as well as other unusual sensory experiences. Indeed, in a newly published study Swiney and Sousa (2013) used a sham-helmet to induce misattributions of agency for thought. This is interesting because demand characteristics usually are discarded as experimental artifacts explained by participants' interpretation of the experiment's purpose resulting in a behavioral change to fit that interpretation (Orne 2009). The demand characteristics in Persinger's study, however, may function to strengthen expectations that influence how individuals actually perceive and behave in the laboratory. In other words, if the aim is to maximize the probability of participants having mystical experiences we may adopt and exploit the suggestiveness of Persinger's experimental procedures. Indeed, rather than controlling for expectancy effects as Granqvist did, we decided to optimize the suggestiveness in our study by adding even more power to the induction of expectations. Thus, we used multiple suggestive components including a home made "God-helmet" device, verbal suggestions, a hospital setting, equipment for obtaining physiological data, white coats, combined with sensory deprivation in order to elicit mystical experiences in our participants.

The study, however, is preliminary in the sense that it only aims to demonstrate the potential for eliciting mystical experience in the lab without the use of hallucinogenic substances (Pahnke & Richards 1966; Pahnke 1967; Griffith et al. 2006) or hypnotic induction (Deeley et al. 2014). The study was not designed to identify and measure effects of specific variables. Thus, while employing multiple suggestive components, we did not explore their relative contributions to the reported experiences. However, to demonstrate the effectiveness of this paradigm is a first step toward a more systematic study of mystical expe-

periences in which relevant components can be isolated and analyzed in a controlled environment.

## 4 Methods

### 4.1 *Participants*

23 Danish volunteers participated in the study (11 females; age:  $M = 41.8$ ,  $SD = 13.3$ ). To recruit participants posters were placed in a New Age shop and in the meeting house of a Spiritist group ('The House of Light') in central Aarhus. Participants without prior exposure were recruited through the Danish subject pool [www.forsogsperson.dk](http://www.forsogsperson.dk). Recruitment posters described the study in general terms: participants would have to wear an electromagnetic device which might elicit mystical, spiritual, or unusual sensory experiences by weak electromagnetic brain stimulation. The entire sample consisted of three groups: eight participants with prior experience of spirit contact (spiritists); seven participants with prior meditation experience (New Age); and eight control participants (inexperienced).

### 4.2 *Equipment and Procedure*

The purpose of our study was to examine if it is possible to elicit mystical experiences through induction of strong expectations combined with sensory deprivation. Expectation induction was produced by a combination of a particular version of the "God Helmet" and sensory deprivation. The "God Helmet" was a modified snowboard helmet that emitted a random, non-controlled and very weak magnetic field (see Figure 1). Real magnetic coils were added to the helmet to avoid deception in the experiment. Importantly, the magnetic field was non-controlled and weaker than the magnetic field emitted by a standard wristwatch, which is too weak to produce any known effect on brain function. Information about the magnetic field was not withheld from the participants. We did however not state our skepticism as to the alleged efficacy of the weak magnetic field to elicit experiences until the debriefing. The debriefing stated that there were no empirical support for an effect of the magnetic stimulus, but, ultimately, participants had to decide for themselves. This enabled us to obtain longitudinal data on experiences reported during the experiment.

To add credibility to the induction context, participants were received in the basement of the neurological section at Aarhus Hospital. After a short welcome, the participants were given a tour and shown a range of equipment associated with neurology and neuroscience including two MR-scanners. The study itself was carried out in the section's EEG laboratory. Before the study, participants were informed about the procedures of the study and asked to



FIGURE 1 *The "God Helmet".*

sign a written consent form testifying that they had no history of anxiety disorders, psychosis or schizophrenia. All participants were then given a highly suggestive instruction (identical across participants). The instructions explained what was likely to happen in the room; that similar studies had been effective in eliciting unusual sensory experiences, more precisely, experiences of another being: *a sensed presence* (see appendix for full description of the instructions). Participants were then equipped with EKG sensors (a heart rate variability measure) and a respiration-belt (respiration measure) to boost the effect of the laboratory setting (we did obtain data but not for analysis, see discussion). Participants were instructed to push a response button whenever the feeling of something unusual ended ('not during but after the experience'). We did this to measure the time of occurrence and frequency of experiences, but also to demonstrate how researchers might identify experiences for the purpose of doing analysis of physiological measures, like heart rate and respiration, during such experiences. The participants were then seated in a comfortable chair in a sensory-deprived room, blindfolded and equipped with earplugs while wearing the helmet. To indicate that the helmet was activated, we inserted a

power plug into the helmet and informed the participants that the helmet was active. Finally, the participant was asked to relax and enjoy the time in the room. The participants were then left alone in the room for exactly 60 minutes.

#### 4.3 Questionnaires, Scales, and Interviews

Participants completed a post-experimental questionnaire, which mainly consisted of 10-point Likert scale items probing their experience, (e.g., Q: "To what extent did you experience another being in the room?"; A: 0: not at all, 9: to a very high extent). Modality specific items were used to investigate the perceptual aspects of experience (visual, auditory, haptic: to what extent did you *see, hear, feel* . . . etc.), rather than the phenomenological aspects theorized by previous researchers (e.g., *absolute unitary being, unconditional love, timelessness* and *spacelessness, ineffability*). A perceptual focus was also chosen to prevent participants from using stereotypic descriptions derived from theoretical accounts of mystical experience. The perceptual experience items were divided into two general categories: Experiences of sensed presence and unusual experiences. The questionnaire also included questions of demographics and background.

After the questionnaire we used a semi-structured interview to obtain a richer description of participants' experience in the room, their world-views, and unusual experiences in their past. Finally, we measured participants' suggestibility using a Danish translation of the Carleton University Responsiveness to Suggestibility Scale (CURSS). The CURSS measures suggestibility by instructing participants to follow suggestions at various levels of difficulty. The CURSS is a seven-item instrument that assesses subjective as well as objective responses to suggestions. The version of the CURSS we administered yielded two scores. CURSS:O (objective) reflects the number of suggestions to which the subject made the appropriate overt response. CURSS:O scores range from 0 (no suggestion passed) to 7 (all suggestions passed). CURSS:S (subjective) scores reflects the degree to which the events called for by each suggestion were subjectively experienced. Each subject will rate their experience of each suggestion on a subscale ranging from 0 to 3. CURSS:S scores range from 0 (no subjective effects rated to any suggestion) to 21 (strong subjective effects rated for each suggestion) (Spanos et al. 1983).

The entire session lasted approximately two and a half hours. Three months after, participants were asked by mail to complete the same questionnaire. We did this to probe long-term memory effects, and to test whether the reported experiences had lasting effects on the participants as an indication of authenticity.

## 5 Results

### 5.1 *Subjective Ratings of Experience*

In our analyses we used an alpha level of 0.05 for all statistical tests.

To probe the overall effect of participation on subjective reports, we collapsed reports of sensed presence and unusual experiences across sensory modalities in the entire sample. Almost half of the participants responded in accordance with the suggestion that they experienced another being in the room, and even more participants reported some degree of other unusual experiences (Figure 2).

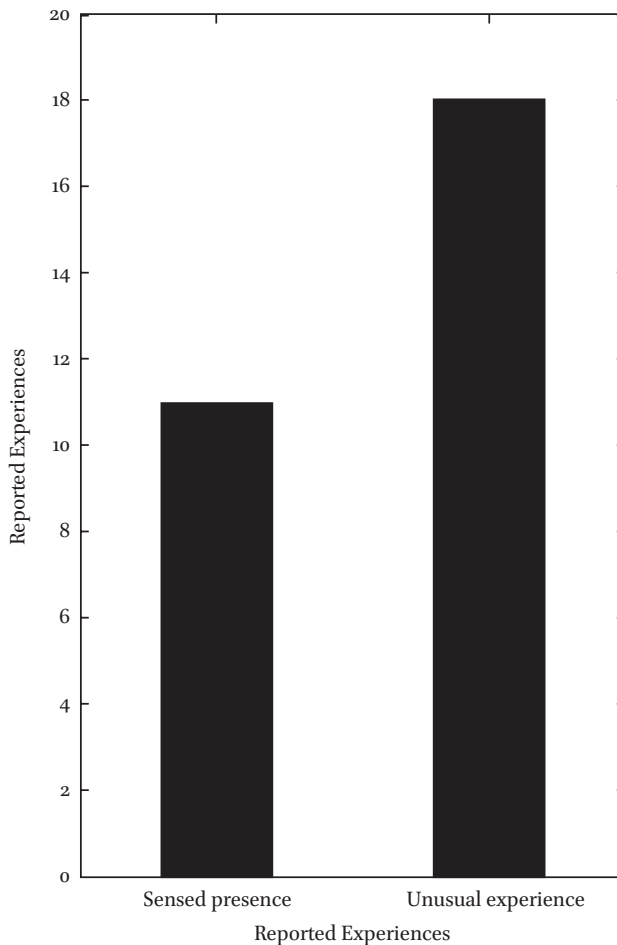


FIGURE 2 *Number of participants reporting experiences of sensed presence and unusual experiences.*

The modality-specific effects of participation were investigated through modality specific reports of sensed presence and unusual experience. Most participants reported a general as well as a haptic experience of a sensed presence, closely followed by a visual experience of a presence. Auditory experiences were also reported, but less frequently. Within the category of unusual experiences, participants most frequently reported a general feeling of something unusual and unusual haptic experiences, closely followed by unusual visual experiences. Again, auditory experiences were less frequently reported (Figure 3). Interestingly, we found a significant correlation ( $r = .59, p = .03$ ) between participants reporting “unusual experiences” and participants score on a 10-point rating-scale of item: “If you had a spiritual or mystical experience during the experiment, to what extent was it similar to spiritual or mystical experiences you have had in the past?”

To test the effect of our main variable “experience with spiritual practice” on the strength of reported experiences<sup>2</sup> (sensed presence and unusual experience) (Figure 4) we conducted a series of statistical hypothesis tests. An independent samples one-way ANOVA showed a reliable effect of experience with spiritual practice (3 levels: spiritist, new age, inexperienced) on “sensed presence”:  $F(2, 20) = 5.63, p = .012, \eta^2 = .36$ . A non-parametric one-way Kruskal-Wallis test confirmed this finding:  $\chi^2(2, N = 23) = 8.29, p = .02$ . Using Bonferroni-Holm sequentially rejective multiple test (Holm 1979), we found that compared to the “inexperienced” group, the “spiritist” group responded more to the experimental paradigm, as they reported significantly stronger experiences of “sensed presence”:  $F(1,14) = 13.38, p = 0.008, \eta^2 = .49$ . The statistical tendency indicated a similar effect when the “spiritist” group was compared to the “new age” group:  $F(1, 13) = 4.07, p = .13, \eta^2 = .24$ .

An independent samples one-way ANOVA was used to test the effect of “experience with spiritual practice” on reports of the strength of “unusual experience” between the “spiritist,” “new age” and “inexperienced” group. We found a statistical tendency from “experience with spiritual practice” on reports of “unusual experience”:  $F(2, 20) = 2.7, p = .09, \eta^2 = 0.21$ . A one-way Kruskal-Wallis test confirmed the result by showing a statistical tendency in the difference in reports of strength of “unusual experience” as a function of “experience with spiritual practice”:  $\chi^2(2, N = 23) = 4.5, p = .11$ .

2 Taking the highest score from each participant within each of the two broader categories of experience (Sensed Presence & Unusual Experience).

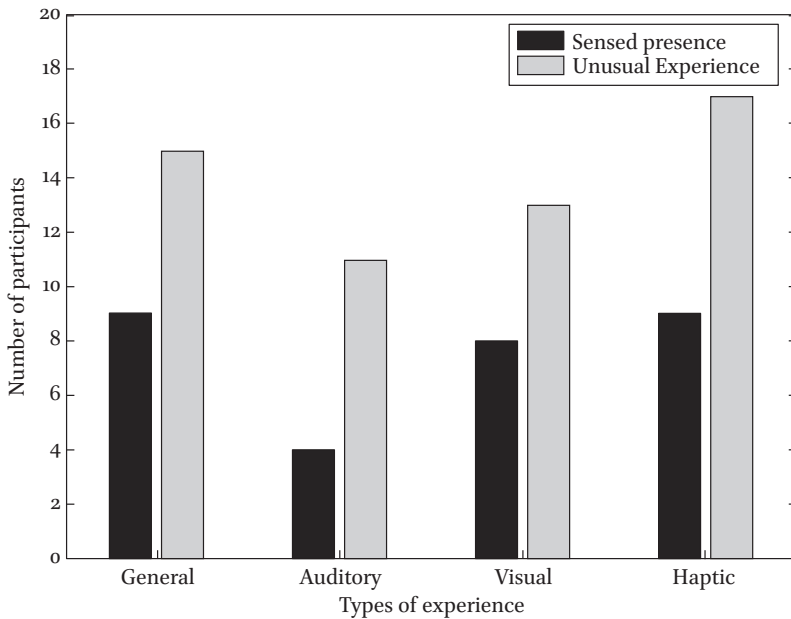


FIGURE 3 Modality-specific distribution of reported experiences.

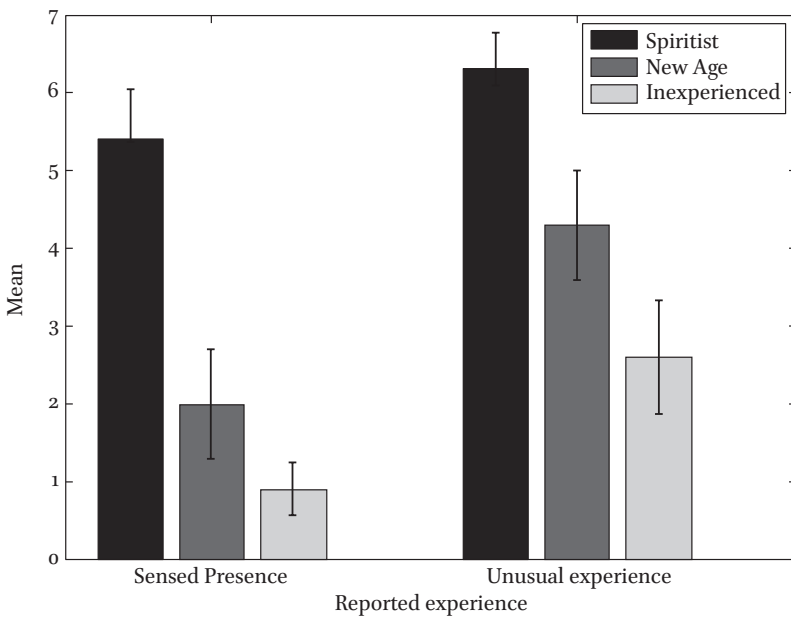


FIGURE 4 Mean and standard deviation for strength of reported experiences across the spiritist, new age and inexperienced groups. ERRORBARS ARE +/- 1 SEM



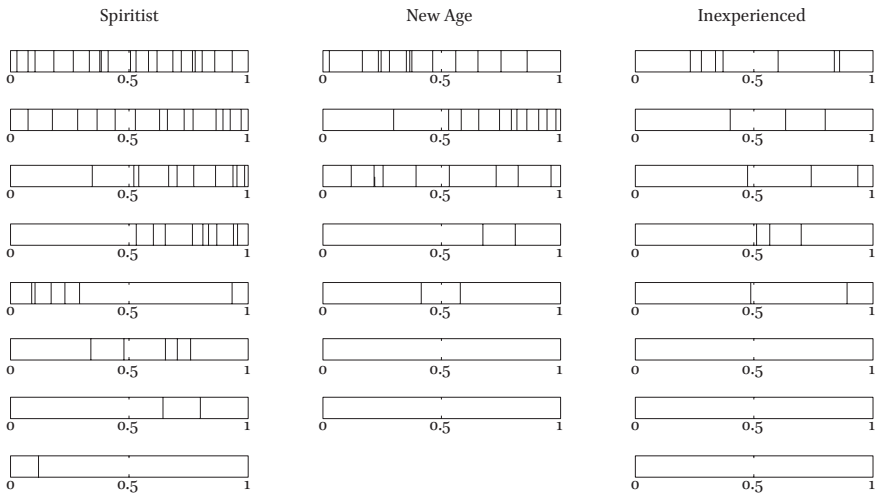


FIGURE 5 *Button press distribution of each participant during a full hour of sensory deprivation.*

5.2 *Number of Experiences*

Each plot in figure 5 represents the button presses (vertical lines) of one participant. Rows are participants and columns one of the three levels of experience with spiritual practice.

Across the entire sample participants reported 5.30 experiences on average (SD = 5.44) using the response button (Figure 5). Figure 5 and Table 1 depict button presses across the different groups. In order to investigate possible group differences a one-way analysis of variance (ANOVA) between subjects was conducted to compare the effect of “experience with spiritual practice” on total number of reports from participants between the “spiritist,” “new age” and “inexperienced” group. We found a statistical tendency of a medium to strong effect from “experience with spiritual practice” on total number of reports for

TABLE 1 *Mean (M) and Standard Deviation (SD) of button presses in the spiritist, new age and inexperienced group*

	Spiritist	New age	Inexperienced
Number of	<i>M</i> = 8.50	<i>M</i> = 5.14	<i>M</i> = 2.25
Button Presses	<i>SD</i> = 6.30	<i>SD</i> = 5.43	<i>SD</i> = 2.38

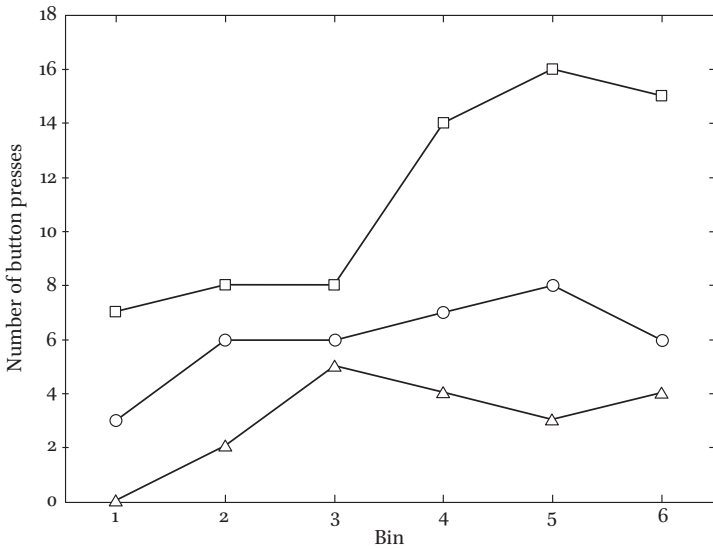


FIGURE 6 *Button press distribution across the spiritist, new age and inexperienced group sorted in bins of 10-min.*

SQUARE: SPIRITIST; CIRCLE: NEW AGE; DIAMOND: INEXPERIENCED

our three groups:  $F(2, 20) = 3.17, p = .064, \eta^2 = 0.32$ . This indicates that there are group differences in the overall report of experiences.

### 5.3 *Temporal Dimension*

To probe the temporal dimension of the report of experiences, we investigated the distribution of button presses across the three groups.

Figure 6 depicts the temporal distribution of button presses across the three groups organized in six 10-minute bins. It shows a general increase in frequency until the 30-minute bin. After the 30-minutes we either see a dramatic increase in frequency (spiritists) or stabilization (new age, inexperienced).

### 5.4 *Suggestibility*

Across the entire sample ( $N = 23$ ) we found a slightly higher level of suggestibility (CURSS:O:  $M = 3.22, SD = 1.76$ ), (CURSS:S:  $M = 7.35, SD = 5.49$ ) than would be expected across a normal population (Spanos et. al 1983). We did not find any significant group differences ( $p > .1$ ). To probe the effect of participant suggestibility on reported experiences we correlated the CURSS:O and CURSS:S suggestibility score with highest reported experience of each participant within each category of experience. We found no correlation between individual suggestibility and participants reporting experiences of a “Sensed Presence”

(CURSS:O:  $r = .10, p = .80$ ) (CURSS:S:  $r = .30, p = .64$ ). Nor did we find a correlation between individual suggestibility and participants reporting “Unusual Experiences” (CURSS:O:  $r = -.02, p = .95$ ) (CURSS:S:  $r = -.05, p = .82$ ).

5.5 *Combining Interviews and Subjective Ratings*

To further probe the authenticity and kind of experience reported, we interviewed the participants in order to get more detailed descriptions of their experiences. We here showcase some quotations that range from intense reports of mystical experiences to reports of minor experiences. In order to demonstrate the potential in employing our paradigm we also include the modality specific type of experience, subjective ratings of the experience at  $\tau_1$  and  $\tau_2$ , as well as the participant’s background.

TABLE 2 *Combined results: Modality-specific experience, quotation, subjective measure at  $\tau_1$  (immediately after the experiment) and  $\tau_2$  (three months after the experiment), participant name and group.*

Type of experience	Thick description (interview)	$\tau_1$	$\tau_2$	Participant
Sensed Presence (General)	“I clearly sensed that I was making contact with the other side. (...) I sensed a masculine energy. (...) You know, when you walk past a person, it feels like there is a wind of sorts. That was how it felt, except it felt more constant.”	9	8	Nr. 23; Spiritist.
Unusual Experience (Visual)	“All of a sudden I saw planets that flew past me. I could see it. Saturn and Mercury. (...) I both felt it and saw it. It felt like an enormous expansion into something infinitely great. (...) I sat in the middle of it all with vast space around me. It was tremendously beautiful.”	9	8	Nr. 1; New Age.
Sensed Presence (Visual)	“I experienced a person that came very close to me. (...) I did not have dialog with him (...) It was as if he wanted to say: ‘Do you see me?’ (...) I could clearly see his facial features; his broad nose and eyes.”	8	9	Nr. 9; Spiritist.
Unusual Experience (Visual)	“I saw a symbol. (...) It was a circle with other circles inside of it. It was some sort of energy. (...) It is hard to explain what it was (...) Infinity.”	9	8	Nr. 15; Spiritist.

TABLE 2 (cont.)

Type of experience	Thick description (interview)	$\tau_1$	$\tau_2$	Participant
<b>Sensed Presence</b> (General)	“Someone was definitely there. (...) Sometimes my arm or leg made a twitch (...) It felt like someone was inside of me (...) Something that at some level took control of me.”	5	3	Nr. 8; Spiritist.
<b>Unusual Experience</b> (Haptic)	“In the beginning of the session I felt my hair standing up on the right side of my head (...) And in the end of the session it was on my left side (...) It was a actually a very fun experience.”	7	5	Nr. 13; Spiritist.
<b>Sensed Presence</b> (Haptic)	“I felt something that mildly pushed against me. It was like an animal that tried to get in under my clothes (...) It was like a snake pushing itself against an isolated area.”	3	3	Nr. 18; Inexperienced.
<b>Sensed Presence</b> (General)	I was absorbed in my own thoughts when suddenly my hand moved, without me asking it do so. (...) I was startled by it. (...) I am not the big believer in possession, but that is the kind of thoughts that is going through ones head, when you have had the idea planted in advance. (...) But thinking about it rationally I concluded that no one had possessed me.	2	2	Nr. 17; Inexperienced.
<b>Unusual Experience</b> (Haptic)	“I experienced a shift in temperature from warm to cold.”	2	0	Nr. 10; New Age.
<b>Sensed Presence</b> (Haptic)	“I felt a touch on my hands. I am not sure if it was just something natural that created the sensation of being touched.”	2	1	Nr. 4; Spiritist.

## 6 Discussion

Our data clearly supports the potential for studying mystical experiences in a controlled environment. The experimental procedure we employed resulted in fascinating reports of unusual and mystical experiences. Based on participants' subjective ratings obtained immediately after and three months after

the experiment, some of these mystical experiences appear to have had a high degree of authenticity with lasting effects on participants' memory and attributions. These findings indicate that at least some forms of mystical experience can be elicited and studied in a controlled environment. We believe this is an important contribution to the field, and we hope that this insight will help revitalize the debate whether mysticism research can and should be studied in the lab.

In accordance with the prediction model, our findings suggest that sensory deprivation combined with a highly suggestive environment seemingly creates an effective context for expectation driven experiences. Almost half of our participants reported experiences of a sensed presence. We find, however, that successful elicitation of mystical experiences is particularly depended upon the cultural background of the participants. Participants who believed in spirits reported stronger and more frequent experiences of sensed presence than the two other groups. Interestingly, while the new age group did report experiences of sensed presence, they predominantly reported experiences that corresponded with a New Age worldview. They did this in spite of the fact that they were only given specific suggestions toward an experience of a sensed presence. The inexperienced group hardly reported any experiences of sensed presence or unusual experiences. These findings are in accordance with our perception model which predicts that prior perceptual experience have a significant impact on how the brain creates future predictions. To what extent sufficiently powerful contexts and suggestions may overwrite participants' prior beliefs remains an open question, but our findings suggest that it may be difficult to induce mystical experiences in non-believers.

Previous studies indicate that suggestibility play a central role in mystical experiences (Hood 1973; Granqvist et al. 2005). In our study, however, mystical experiences did not appear to be a function of individual levels of suggestibility. One reason for this may be that several of the participants clearly liked the idea of being susceptible to suggestions, whereas some noted that suggestibility was associated with a proneness for hallucination and illusion and therefore was strongly opposed to fit within that category. Perhaps the nature of our experiment made this particular measure too problematic as it could be interpreted as a measure that would render their reports unauthentic. There are, however, other ways of measuring suggestibility, e.g., the Tellegen's absorption scale (TAS), which poses questions like "Sometimes I feel as if my mind could envelop the whole world" and "sometimes I 'step outside' my usual self and experience an entirely different state of mind." This questionnaire would probably feel less controversial among our participants and thus reduce the noise within the measurement. Unfortunately, the TAS has been suspected of

being a highly reactive scale, and thus might not be the ideal measure of suggestibility (Council et al. 1986).

At a more general level, our study supports the potential for investigating mystical experiences at different levels using multidimensional and cross-disciplinary approaches (Paloutzian 1983). We obtained quantitative data on cultural background, subjective experience, and temporal measures of reported experiences. We also collected rich qualitative descriptions through interviews, scores on a suggestibility scale, physiological measures (EKG and respiration), and follow-up data to examine memory effects. These measures are not only interesting in themselves, they also showcase the potential incorporating a range of other important personality trait measures (e.g., social desirability, fantasy proneness, Five Factor Model), physiological measures (e.g., EEG, GSR), cultural background measures (e.g., beliefs, practices), and more refined measures of memory.

Our results also provide insights into the temporal aspect of the elicitation of mystical experiences. We find a general increase in frequency of experiences during the first 30 minutes of sensory deprivation across all groups. After 30 minutes, we find a dramatic increase of experiences among the spiritist participants. This indicates that future studies of mystical experience and sensory deprivation should employ conditions that last at least one hour to maximize the probability of eliciting experiences.

It is interesting that the paradigm we use seems to depend on a high degree of belief in the wonders of modern science. Based on Granqvist's insights on Persinger's original studies, it appears that the participants' trust in the neural effects of wearing the electromagnetic helmet is important for eliciting unusual experiences in participants (Granqvist et al. 2005; Swiney & Sousa 2013). Studies on hypnosis shows that participants are more likely to report experiences according to specific suggestions if they believe in the practice (hypnosis) as well as in the practitioner (hypnotist) (Kirsch 1990). This important notion points to a limitation in the study. The experimental context mixes strong beliefs about science with strong beliefs in the possibility of mystical experiences. Some might argue that this renders the reported experiences problematic in terms of ecological validity. Surely, the reports of mystical experiences in historical accounts are largely independent of science and technology. In a contemporary western context, however, Spiritists and New Agers commonly use techniques and equipment inspired by scientific research (Hammer 1997). At any rate, if the aim is to systematically identify and analyze components that increase the probability of eliciting mystical experiences, our design offers a unique potential. Including and excluding various components

in the design will enable future studies to examine how each component like sensory deprivation, verbal suggestion, behavior, personality traits, and physiological states, contributes to reported experiences. We believe that this potential represents a critical supplement to mysticism research because it enables researchers to make educated guesses about the effects of these components in mystical experiences outside the lab. Indeed, the experimental approach will always be a supplement to historical and anthropological studies, which investigate religious phenomena in their natural context.

## 7 Conclusion

With the present article we wish to revitalize the fascinating idea of eliciting mystical experience in the lab. Our study shows that eliciting mystical experiences in the lab can be successful without the use of hallucinogenic substances or hypnotic inductions used in earlier studies. The immediate reason for resuscitating this approach, however, comes from recent developments in the brain sciences, where models of perception have made significant progress. Indeed, we find that the prediction model, which has become a dominant paradigm for understanding perception, appears to be particularly useful for understanding mystical experiences. Importing the prediction model enables us to analyze mystical experiences with a general model of perception, rather than to use pre-defined, abstract, and often speculative models within the study of mysticism. Understanding perception in terms of prediction and error monitoring affords a rich analysis of why and how contextual components in religious practices may increase the probability of participants reporting mystical experiences. Basically, we propose that contexts which include components that strengthen individual predictions of mystical experience (e.g., suggestive components), combined with components that limit the access to sensory information that conflicts with these predictions (e.g., sensory deprivation), function as efficient facilitators of mystical experiences, because they allow religious and spiritual expectations to dominate subjective experience. Indeed, we find that a suggestive context combined with sensory deprivation is sufficient to elicit mystical experiences. We find, however, that successful elicitation of mystical experiences is particularly depended upon the cultural background of the participants. Although, the study is preliminary in the sense that it only demonstrates the potential for eliciting mystical experience, rather than examining the relative contributions of each of the components we employed, we hope that our study represents an early step toward a new

line of research. Experiments allow theories on mysticism to be tested, hypothesized mechanisms to be investigated, and specific components to be isolated and analyzed.

## Appendix

### *Instructions*

Now I am going to tell you what is going to happen, once you get inside the room where the experiment takes place and are equipped with the electromagnetic helmet. You will be sitting blindfolded in complete darkness in the soundproof room for a full hour. Since you will be sitting in the dark for a large amount of time, you may feel like falling asleep. You cannot do that. We would like to ask you to attentive the whole time, which is why it is important that you do not fall asleep.

Once you get into the room and we turn on the electromagnetic helmet, your brain has to adapt to the new condition it is in. For most people, this trigger the feeling of some sort of unease; e.g. rapid heartbeat, sweaty palms, the feeling of unease, tremor, restlessness, your body feeling warmer or cooler, etc. This is perfectly normal and not in any way dangerous, so you should not worry about this. It will pass after a short period of time. But it is an indication that your brain is adapting to its new conditions.

After some time you will be ready to start experiencing. It is very important that you are aware, that the experiences can occur at any time. Some participants experience something right away, while others experience something at the very end of the session. That's why it is important that you are attentive the whole time. Some participants have very long lasting experiences, whereas others only experiences brief glimpses. Some participants have a lot of experiences, whereas some only have one or two experiences. Finally, the magnitude of the experience can vary: Some participants have very powerful experiences, whereas others have weak experiences. We are interested in all kinds of experiences, which is why it is important, that you remain attentive to all kinds of sensory changes. When you have an experience, we would like you to press the response-button after the experience have ended. It is important, that you do not press the response-button during the experience. You only have to press it afterwards. When you are having an experience we would like you to get absorbed in the experience, so to speak. At a certain point the experience will start to fade away, and it is at that point that we would like you to press the button.

Now I would like to tell you what the vast majority of our participants normally experience. Most of our participants experience that there is someone or something in the room with them: a sensed presence. It is different how people perceive this presence. Some report that they see another being in the room; some hear voices; some feel



a physical touch; while some only have the feeling that someone is in the room with them. Some participants also have other experiences, and no matter what you experience, we would like you to press the response-button.

Lastly, I would like to inform you that you can stop the experiment at any time you want if do not wish to take part in it after all. If that is the case, please call us. We will then come inside the room to assist you.

## References

- Almond, Philip C. (1982). *Mystical Experience and Religious Doctrine*. Berlin: Mouton Publishers.
- Bar, Moshe (2009a). Predictions: A universal principle in the operation of the human brain. *Philosophical Transactions of the Royal Society* 364(1521): 1181-1182.
- (2009b). The proactive brain: Memory for prediction. *Philosophical Transactions of the Royal Society* 364(1521): 1235-1243.
- Beuregard, M. & V. Paquette (2006). Neural correlates of mystical experience in Carmelite nuns. *Neuroscience Letters* 405: 186-90.
- Bourque, Linda B. (1969). Social correlates of transcendental experiences. *Sociological Analysis* 30(3): 151-163.
- Braffman, Wayne & Irving Kirsch (1999). Imaginative suggestibility and hypnotizability: An empirical approach. *Journal of Personality and Social Psychology* 77(3): 578-587.
- Bulbulia, J. & U. Schjoedt (2012). The neural basis of religious belief. In F. Krueger & J. Grafman (eds.). *The Neural Basis of Human Belief Systems*. Psychology Press.
- Council, James R., Irving Kirsch & Laurin P. Haefner (1986). Expectancy versus absorption in the prediction of hypnotic responding. *Journal of Personality and Social Psychology* 50: 182-189.
- Deeley, Quinton, Eamonn Walsh, David A. Oakley, Vaughan Bell, Cristina Koppel, Mitul A. Mehta, and Peter W. Halligan (in preparation). *Modeling psychiatric and cultural possession phenomena with hypnosis and fMRI*.
- Deikman, Arthur J. (1963). Experimental meditation. *Journal of Nervous and Mental Disease* 136: 329-343.
- Friston, K. (2005). A theory of cortical responses. *Philosophical Transactions of the Royal Society B: Biological Sciences* 360(1456): 815-836.
- Friston, Karl & Stefan Kiebel (2009). Predictive coding under the free-energy principle. *Philosophical Transactions of the Royal Society* 364(1521): 1211-1221.
- Frith, Chris (2007). *Making up the Mind: How the Brain Creates our Mental World*. UK: Blackwell Publishing.

- Geertz, Armin W. (1990). Introduktion: Mystik som et religionsvidenskabeligt problemområde. *Mystik—den indre vej?*, Red. Per Bilde & Armin Geertz, Aarhus Universitetsforlag, Aarhus.
- Granqvist, Pehr, Mats Fredrikson, Patrik Unge, Andre Hagenfeldt, Sven Valind, Dan Larhammer, and Marcus Larsson (2005). Sensed presence and mystical experiences are predicted by suggestibility, not by the application of transcranial weak complex magnetic fields. *Neuroscience Letters* 379: 1-6.
- Granqvist, Pehr & Marcus Larsson (2006). Contribution of religiousness in the prediction and interpretation of mystical experiences in a sensory deprivation context. Activation of religious schemas. *The Journal of Psychology* 140(4): 319-27.
- Greeley, Andrew M. (1974). *Ecstasy: A Way of Knowing*. Englewood Cliffs, N.J.: Prentice-Hall.
- Griffiths, R.R., W.A. Richards, M.W. Johnson, U.D. McCann, R. Jesse (2008). Mystical-type experiences occasioned by psilocybin mediate the attribution of personal meaning and spiritual significance 14 months later. *Journal of Psychopharmacology* 22(6): 621-632.
- Griffiths, R.R., W.A. Richards, U. McCann, R. Jesse (2006). Psilocybin can occasion mystical-type experiences having substantial and sustained personal meaning and spiritual significance. *Psychopharmacology* (Berl). 187(3): 268-83, commentaries 284-292.
- Griffiths, R.R., M.W. Johnson, U. McCann, W.A. Richards, B.D. Richards, and R. Jesse (2011). Psilocybin occasioned mystical-type experiences: immediate and persisting dose-related effects. *Psychopharmacology*, 15 June.
- Hammer, Olav (1997). *På spaning efter helheten: New Age, en ny folketro?* Stockholm: Wahlström & Widstrand.
- Hammersholt, Torben (2011a). *A critical Analysis of the Comparative Study of Mysticism with Perspectives from Early Buddhism*, PhD thesis, Institute of Philosophy, Education and the Study of Religions, University of Southern Denmark.
- (2011b). Et kritisk religionsvidenskabeligt perspektiv på mystikkens forskningshistorie. *Mystik—i filosofi, religion og litteratur*, Red. Aksel Haaning og Magnus Riisager, Forlaget Univers, Højbjerg.
- Hill D.R. & M.A. Persinger (2003). Application of transcerebral, weak (1 microT) complex magnetic fields and mystical experiences: are they generated by field-induced dimethyltryptamine release from the pineal organ? *Percept. Motor Skills* 97: 1049-1050.
- Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics* 6(2): 65-70.
- Hood Jr. & W. Ralph (1973). Hypnotic susceptibility and reported religious experience. *Psychological Reports* 33: 549-550.

- (1975). The construction and preliminary validation of a measure of reported mystical experience. *Journal for the Scientific Study of Religion* 14: 29-41.
- Hood Jr., W. Ralph & R.J. Morris (1981). Sensory isolation and the differential elicitation of religious imagery in intrinsic and extrinsic persons. *Journal for the Scientific Study of Religion* 20(3): 261-73.
- Jack, A.I. (1998). *Perceptual Awareness in Visual Masking*. Unpublished Psychology Ph.D., UCL.
- Jackson Jr., Wesley & Ellis, Rosemary (1971). Sensory deprivation as a field of study. *Nursing Research* 20(1): 46-54.
- Katz, Steven T. (1978). Language, epistemology, and mysticism. Steven T. Katz (ed.), *Mysticism and Philosophical Analysis*, 22-74. London: Sheldon Press.
- Keller, Carl A. (1978). Mystical literature. In Steven T. Katz (ed.), *Mysticism and Philosophical Analysis*, 75-100. London: Sheldon Press.
- Kirsch, Irving (1985). Response Expectancy as a Determinant of Experience and Behaviour. *American Psychologist* 40 (11): 1189-1202.
- (1990). *Changing Expectations: A Key to Effective Psychotherapy*. Brooks/Cole Publishing Company.
- La Barre, Weston. (1972). Hallucinations and the shamanistic origins of religion. In P.T. Furst (ed.), *The Flesh of the Gods*, 261-278. New York: Praeger.
- Luhrmann, T.M. (2012). *When God Talks Back: Understanding the American Evangelical Relationship with God*. Alfred a Knopf Incorporated.
- Luhrmann, T.M., Nusbaum, H., Thisted, R. (2010). The absorption hypothesis: learning to hear god in evangelical christianity. *American Anthropologist* 112(1): 66-78.
- MacLean, K.A., M.W. Johnson, and R.R. Griffiths (2011). Mystical experiences occasioned by the hallucinogen psilocybin lead to increases in the personality domain of openness. *Journal of Psychopharmacology* 25(11): 1453-1461.
- MacLean, K.A., M.W. Johnson, J.M.S Leoutsakos, and R.R. Griffiths (2012). Factor analysis of the mystical experience: A study of experiences occasioned by the hallucinogen psilocybin. *Journal for the Scientific Study of Religion* 51(4): 721-737.
- Newberg, A.B., A. Alavi, M. Baime, M. Pordehnad, J. Santana, and E.G. d'Aquili (2001). The measurement of regional cerebral blood flow during the complex cognitive task of meditation: A preliminary SPECT study. *Psychiatric Research: Neuroimaging* 106: 113-22.
- Nielbo, K.L., & J. Sørensen (2011). Spontaneous processing of functional and non-functional action sequences. *Religion, Brain & Behavior* 1(1): 18-30.
- Nielbo, K.L., Schjoedt, U., & Sørensen, J. (2013). Hierarchical organization of segmentation in non-functional action sequences. *Journal of the Cognitive Science of Religion* 1(1).
- Orne, Martin T. (1959). The nature of hypnosis: Artifact and essence. *Journal of Abnormal and Social Psychology* 58: 277-299.

- . (2009). Demand characteristics and the concept of quasi-controls. In Robert Rosenthal & Ralph Rosnow (eds.), *Artifacts in Behavioral Research Research*, 110-137. New York: Oxford University Press.
- Pahnke, Walter N. (1967). LSD and religious experience. In Russell Leaf & Richard Debold (eds), *LSD, Man and Society*, 60-84. Middletown, Connecticut: Wesleyan University Press.
- Pahnke, W.N. & W.A. Richards (1966). Implications of LSD and experimental mysticism. *Journal of Religion and Health* 5: 175-208.
- Paloutzian, Raymond F. (1983). *Invitation to the Psychology of Religion*. Scott, Foresman, and Company.
- Persinger, M.A. (1997). Keynote Address, International Symposium, Magnetic Fields: Recent Advances in Diagnosis and Therapy, Lawson Research Institute Conference, London, Ontario, Canada, 1997.
- . (2002). Experimental simulation of the God experience: Implications for religious beliefs and the future of the human species. In Rhawn Joseph (ed.), *Neurotheology: Brain, Science, Spirituality, Religious Experience*, 279-292. San Jose, California: University Press.
- Ruohonen, J. (1998). *Transcranial Magnetic Stimulation: Modelling and New Techniques*. Doctoral Dissertation at Department of Engineering Physics and Mathematics, Helsinki University of Technology.
- Schjoedt, Uffe (2009a). The religious brain: A general introduction to the experimental neuroscience of religion. *Method and Theory in the Study of Religion* 21: 310-339.
- Schjoedt, U. (2009b). *The Neural Substrates of Prayer: Toward an Experimental Neuroscience of Religion*. Aarhus University Press (PhD dissertation).
- Schjoedt, U., H. Stødkilde-Jørgensen, A.W. Geertz, T.E. Lund, A. Roepstorff (2011). The power of charisma: Perceived charisma inhibits the frontal executive network of believers in intercessory prayer. *SCAN* 6(1): 119-127.
- Schjoedt, U., J. Sørensen, K.L. Nielbo, D. Xygalatas, P. Mitkidis, and J. Bulbulia (2013a). Cognitive resource depletion in religious interactions (Target article). *Religion, Brain, and Behavior* 3(1): 39-55.
- (2013b). The resource model and the principle of predictive coding: A framework for analyzing proximate effects of ritual. *Religion, Brain, and Behavior* 3(1): 79-86.
- Sheehan, P.W. (1971). Countering preconceptions about hypnosis: An objective index of involvement with the hypnotist. *Journal of Abnormal Psychology* 78: 299-322.
- Smart, Ninian (1965). Interpretations and mystical experience. *Religious Studies* 1(1): 75-87.
- Spanos, Nicholas P., Lorraine H. Radtke, David C. Hodgins, Lorne D. Bertrand, Henderikus J. Stam, and Patricia Moretti (1983). The carleton university responsive-

- ness to suggestion scale: Relationship with other measures of hypnotic susceptibility, expectancies and absorption. *Psychological Reports* 53: 723-34.
- Spilka, Bernard, Ralph W. Hood jr., Bruce Hnsberger, and Richard Gorsuch (2003). *Mysticism. The Psychology of Religion: An Empirical Approach*, 290-340. New York: The Guildord Press.
- Stace, Walther T. (1960). *Mysticism and Philosophy*. Hong Kong: The Macmillan Press Ltd.
- Swiney, Lauren & Pablo Sousa (2013). When our thoughts are not our own: Investigating agency misattributions using the mind-to-mind paradigm. *Consciousness and Cognition* 22: 589-602.
- Taves, Ann (2009). *Religious Experience Reconsidered: A Building-Block Approach to the Study of Religion and Other Special Things*. New Jersey: Princeton University Press.
- Thomas, Eugene & Pamela E. Cooper (1978). Measurement and incidence of mystical experiences: An exploratory study. *Journal for the Scientific Study of Religion* 17(4): 433-37.
- Wulff, David M. (2002). Mystical experience. In E. Cardena, S.J. Lynn, S. Krippner (eds.), *Varieties of Anomalous Experience: Examining the Scientific Evidence*, 397-440. Washington: American Psychological Association.
- Zubeck, John P. (1969). *Sensory Deprivation: Fifty Years of Research*. New York: Appleton-Centery-Crofts.