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The Neuronal Mechanism of the Faith

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Abstract

Top-down processes overrode brain circuits devoted reading and detection conflict (the Stroop effect). Most of the time bottom-up information matches top-down expectations. If we imagine something different, so it is different. A number of recent brain imaging studies point to top-down brain mechanism under the influence of suggestion. By Kosslyn, brain scans show that the control mechanisms for detecting what to do in the face of conflict become uncoupled, when subjects are hypnotized. Top-down processes override sensory bottom-up information. Subjects think that sights, sounds, and touch from outside world constitute reality. But the brain constructs what it perceives based on past experience. We propose this process label as a neurobiological mechanism of the faith (in religious tradition "the Heart").

Keywords: Neuronal mechanism; Electrochemical activities; Brain

Neuronal Correlates of the Faith

At the beginning of the serious research of neuronal correlates of the faith were Snyder's experiments to boost creative intelligence through the transcranial magnetic stimulation (TMS) [1]. Subjects in experiments by Persinger, believe they felt the presence of God, and similar mystical experience. Subjects were exposed to a specific series of pulses from TMS, described feeling an invisible presence near them, or feeling connected the whole world. Persinger believes that the magnetic interference could be at the heart of such mystical experiences.

The perception and thought is based on the electrochemical activities in the brain. A magnetically stimulated reality or a natural reality, it makes no difference to the brain. Persinger also posited that the TMS could be used for trying to identify those fundamental algorithms, a series of specific magnetic pulses that correspond to a given reaction in the brain. Young used TMS to boost a creative function of the volunteer's brains showed a marked increase in creative skills [2]. When the right hemisphere of the brain, the seat of emotion, was stimulated in the cerebral region presumed to control notions of self, and then the left hemisphere, the seat of language, is called upon to make sense of this subjective entity, the mind generates a feeling of "sensed presence". A different subjects label this ghostly perception with the names that their cultures have trained them to use: Elijah, Jesus, the Virgin Mary, Muhammad, etc. It may seem sacrilegious to reduce God experience to a few synapses activity, but modern neuroscience isn't shy about defining our most sacred notions: love, joy, altruism, etc. Persinger's work practically constitutes a base for the grand unified theory of the otherworldly [3]. He believes cerebral fritzing is responsible for many mystical feelings, including faith in divine, and in the almighty too [4].

Fundamental algorithms of sensory transduction

Contemporary neuroscience suggests the existence of fundamental algorithms by which all sensory transduction is translated into intrinsic brain-specific code [5]. Direct stimulation of these codes within the human temporal or limbic lobes by applied electromagnetic patterns may require energy levels within the range of contemporary communication networks (a subharmonic frequency range at about 10 Hz, vary only by 0.1 Hz) [6]. A neurophysiological basis of consciousness is allowing that all experiences exists as correlates of complex and determined sequences of electromagnetic matrices. They could control the format of cognition, and also allow direct access to the most complex neurocognitive process associated with the sense of self, consciousness, working memory defining the subject within the brain.

The temporal patterns of potential codes relates to the temporoparietal lobes, the hippocampal-amygdaloid complex of the brain. Induction of complex information is possible due simulation of the resonance patterns created by sensory afferents [7]. Extraction and translation of neural patterns from different sensory inputs into common codes is within these regions before they are consciously perceived [8]. The information content of the wave structure rather than intensity is important for interaction with neural network. We propose the neurobiology of faith as one of the fundamental algorithms and by a brain-specific code define all the humans [9].

Neural stimulation of low-intensity complex magnetic signals

There are several studies founding that neural stimulation using low-intensity complex magnetic signals induce religious, mystic, spiritual experience which can have positive emotional effects as the altered states of consciousness. Within the hippocampal-amygdaloid complex, the amygdala functions support emotions, fear on the right, and positive emotions on the left. The hippocampus as a cognitive structure, the left is verbal, and the right is for the non-verbal communication (understanding "beyond words", music). The increasing hippocampal activity could have positive affective and cognitive effects ("thinking positively"). The hippocampus is strongly linked to the prefrontal cortex, whose activity is needed for the capacity of anticipating. The hippocampus is also involved in monitoring of person's inner state. Awareness, monitoring of outer states means a process of Darwinian selection of information from the subject's environment. The activities in these structures are raising the probabilities of spiritual, emotional and cognitive states of the faith. The statistical dominance of the left amygdala more pleasant feelings in spiritual, religious tradition is interpreted as "spiritual growth" [10]. Interesting coincidence of the death anxiety in human spirituality and limbic system functions has also his religions relevance, when one of the main functions of the different religions is the release from fear, death anxiety, etc. Other hippocampus function is contextualizes information. On the right, it does with non-verbal information, as well as experiencing events without "the inner dialog". In some spiritual, religious tradition of Asia it is interpreted as inhibition of "spiritual states". When the balance of activity shifts to the left amygdala, and right hippocampus is more active that its counterpart, subject experience an extreme positive affect, and shift to the positive cognitive style. This sudden dramatic episode might label as a "miraculous", "healing", or an "awakening", which contains the elements of a "sensed presence" experience, also as "meeting with angels". This hypothesis constitutes the basis of the Persingers's model of the "God Experience". Interhemispheric intrusions include some less dramatic phenomena, the more usual "sensed presence" experience, in which subject feels or senses the presence of another person, or an energy that feels "like alive". The right hemispheric homologue to the left hemispheric pathways that support the human sense of self, emerge into the subject's awareness experienced as an ego-alien-entity. The concept of vectorial hemisphericity and interhemispheric intrusions hypothesizes, that repeated stimulation of the left amygdala and right hippocampus allowing experience and learn to access the positive emotional and cognitive components of spirituality, as entrance to altered state experiences.

Posthypnotic suggestion operates through top-down mechanism

Experiments connected with Stroop paradigm is also indicating that posthypnotic suggestion must operate through a top-down mechanism of faith that modifies the processing of input words. Related neuroimaging studies indicated that the hypnotic instruction not to see color prevented activation of prestriate areas related to processing color. The processing of printed words [11] involves areas of the prestriate visual system (visual word form), the temporoparietal junction (phonology), prefrontal and posterior areas related to semantics. The instruction not to see the stimulus as a meaningful word influences above stream of information processing.

People who are susceptible to suggestion indicate that when they act on the suggestions, their brains show changes in how they process information. The suggestions, research reports, literally change what subjects see, hear, feel, and believe to be true (cross-modality, metaphorical thinking). The idea that perceptions can be manipulated by expectations, is fundamental to the study of cognition, said Posner. But now we are really getting at the mechanism. As sensory data is from bottom to top carried to the brain that creates a comprehensible, conscious impression. The surprise is the amount of processing from top to bottom, called feedback. There are 10 times as many neuronal fibers carrying information down as there are carrying it up. These extensive feedback circuits mean that consciousness (relations between feels and beliefs) is based on "top-down processing". What subjects see depends on a framework (situation) built by experience that is constructing the interpretation of stimuli. This could explain hypnosis, which creates such top-down processing that suggestions overcome reality.

Top-down processes overrode brain circuits devoted reading and detection conflict (the Stroop effect). Most of the time bottom-up information matches top-down expectations. If we imagine something different, so it is different. A number of recent brain imaging studies point to top-down brain mechanism under the influence of suggestion. As it told Kosslyn brain scans show that the control mechanisms for detecting what to do in the face of conflict become uncoupled, when subjects are hypnotized. Top-down processes override sensory bottom-up information. Subjects think that sights, sounds, and touch from outside world constitute reality. But the brain constructs what is perceived based on past experience. We propose this process label as the neurobiological mechanism of the faith (in religious tradition "the Heart"). "According to your faith will it be done to you" (Mathew, 9: 27-29).

The main characteristics of the faith is a trust

Another new step to the psychology of faith represents a finding of Kosfeld et al. [12]. The main characteristics of the faith is the trust. The neuropeptide oxytocin intranasally administered crosses the blood-brain barrier into the central nervous system and increases trusting behavior. The oxytocin influence is "a remarkable finding" means Damasio. He had previously argued that the hormone and neurotransmitter oxytocin acts somewhat as a potion. "It adds trust to the mix, for there is no love without trust". As of oxytocin, is a peptide consisting of nine amino acids, produced mostly in the hypothalamus, the brain's master-controller of biological

regulation, and "the emotional computer" (associated with the amygdala and nucleus accumbens). Oxytocin is triggering complex and specific action-programs, which overcomes the aversion to unfaithful betrayal. This is combined with the effects of reward that result from enhanced approach behavior. Oxytocin release in selected brain regions, based on an individual's genetic make-up, plus past experience, triggers a chain of neural events changing the probabilities of the future projection. Oxytocin modulates the activity of cognitive neural networks, resulting in enhanced trusting behavior. So, a high level of trust could be achieved due the excessive oxytocin release. The neurobiological mechanism responsible for our ability to trust by oxytocin specifically increases the individual readiness to accept social risks arising in interpersonal interactions. The results of Kosfeld et al. is suggesting an essential role of oxytocin as a biological basis of prosocial faithful behavior. Recent research by Heinrichs [13], one of the co-author of above study, has shown that oxytocin reduces anxiety, fear and enhances the stress buffering effect of social support associated with social dysfunctions (social phobia, depression, autism). In this way could help the religious faith to regain the social health of the individuals.

The mechanism of faith depends on oxytocin

The mechanism of the faith behind the effect of oxytocin might render subjects more optimistic about the likelihood of a good outcome. Leibovici made an experiment with adult patients to determine whether remote, retroactive intercessory prayer, said for a group of patients with a bloodstream infection, has an effect on outcomes. His results could support our hypothesis about positive effect trust, faith, self-suggestion of prayer on the healing process of statistically significant groups of patients.

Levels of oxytocin are found to be higher amongst people who claim to be "falling in love" and other forms of pair bounding, such as friendship, family relation, relation to such communities (religious), and increasing tolerance to pain, reducing anxiety, encouraging "tend and befriend", as opposed to "fight or flight" behavior in response to stress.

Oxytocin and oxytocin receptors are found in the heart, and play an important role in the embryonal development of the heart by promoting cardiomyocyte differentiation. Inhibits the development of tolerance to various addictive drugs (opiates, cocaine, ethanol/alcohol) and reduces withdrawal symptoms. From above experimental results we can hypothesize:

- To some resonance between function of oxytocin processing "falling in love" (friendship, family) in people, and in religious faith ("God is Love", "to be in transcendental love with Jesus Christ"),
- Ss analogy to function of oxytocin in the heart, during the religious faith, trust as "the Heart a highest spiritual center of the humans" (led by the arguments of "Reason", or by "the Voice of Heart").
- Correlation between role of the oxytocin in inhibition of tolerance to addictive drugs, and psychological role of living in religious communities resulting many times also in release of subjects from drug addiction through "the Faith in God". Thanks to the strong prevalence of a top-down processing, the humans are not far from characteristics of as a neuronal soul machine, or the neuronal faith system [14].

The violent persons have low level of faith

In contrary to the faithful thinking are the violent people with low level of faith, hope and trust. Researchers found that they are born with a tendency to violence. Their minds have less activity in the part of brain creating a sense of conscience and in an area acting as an "emergency brake" (the medial prefrontal cortex-MPFC), and the anterior cingular cortex (the ACC) deciding when trigger the aggressive emotions. As it showed Raine, the fact that there is an identifiable biological disposition suggests it's not on how the child was raised. It's that they had a biological dysfunction, combined with a situation that led to the violence. The use of brute-force strategies by the antisocial groups such as criminals, anti-semitists, skin heads, xenophobes, fascists, etc. is connected to tendency of violence, and to underdeveloped feedback of conscience.

Raine PET study results showed that the 96 murderers averaged 5.7 percent less activity in the medial prefrontal cortex (MPFC), and an average of 14.2 percent less activity in a part of the medial prefrontal cortex known as the orbitofrontal cortex ("conscience"), on the right hemisphere. The MPFC, located behind the forehead, has been shown in animal research to be involved in inhibiting the limbic system that produces aggressive behavior. The MPFC is like the emergency brake on the deeper areas of the brain involved in aggressive feelings. The orbitofrontal cortex, which is just above right eye, is involved in fear conditioning - the subconscious association between antisocial behavior and punishment, in humans is thought to be the key to developing a sense of conscience. A conscience is probably just a set of conditioned responses. The violent offender may have a brain dysfunction, a deficiency of monoamine oxidase A (MAOA), an enzyme that degrades amine neurotransmitters (maltreated children with a genotype conferring high levels of MAOA expression were less likely to develop antisocial problems). A similar effect is produced by, the MAOB, an enzyme which breaks down dopamine [15]. The less MAOB a subject has, the more the dopamine flows, and the more likely is to be a thrill seeker. Genes may play a part as well, the gene of D4 dopamine receptor acts as the novelty-seeking gene (which may play in science a positive role). It provides a code for dopamine receptor responsible for minimizing anxiety allowing a risky behavior. The states of fear or anger in the ACC and the left parietal cortex are correlated with transgressions of social norms. Violence is supported also with elevated testosterone, copper and reduced zinc blood levels compared to the nonviolent males, etc.

Reality of Faith, or Faith of the Reality?

(From Edelman's Neural Darwinism to Zurek's Quantum Darwinism)

The neurobiology of the faith is in good accordance with Edelman's concept of neural Darwinism. The theory of neuronal group selection (TNGS) is based on selective dynamical (on-line) links between distant neuronal groups through reciprocal connections called reentry. G. Edelman discuss its role in a dynamic model of memory. In his view, the memory is not simply localized in the brain, but is localized in the activation patterns of neural firings. In result, the total number of possible memory states increases astronomically. It is determined not by the numbers of nodes but the number of combinations of node activation patterns.

In his studies with magnetoencephalography, Llinás et al. discovered that a wakefulness and dreaming (REM sleep)-unlike dreamless deep sleep, are characterized by coherent thalamocortical oscillations at 40 Hertz. The difference is that the 40 Hertz oscillations are reset by sensory input during wakefulness but not REM sleep. We do not perceiving the external world while dreaming (stimulus coming from the environment is blocked). For Llinás, cognition is an intrinsic property of the brain which is not learned but "neurological a priori". Consciousness is based on simultaneity of activities in the thalamocortical system, i.e., a superposition of spatial and temporal mapping via thalamocortical resonant interactions [16]. Intrinsic oscillatory electrical activities, resonance and coherence are the root of cognition and self-awareness. Llinás views the brain as a self-referential system, a functional reality emulator construct the world, rather than reconstruct it. Sensory input modulates rather than informs the operations of the nervous system: we are basically "dreaming machines" that construct virtual models of the world. Most of the time we are daydream, i.e., we think about something what happened to us, or what we think about the other people, etc. Our brain is making a simplification of the external world. Science is a powerful mean to unveil what is really going on. Probably the medial prefrontal cortex (MPFC) may bind together the perceptions and memories and constructing this way the sense of self. Qualia are the part of self that relates back to us (the anterior insula). Qualia facilitate the simplifying patterns that increase the speed of decisions and the reentry. The mirror neurons mimic the experiences of the environment (the other humans). The mutual monitoring mustn't be symmetric, for example, the amygdala is projecting more to hippocampus, than vice versa. Or the top-down processing is much more intensive than the bottom-up processing, etc. The self is not a stable irreducible entity, however is a centralized top-down processing which construct predictions. The self is a construct based on the mutual information produced by interacting and monitored parts of the brain. As mutual information it exists only as a calculated entity, generated by emotional computer algorithms.

The brain is thermodynamically open, conscious perception is limited

In the states of concentration, praying, meditation, etc. there can be blocked the most of stimulus directed into the self-consciousness. The brain is thermodynamically open, only the conscious perception is limited to certain level [17]. During relative and temporal isolation of self-consciousness from the environment, are possible the states of superpositions carrying the human geniality states lasting only a limited time. But qubits are proved by scientist at Michigan University and helped to the first quantum chip. Chips are able technically stabilize the states of superposition, and it could led to about 2 times much quicker operations.

The capacity to predict the outcome of future events, critical to successful movements, is most likely the ultimate and most common of all global brain functions (algorithms). The self is the centralization of prediction. Top-down processes overrode brain circuits devoted reading and detection conflict. Most of the time bottom-up information matches top-down expectations. We can hypothesize that the self is a centralized top-down processing of our expectation's probabilities.

In the space of consciousness, as it has been formulated by Novak, the "real" is already a virtual. The difference between real and virtual is stochastic: a matter of probabilities. In a conventional sense, the real is that which is most likely. The faith, trust, hope as global signals can psychologically change the common structure of probabilities and stabilize neuronal formations that were previously unlikely as to be delegated to the realm of "dreams" and "miracles".

Quantum Darwinism: Propagation of the fittest information

Zurek's "Environment as a Witness" paradigm is connected to "real as most likely". It is showing how redundantly information about the system is recorded in the environment. Massive redundancy cause some information to become objective, at the expense of incompatible information. The process of "fittest information" propagation is the Quantum Darwinism. (Information about the system is obtained by measuring its environment. As we read this paper, we measure the albedo of the page, but actually, our eyes are capturing photons from the electromagnetic environment. Information about the page is inferred from assumed correlations between text and photons. The scientist gets information about the system by capturing and measuring a fragment of the system. The ensemble of states allows by capturing a small fragment to deduce the system state. Then the system state is objectively recorded. Information about the system is encoded in the environment and any majority subset of the system has nearly-complete information. The recorded information is unaffected by the loss of any minority subset. Only the total amount of encoded information change. More than half of the environment is required to obtain useful information.

The redundant imprinting of selected observables on the environment is Quantum Darwinism, which leads to objective

reality. As redundant information is classical, it can be obtained by many independent observers. Its selective proliferation is the essence of Quantum Darwinism. Purely quantum information represents incompatible observers with the pointer observable. To this information Quantum Darwinism selects against (so called counter-selection). Quantum information represents the non-preferred observables, marginalized by Quantum Darwinism, which can only be measured by capturing all environments. The non-redundant information represents a grey area, the border between the classical and quantum domains. The environment is a witness, a communication channel suggests to recognize that we gain practically all of our information indirectly, from the environmental degrees of freedom. In the Hilbert space an environment-induced super selection, redundancy appears, but the objectivity can arise through the dynamics of decoherence. The decoherence is the mechanism that delivers Quantum Darwinism. But we never directly bump into the system to measure its state. We actually use the environment that has bumped into the system to find out about it. Quantum Darwinism claims that we never observe the entirety of the environments. Subjects observe a fraction of the environment (a small part of all photons that have interacted with the page fall into our eyes). The pointer states are distinguished by their ability to survive decoherence, and can continue to be measured by the environment without suffering ill effects of such inquisition (in contrast to fragile superpositions). The environment plays an active role of amplifier selectively proliferating information about the system [18].

Conclusions

The research of neuronal correlates of the faith began with Snyder's the transcranial magnetic stimulation (TMS), and with Persinger's TMS experiments, when subjects believed they felt "the presence of God", "sensed presence", "unity with the whole world".

We propose that the magnetic interference could be at the heart of such mystical experiences.

We hypothesize the existence of fundamental algorithms by which all sensory transduction is translated into intrinsic brain-specific code within the human temporal or limbic lobes. They could control the format of cognition, and also allow direct access to the most complex neurocognitive process associated with the sense of self, consciousness and working memory that define the individual within the brain.

We propose that the neurobiology of faith as one of the fundamental algorithms by a brain-specific code defining all the humans.

The idea that perceptions can be manipulated by the expectations is fundamental to the study of cognition and faith. Now we are actually getting at the mechanism. Top-down processes override sensory bottom-up information. The brain constructs what is perceived based on past experience.

We propose label this process as the neurobiological mechanism of the faith (in religious tradition "the Heart").

The main characteristic of the faith is the trust. The neuropeptide oxytocin intranasally administered crosses the blood-brain barrier into the central nervous system and increases trusting behavior. Oxytocin is triggering complex and specific action-programs, and overcomes the aversion to unfaithful betrayal. Oxytocin modulates the activity of cognitive neural networks, resulting in enhanced trusting behavior [19].

We propose than the neurobiological mechanism responsible for our ability to trust due the oxytocin specifically increases the individual readiness to accept social risks arising in interpersonal interactions.

We suggest an essential role of oxytocin as a biological basis of prosocial approach behavior and the transcendental faith. Oxytocin reduces anxiety, fear and enhances the stress buffering effect of social support associated with social dysfunctions (social phobia, depression, autism). The religious faith could help to regain social health of subjects.

We propose that the mechanism of the faith behind the trust effect of oxytocin might render subjects more optimistic about the likelihood of a good outcome. It helps to overcome betrayal aversion in interaction related to the future's vision and his mission within a more optimistic top-down processed interpretation [20].

We suggest test our hypothesis of neurobiological mechanism of the faith for example in USA. The reason is that despite the good statistical results of America, polling suggests that people in Afganistan and Iraq are more optimistic about their futures than people in the United States [21].

We propose an experiment with the intranasal biomedical application of oxytocin spray to measure its increasing effect relating optimism and trust in the future. Than could be triggered a new national trust program (similar to social programs) to help the frustrated individuals to shift for more faithful attitude in identity perception and future predictions.

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