ISSN 2055-0286
Advances in Social Sciences Research Journal; Vol. 13 No. 05 (2026) (146-159)
https://doi.org/10.14738/assrj.1305.11581

Hypnosis and Predictive Models of Consciousness

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Abstract: This article aims to present a model to explain the phenomenology of hypnosis, with particular reference to plastic monoideism and its phenomenology, integrating some of the current scientific theories of consciousness, particularly those of Karl Friston's free energy theory. Experimental studies demonstrate the existence of a close relationship between the individual's representational system on the one hand, and their neurophysiological, endocrine, and immune systems on the other. In hypnosis, mental images immediately reverberate on the physical plane in such a profound way that they alter even the most primitive systems, such as vision and pain. It has been demonstrated that these processes occur when the mind focuses on a single idea, but why and how this occurs is unknown. At the same time, studies on consciousness have provided significant contributions to understanding the models we use to interact with reality and create our internal reality. Among the various theoretical approaches, those based on a constructivist epistemological paradigm would seem to be most in tune with the phenomenology of hypnosis. The theories of Anil Seth, Andy Clark, and Chris Frith (who share the idea that our brain is not a passive receiver of information but a predictive machine, that consciousness is a controlled hallucination, and that the mind extends to encompass social reality and artifacts) open the possibility of investigating the study of hypnosis. Within this line of thought, Karl Friston's free energy theory proposes a mathematical-statistical theoretical model that extends these concepts to every living being, from cells to the human brain. This line of research has two important implications: 1) having a theoretical model that can be implemented through algorithms capable of explaining hypnotic phenomena paves the way for the use of technologies to support the clinical applications of hypnosis; 2) Having a tool like hypnosis that can be interpreted in light of the theory of consciousness opens the way to the possibility of studying consciousness using hypnosis.

CONSCIOUSNESS AND HYPNOSIS: A PROFOUND LINK

The study of consciousness is currently a key topic in philosophical and neuroscientific debate, and has implications for understanding issues important to human development and health. Understanding what makes humans *conscious*, the connection between the materiality we perceive with our senses and the internal representations we construct[1] are closely related to the study of consciousness.

Hypnosis, a particular condition induced by monoideism (Casiglia, 2015, 2025; Casiglia, Gadotti et al., 2022; Casiglia et al., 2019, 2023), generates profound changes in

[1] investigating the ways in which our mind integrates technological artefacts and understanding the connections between our representational system and our endocrine and immune systems

our perceptual systems as well as our nervous, endocrine, and immune systems through its property of plasticity. In hypnosis, mental images become a phenomenological reality.

In the paper *The Nature of Consciousness Characterized by Means of Hypnosis* (Casiglia & Gadotti, 2026), the authors explored, starting from experimental studies, the connections between the representations induced by monoideism and the changes that occur at the physiological and neurophysiological levels. These connections demonstrate the existence of a close relationship between mental representations in hypnosis and the receptor systems (Casiglia, 2025).

Other experimental studies support this thesis. Among the best-known studies are those on the use of hypnosis in the therapy of human papillomavirus: it has been shown that the rate of complete disappearance of warts is significantly higher in the group treated with hypnosis than in those treated with acid cryotherapy (Barabasz et al., 2010) and that hypnotic healing of warts results from the activation of a cellular immune response (Ewin, 2011).

Equally well-established studies demonstrate the ability of hypnosis to act on the analgesic system. Following the experimental studies (Casiglia et al., 2007, 2011, 2012, 2015, 2016, 2018, 2020, 2025; Facco et al., 2011, 2013, 2018), the use of hypnosis to generate analgesia and anaesthesia has now become part of the clinical protocols of several hospitals around the world (Bankole et al., 2023; Lewenstein et al., 1981; Matles et al., 1965; Makovac et al., 2020; Pilia, 2022; Prinsloo et al., 2022; Valdez, 2022).

Research has also documented how hypnosis can influence the endocrine system, acting primarily through the hypothalamic-pituitary-adrenal axis. Hypnosis acts as a modulator of the stress response, influencing the secretion of hormones that regulate mood, metabolism, and the immune response (Rossi, 2002). A particularly well-studied study in this regard is that on cortisol incretion (Rizkiani et al., 2020; Schmidt et al., 2025; Varga & Bányai, 2017; Acunzo et al., 2017): hypnotic induction and trance (Casiglia et al., 2012a) have been shown to reduce cortisol levels in patients undergoing Cesarean section, the cortisol response upon awakening, and morning heart rate in the following days, improving resilience to daily stress. Simple hypnotic instructions can also increase blood flow in the arteries of the uteroplacental system (Coppola, 2023). More generally, it is possible to give instructions under hypnosis to unconsciously increase cardiac stroke volume (Casiglia et al., 2012, 2016) as well as the diameter and flow of deep arteries and veins (Tikhonoff et al., 2018).

There is therefore a profound connection between consciousness, body and hypnosis, but there is still no coherent literature on the nature of this connection, also because investigating this connection means placing oneself fully within the study of the so-called hard problem posed by David Chalmers in 1995 (Vitas, 2025).

CONSTRUCTIVIST APPROACH TO THE STUDY OF CONSCIOUSNESS: THE BAYESIAN PREDICTIVE MIND

Background: The authors previously established an epistemological premise (Casiglia & Gadotti, 2026), adhering to the school of thought that considers all reality a *controlled hallucination*. According to this conception, representational reality encompasses both processes generally defined as *internal* to the subject and those generally defined as *external* (Casiglia, 2025a). This premise is consistent with constructivist psychological and philosophical currents. From a neuroscientific perspective, it is in line with the theories of Anil Seth, Andy Clark, and Chris Frith (Clark, 2015; Clark & Chalmers, 1998; Frith, 2007; Seth, 2013, 2021), who share the idea that the brain is not a passive receiver of information but a *predictive machine* and that, as mentioned, consciousness is a controlled hallucination. The authors propose a probabilistic view of the brain based on the Bayesian model, introducing the concept of an extended mind that encompasses social reality and the artifacts of thought. Free energy theory (Parr et al., 2022) probably represents the most complete systematization of this and other theories within a mathematically defined model and therefore represents a point of reference for attempting to hypothesize a scientific explanation of the hypnotic phenomenon.

A Summary to Continue: Before going into the details of the theoretical discussion, it may be useful to briefly review some passages from the philosophical and psychological theories on the theme of consciousness that express central concepts of the proposed reasoning. Kant raises the problem of the unknowability of external reality (*νοούμενον, noumenon*) and the knowability of only internal reality (*φαινόμενον, phenomenon*) resulting from a priori forms of our intuition. This concept finds confirmation in neuroscientific terms in the top-down processing mechanisms that pre-organize sensory data. In his critique of Kant proposed in the *Phänomenologie des Geistes (Phenomenology of Spirit)*, Hegel (1807) suggests that consciousness is not a passive observer but an entity that transforms itself through the encounter with the outside. This paves the way for a line of thought that holds that the external object is not merely represented but leaves a structural trace in the subject, changing, in the relationship with the object, the structures of meaning that object assumes in relation to the subject's representational world. This concept is one of the pillars of the theory that supports the centrality of the relationship with the objects of the world in the construction of the true Ego and of the *unthought known*, the basis of childhood psychic evolution (Bollas, 1987). This interaction also influences that part of the internal representation that, applying a naive psychology, we generally call physical structure. For neuroscience, this is the philosophical foundation of top-down processing, which posits that, even before the retinal stimulus reaches the association areas, the brain has already projected a working hypothesis. What we perceive is what the *subject's searchlight* is actively seeking or predicting, as the *searchlight theory* maintains. The construction of internal reality therefore follows a Darwinian logic. Personal reality is the set of conjectures that have not yet been disproved (falsified) by the environment. The brain constantly generates models of reality: if the model allows us to navigate the world without colliding with the thing itself (which remains the external obstacle), the model is maintained.

Free energy theory (Parr et al., 2022) systematizes these concepts by extending this vision to every living being, from cells to the human brain. For Friston, in a universe tending toward disorder (entropy), every living system must maintain its integrity, i. e. the coherence between its internal model and the data coming from sensory stimuli. Surprise refers to the gap between what the brain expects and what it receives from the senses. Since the brain cannot calculate mathematical surprise in real time due to the complexity of this operation, which would require too much energy, it calculates a value that is its upper limit *(variational free energy)*, which tends to be minimized to minimize prediction error. The mathematical concept of the *Markov blanket* also defines the boundary between what is inside and what is outside by defining a statistical frontier that separates internal states (the brain/organism) from external states (the environment).

The theory identifies the variables summarized in Table 1. The free energy (F) is expressed by the function:

$$F(q, y) = D_{KL}[q(\vartheta)||p(\vartheta|y)] - ln\, p(y)$$

where $p(\vartheta|y)$ is the posterior reality (also called *posterior distribution* or *uncertainty about causes*) that is the probability of the causes ϑ, given that I have observed the sensory data *y*, or the brain's attempt to trace the signal (the effect) back to its origin in the external world (the cause); it is an inference process that directly depends on the current observation (if the data *y* change the posterior reality changes); *p(y)* is instead the likelihood (or evidence of the model) and represents the probability of observing the data y exactly, regardless of what the specific cause ϑ is: it is therefore the probability that the internal model of the world is able to predict or explain those sensory data; D_{KL} represents the distance between what we believe *(q)* and the posterior reality (*p*): the closer this divergence is to zero, the more accurate our representation is; the negative log-likelihood $-lnp(y)$ represents surprise.

The formula should be read as follows. The free energy that depends on the brain's internal representation of the world *(q)* and sensory data *(y)* arises from the difference between the distance between our internal representation $q(\vartheta)$, which we previously had compared with the data coming from the senses, and the posterior reality that the brain creates based on input derived from external states of the world conditioned by sensory data, and the logarithm of the posterior reality derived from the sensory data.

Let's translate this language with a concrete example often used to explain the theory. Suppose, walking around town, we see a black spot and assume it is a cat. The explanation according to free energy theory is as follows: *y* is the dark spot; ϑ are the hidden causes (in this case, who actually created the dark spot); *m* is the internal model of the system; $q(\vartheta)$ is the brain's internal representation (*recognition distribution*) of the world, $p(\vartheta|y)$ is the probability that it is a cat conditioned on seeing the black spot, *p(y)* (i.e., the likelihood or evidence of the model) represents the probability of accurately observing the dark spot regardless of who created it; D_{KL} is the distance between the internal representation of the cat and the probability that it is a cat conditioned on seeing a black spot (the closer it is to 0, the more accurate the internal model).

From Bayes' theorem, we derive:

$$p(\vartheta|y) = \frac{p(y|\vartheta) \cdot p(\vartheta)}{p(y)} .$$

A very low *p(y)* indicates that what you see is absurd according to expectations. Consequently, $p(\vartheta|y)$ or posterior reality (which is the update the brain makes after seeing the data) experiences a crisis because the model is unable to make sense of the data. The prediction error becomes extremely high, and the brain will therefore try to change its beliefs to increase the evidence (i.e., minimize free energy).

For Friston, we do not perceive the world, but only changes on our sensory veil. The brain must infer what is happening outside based solely on how its boundaries vibrate: if there is a prediction error (high free energy), the system has only two ways to reduce it: 1) update internal reality by changing the model (perceptual inference) or 2) act to ensure that the senses provide the data I expect (active inference).

The Generation of Controlled Hallucination: Internal reality therefore follows a generative model that produces a controlled hallucination. The brain operates by creating predictions that are constantly compared with discrepant data coming from the senses. Therefore, there are two types of information flows. Top-down flows carry predictions from the cortex to the senses, while bottom-up flows carry only the error from the senses to the cortex. If the internal model is perfect, there is no need for sensory signals: the brain lives within its representation. This explains why, although we are immersed in a *chaos* of stimuli, we perceive a stable and coherent reality. The *Kullback-Leibler divergence*, also called *relative entropy*, measures how much a probability distribution representing our prediction differs from a second reference distribution representing reality or data. Formally, for two discrete probability distributions *P* (reality) and *Q* (our model/approximation), the divergence is calculated as:

$$Dkl(Q||P) = \sum_{x} Q(x) \ln \frac{Q(x)}{P(x)}$$

If *Q(x)* = *P(x)*, the model is perfect, and therefore the ratio is 1 and the logarithm of 1 is 0 (the divergence is 0). The more the two distributions differ, the more the value of *Dkl(Q||P)* increases.

The value of *Dkl(Q||P)* allows us to express three main concepts.

The first is the *cost of information*, that is, the effort the brain makes to update its beliefs; if I receive information that distorts what I thought, *Dkl(Q||P)* increases, and the brain will try to minimize the information so as not to have to continually rewrite its entire internal database.

The second concept is the approximation error: the brain cannot perfectly understand external reality (which is too complex) and creates a simplified version of it *(Q)*; *Dkl(Q||P)* measures how much information we lose by using this simplification. Minimizing *Dkl(Q||P)* means making our controlled hallucination as accurate as possible with respect to the signals arriving from the senses.

The third concept represents surprise. Mathematically, the value of *Dkl(Q||P)* is related to logarithmic surprise: if the biological system minimizes divergence, it is technically reducing uncertainty about its future state.

APPLICATION OF FREE ENERGY THEORY TO HYPNOSIS

Interpreting hypnosis in light of the proposed theory requires the introduction of another element of the theory: *precision weights*, a multiplier that changes the signal's amplitude.

If we consider a signal (or an error) as a normal (Gaussian) distribution, the variance σ^2 represents the uncertainty. The precision[2] ω is given by the formula:

[2] in multidimensional terms, precision is the inverse of the covariance matrix

$$\omega = \frac{1}{\sigma^2}.$$

The brain calculates the prediction error as the difference between the actual data *y* and the prediction *μ*:

$$\epsilon = y - \mu$$

The brain does not use the pure error but the weighted error *ζ* which actually drives the system update:

$$\zeta = \omega \cdot \varepsilon$$

If the sensory signal is reliable (high precision), the brain increases the value of *ω* because, if there is an error between what is expected and what is seen, and the signal is reliable, it means that the expectation is wrong and must be updated. Conversely, if the sensory signal is unreliable, the brain decreases the value of *ω* because it tends to consider that channel as background noise. From a mathematical point of view, if *ω* is high it means that the variance *σ*^2 of the data is low since *ω* = *1*/*σ*^2. The value of ω has a significant impact on the calculation of free energy because it acts as a multiplier: if probability distributions are approximated with a Gaussian distribution in the free energy formula *(F)*, *ω* multiplies the prediction error:

$$F \sim \frac{1}{2}\omega \cdot \varepsilon^2 - \frac{1}{2} ln\, \omega.$$

Therefore, the more reliable the sensory channel, the higher the weight value, and therefore the free energy increases. In reality, this increase is offset by the value $\frac{1}{2} ln\, \omega$ to prevent the brain from becoming overly sensitive.

Using this model, we can hypothesize that hypnosis affects precision weighting, shifting the balance between what the brain expects and what the senses convey. This means that the hypnotist's suggestion acts as a *hyper-prior* (a very high-priority prediction). The brain artificially increases the precision (importance) of the internal prediction and lowers the precision of the external sensory signal: under these conditions, even if the nerves transmit signals of pain or cold, the brain's monitoring system ignores them as if they were irrelevant *statistical noise*. The hallucination is no longer controlled by the senses, but by the suggestion (Landry et al., 2017). The ability of the hypnotist's suggestion to act as a *hyper-prior* arises precisely from the process of monoideism, which focuses attention on a single idea, progressively excluding sensory data as the hypnotic state deepens, thus preparing the brain to accept the hypnotist's suggestion as true.

Hypnosis can change internal reality in two mirrored directions by acting on the mechanisms of controlled hallucination. One way is to create a *positive hallucination*[3] (perceiving what isn't there). In this case, the brain generates an image (e.g., a cat on a chair) and assigns it such subjective certainty that it is integrated into the perceptual field. The circuits – for example, those of primary vision (V_1, V_2) – actually activate, as if photons were striking the retina. This can be expressed mathematically using the free energy formula expressed in terms of error and weights:

[3] At Padua University both positive and negative hallucinations (attentive deficits called *neglects*) have been demonstrated as real, objective and ontologically existent reality, and measured in the units of classical physiology (Casiglia et al., 2010, 2019; Facco et al., 2014; Priftis et al., 2011).

$$F \sim \frac{1}{2}\omega \cdot \varepsilon^2 - \frac{1}{2}\ln \omega$$

The hypnotist induces the subject to manipulate ε and ω. More specifically, in the case of positive hallucination (seeing what isn't there), there is a very strong conflict between what the data conveys and what the model predicts: the value of ε is very high. The hypnotist greatly increases the weight ω of his internal model, reducing the weight of the sensory channel to almost 0. In this way, the brain is trained to consider the data coming from the eyes as noise. Since $\omega_y \sim 0$, the free energy term $F \sim \frac{1}{2}\omega_y \cdot \varepsilon^2$ disappears. The only way for the brain to avoid being surprised is to accept the prediction of the internal model. From a phenomenological point of view, I see what the hypnotist tells me because the brain has decided that the signal coming from the senses has no statistical weight. The prediction fills the sensory void. A second way is to create a *negative hallucination* (not perceiving what is there). In this case, the brain must first perform an active cancellation task. The internal model predicts the absence of the object and uses this prediction to actively suppress the incoming sensory signal. The senses register the object *(y)*, but the suggestion says that nothing is there *(μ)*. In this case too, we have a very high error ε, but the active suppression of the precision of the data related to the object to be ignored brings the weight ω of all stimuli confirming the presence of the object close to zero. Although the error ε is physically present (light strikes the retina, odor molecules reach the nose), the multiplier ω cancels it out in the free energy formula:

$$F \sim \frac{1}{2}\omega \cdot \varepsilon^2$$

Free energy is minimized by ignoring the data: the brain *erases* the object from consciousness because it has recalibrated the system so that that data does not generate any error signals.

The examples cited above highlight how the brain must deactivate the reality monitoring function, usually located in the medial prefrontal cortex (mPFC), for hypnotic reality to seem real. In hypnosis, connectivity between the dorsolateral prefrontal cortex (dlPFC) and sensory are considered to decrease together to other areas in parallel with increased activation of the prefrontal areas (Casiglia et al. 2018), so that critical function is reduced and the internal hallucination is promoted to external reality. Studies on imagery in blind people (both congenitally and late-onset) would seem to provide further evidence in favour of this interpretation of the hypnotic phenomenon: if perception is truly a top-down prediction, then the neural architecture of vision must be able to function even in the absence of photons. Now, research on blind sight (Cohen et al. 1997; Sadato & Pascual-Leone, 1996) has shown that when a congenitally blind person explores an object tactilely or imagines a spatial shape, their primary visual cortex V_1 becomes intensely activated. This would prove that area V_1 is not a simple screen for retinal signals but a processor of spatial representations. If a hypnotized subject *sees* an object that isn't there, they are using exactly the same mechanism as blind people: they are populating their visual area with data from high-level circuits (ideas, suggestions, memories) rather than sensory data. Blindness demonstrates that hallucination is possible without input; hypnosis demonstrates that hallucination can be externally directed.

In blind people, the visual cortex is recruited for Braille and hearing. This phenomenon, called *cross-modal plasticity*, suggests that internal reality is a flexible construct that attempts to minimize free energy. But this also happens in hypnosis when a hypnotist suggests a perceptual change (e.g.: *this noise is music*) by implementing a signal re-labelling.

Studies on the blind also show that blind people make errors in Braille when their visual cortex is disturbed with transcranial magnetic stimulation, confirming that internal vision (representation) is necessary for experience, even when the input is tactile. The mental images of blind people therefore have a spatial consistency and precision almost identical to the visual perception of sighted people. A blind person completely trusts their internal spatial representation because they have no visual cue to contradict it. Under hypnosis, the brain is induced to do the same: it turns off sensory discrepancy monitoring and treats the mental image with the same dignity as a physical datum. We can express these concepts with the following formula:

$$perceived\ reality = \frac{\omega_{hyp} \cdot \mu_{hyp} + \omega_{sens} \cdot \mu_{sens}}{\omega_{hyp} + \omega_{sens}}$$

In both hypnosis and mental image blindness, the sensory weight ω_{sens} is reduced to almost zero, making the prediction μ_{sens} the only possible reality. Hypnosis exploits this independence of meaning from sensory form. The hypnotist provides the meaning (the suggestion), and the subject's brain – like that of a blind person using V_1 for touch – mobilizes sensory areas to construct the form corresponding to that meaning. Internal reality is altered because the brain believes its own simulation more than the silence (or noise) of the outside world. Hypnosis and blindness thus appear as two sides of the same coin: blindness demonstrates that the machine of internal reality can operate without light while maintaining a coherent structure; hypnosis demonstrates that content can be injected into that idle machine, thus bypassing the control of reality.

ANTHROPOLOGICAL NATURE OF PLASTIC MONOIDEISM

In the authors' view, shared with a high number of experts who have met on several occasions (Casiglia, Gadotti et al., 2022; Casiglia et al., 2023), monoideism represents the basic process that determines the shift in consciousness that characterizes hypnosis. Like hypnosis, monoideism begins in a trigger-like manner at the end of induction and ends precisely with de-hypnotization (Casiglia, 2015, 2025): to all intents and purposes, monoideism *is* hypnosis. In light of the theory reported, monoideism acts as an element that determines the collapse of the weight of sensory data, identifying the new condition called hypnosis. This condition – it should be remembered – occurs not only in a structured research or therapy setting but also spontaneously in everyday life; it is now more represented and was once constantly present in *Homo sapiens* (Casiglia, 2020). This is why it is possible and simple to induce and conduct hypnosis (Casiglia, 2012).

Here the topic shifts toward a line of anthropological studies that examine the problem in light of evolutionary considerations. According to Darwinian theory, variability within *taxa* is due to mutations and – through natural selection – only mutations advantageous to the species are passed on to offspring, while disadvantageous ones are eliminated. Each male child contributes 1–5 new rapid linear mutations to the small Y chromosome; each female child contributes slow but stable ribosomal mutations, which accumulate. Today, with a population of ≈8 billion humans, of which ≈5.5 billion are fertile,

≈800 million heterosexual intercourses are recorded every day in the world, resulting in ≈700.000 conceptions which involve ≈70 new point mutations per child, i.e. ≈50 million mutations per day (Twenge et al., 2017; Kong et al., 2012; Rahbari et al., 2012; Scally, 2012). In the entire prehistory/history of *Homo sapiens*, the total number of individuals who have lived, i.e. ≈100-120 billion (Rutherford, 2016), has so far produced ≈7,000 billion new germline mutations (Auton et al., 2015).

It is obvious that the serial mutations that in the Paleolithic-Neolithic – after the differentiation of the genera *Homo* and *Pan* – progressively led in *Homo* to the faculty that we could call *easy-plastic-monoideism* must have been evolutionarily favourable or they would not have persisted to this day (Casiglia, 2020), especially since contemporary humanity is evolving at a speed ≈1000 times faster than in the Paleolithic. Hypnosis is therefore *something positive*.

Nowadays, by virtue of these ancient and modern mutations that have occurred and added together, passing through hypnosis is not only easy (Casiglia, 2012) but also spontaneous (Casiglia, 2025), which is also the basis of innate ideas (Casiglia, 2023), volition (Casiglia & Gadotti, 2026a), art (Cook, 2013), creativity (Casiglia, 2020, 2022), fine performance (Casiglia, 2025b; Casiglia & Tikhonoff, 2015, 2021; Tikonofff et al., 2012; Vercelli, 2015) and more generally of the ease in producing mental images (Casiglia, 2022) that not only represent reality (Casiglia, 2025) but perhaps are reality (Casiglia & Gadotti, 2026).

CONCLUSIONS

The study of hypnosis has been conducted to date through experiments that have investigated the phenomenology of trance and the close relationship between the mental images suggested during hypnosis and the physiological and neurophysiological changes that occur in the organism. These studies have demonstrated how hypnosis effectively acts at the receptor level on the organs, systems, and apparatuses of *Homo sapiens* (Casiglia, 2024; Casiglia & Gadotti, 2026). This article has proposed a model capable of explaining the phenomena that occur during hypnosis using Friston's free energy theory, whose validity has also been supported by using evidence from other lines of research that share a constructivist approach to reality and a view of the brain as a predictive machine. This has a dual scientific value: it establishes hypnosis as a useful tool for investigating consciousness and provides a mathematical model for implementing applications that can improve the effectiveness of hypnosis by integrating various technologies such as biofeedback, neuro-feedback, and transcranial magnetic stimulation. Studies along these lines are planned in the institutions where the authors work.

Table 1: The variables of the theory of Friston (Parr et al., 2022).

y	sensory data (observazions)
ϑ	the external states of the world (hidden cause)
m	the internal model of the system (the organism)
$q(\vartheta)$	The brain's internal representation of the world (recognition distribution)

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