

Prefrontal Cortex in Meditation

When the Concrete Leads to the Abstract

A schematical hypothesis, concerning the participation of the logic for "logic relaxation"

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Abstract

Meditation involves, among others aspects, a state known as "logic relaxation". Some people may, therefore, consider a paradox the increase of the activation of the prefrontal lobe during meditation described in some studies. After all, this region is classically associated to logic, and should not be activated during the so-called "logic relaxation". In this schematical model, the authors point out the probable explanation with respect to these findings, while they encourage future studies of brain mapping involving the subject. According to this model, the higher activity in prefrontal lobe would be caused by use of the so-called "self-focus skill", an exercise of directing the focus of the attention, that it is especially important in the installation of meditating techniques.

Key Words: meditation, prefrontal cortex, logic, cognition

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Initially, the term meditation reminds us of an ancient spiritual practice, but it has gradually been considered by researchers in the Neuroscience area as a useful complementary procedure in Medicine.

Our group has published an operational definition for meditation involving, basically, five aspects (Cardoso, 2004). In accordance with this definition, a procedure is considered as meditation if it presents the following parameters:

A necessarily self-induced state (1), applied through (2) a specific technique (clearly defined), using (3) a self focus skill (coined "anchor"), intending (4) the "logic relaxation", and presenting (5) muscle relaxation somewhere during the process.

The self focus skill, which is present in all the techniques that we recognize as meditation, intends to keep all the attention unidirectionally focused. It can be a concentration (positive anchor) or a turning off (negative anchor) skill. Positive anchors may focus on one point of the body, a sound, and respiration, among others. Negative anchors are used in the perceptive-like techniques, being called "anchor of anchor absence". The most published technique, using a "negative anchor", is generally known as Mindfulness Meditation. However, the mindfulness meditation can be catalogued in the same operational definition mentioned above. In this kind of meditation a modified state of consciousness is achieved (associated to psychophysical relaxation), as well as it occurs in the concentrative techniques.

Moreover, the apparent "lack of anchor", that would exist in mindfulness is only an initial impression. In fact, this technique, in our opinion, uses what we call of "anchor of anchor absence" (or "negative anchor"), or either, in very simple words, the self-focus skill would consist of leaving the attention free to move itself in direction to any circumstantial event. Also, it was published an interesting operational definition of mindfulness meditation (Bishop, 2004). This definition, if carefully read, does not contradict what it is presented here, therefore, the authors consider two basic components: self-regulation of attention and orientation to experience. If we could perceive the subjective meaning of the text, we would see that is about a very subtle anchor, therefore when the practitioner loses the characteristic psychophysical state, he must to "return to the anchor" (orientation to experience).

The term "logic relaxation", at first seems paradoxal. However, this is probably the most subtle aspect of meditation. This term would involve three aspects: (a) not "to intend" to analyzing (not trying to explain) the possible psychophysical effects; (b) not "to intend" to judging (good, bad, right, wrong) the possible psychophysical effects, and; (c) not "to intend" to creating any type of expectation regarding the process. Through this stratagem, the individual obtains not to become involved in the

stream of thoughts that appears during the meditative practice.

We can say that, basically, a meditation technique is a simple duet that involves the "anchor" (self-focus skill) and the "logic relaxation". The individual will gradually exercise his capacity of being "focused in the anchor". At the very moment he perceives himself involved in the stream of thoughts, he will immediately return to be "focused in the anchor". But if he, despite his "intention to" maintain the so-called "logic relaxation", he perceives himself involved in the stream of thoughts he will – again and again – "return to the anchor" (figure 1).

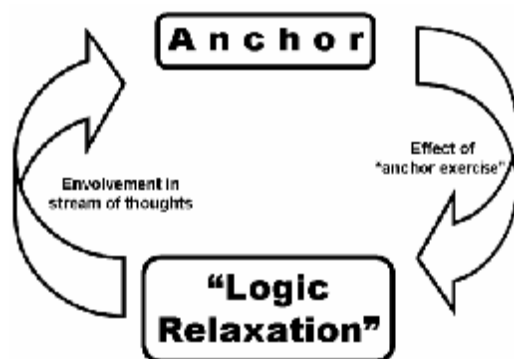


Figure 1. The base of a meditative exercise. During meditation, all the attention should be kept in self focus skill, so-called anchor. This artifice allows so-called "logic relaxation". When the apprentice perceives himself involved in thoughts, he should return all his attention to the anchor.

Recently, the NIH's NCCAM (National Institutes of Health – National Center for Complementary and Alternative Medicine) published a text in which meditation is presented as a procedure to be utilized in Health interventions (NCCAM, 2006). In this

paper, the "anchor" is cited as "focus of attention", and the so-called "logic relaxation" is cited (in certain way) as "an open attitude". According to this paper, an "open attitude" involves "...letting distractions come and go naturally without stopping to think about them. When distracting or wandering thoughts occur, they are not suppressed; instead, the meditator gently brings attention back to the focus. In some types of meditation, the meditator learns to observe the rising and falling of thoughts and emotions as they spontaneously occur...". Amongst the references, citing the papers that had given base to this text, our operational definition is pointed (Cardoso et al., 2004).

Naturally, the term "logic relaxation" raised some questions by some members of the scientific community. In fact, it is hard to figure out a technical procedure (any one) put into practice without the aid of the logic. Some neuroscientists argued that "...it is not clear that during meditation there is no purpose or expectation (of course we can have the belief, although unfounded, that we have no purpose or expectation) because, at the very minimum, we have the expectation of remaining in the meditative state for a few minutes and the expectation that the state will end at some time. We cannot forget that we are meditating..."

The strongest argument of commentators, however, was the following

question: *"...Can we expect that our prefrontal cortex (heavily involved with plans, expectations, working memory and attention) just stops working during meditation? Is there any proof for this expectation?..."*

These arguments, of course, generated a few insights in our group. After all, some papers had demonstrated, in contrast, a higher activity in the prefrontal region during meditation.

In an interesting study, Lazar et al. were able to obtain, through functional magnetic resonance imaging (fMRI), a brain mapping during meditation (Lazar, 2000). Among other results, they found a higher activity in the prefrontal region during the meditative practice.

However, we do not believe that results as these can contradict our operational definition. In contrast, they could be explained through it. Remembering our operational definition, we can notice that one of its components involves a self-focus skill (anchor), and this can be demonstrated by the activity of the prefrontal cortex. The activity detected in this region can be the functional expression of the exercise of "anchor". The "anchor" is a self-focus skill, which can be represented by a sound, by an image, a concentrated attention in a given part of the body, etc. Through a continuous exercise, the apprentice improves his capacity of keeping himself "focused in the anchor". At the very moment he perceives himself involved in

any kind of thoughts, he will immediately return to be "focused in the anchor". This is the most important practical principle of the meditation.

Some studies have demonstrated that the prefrontal cortex could have a basic participation in the "necessary attention for fulfillment of a task". In 2001, Allegri & Harris present a review on the role of the prefrontal cortex in both memory and attention processes (Allegri, 2001). The evidences mainly showed that the activation of this region, especially of the dorsolateral prefrontal circuit, seemed to mediate the executive actions, mainly the activities that we could mention as of "control through the attention". Kane & Engle, in 2002, presented a critical review about the role of the prefrontal cortex in working memory capacity, executive attention, and general fluid intelligence (Kane, 2002). They had confirmed the impression that dorsolateral prefrontal cortex circuit is critical to executive-attention functions. An architectural model of the prefrontal cortex function was presented by Koechlin, Ody & Kounelher, in 2003, pointing out its role in "...co-ordinating thoughts and action in relation with internal goals..." (Koechlin, 2003).

These findings can be compatible with our ideas. Using our operational definition, we can see that one of the components involves the self-focus skill ("anchor"), and this is in agreement with the activity of prefrontal cortex.

"Keeping the anchor" requires attention and to "keep attention" requires activity of the prefrontal cortex. The "anchor" demands an intense effort of the apprentice, or better, from the apprentice's prefrontal cortex.

In 2002, Fuster showed an interesting pictorial study about the frontal lobe and the cognitive development (Fuster, 2002). He determined the lateral prefrontal cortex as the basic element in the temporal organization of goal-directed actions, including the participation of working memory in the executive activities. Based on these arguments, and returning to our operational definition, we can say that the effort "to keep the anchor" would be similar as to put all the plans such as working memory and attention – all the "logical" activity – in a "head of pin". We come across here, perhaps, with the highest "secret" of meditation and it may be the principal object of study of brain researchers in protocols using meditation, once they apply an adequate operational definition.

The great "conceptual knot" is the fact that meditation is, actually, an abstract activity. However, even the abstract aspects of a task can involve the participation of the prefrontal cortex. Cools, Clark & Robbins applied, in 2004, functional magnetic resonance imaging during the performance of volunteers in attentional tasks, demonstrating the capacity of the lateral prefrontal cortex in transforming an abstract task into a

concrete action (Cools, 2004). In our opinion, this seems to be, essentially, the function of the "anchor" in meditation: to function as a bridge, between the concrete and the abstract. Or either, through a specific technique (self-applied), becomes fulfilled an abstract task (intend the "logic relaxation") through a concrete task (keep the "anchor"), allowing a specific state of psychophysical relaxation. We could say that, concerning its practical application, meditation involves two components. The first one: "exercising the anchor", or either, the meditator exercises his capacity "to return to the anchor", every time he perceives himself distracted by thoughts. This step probably explains the increase of activity in the prefrontal lobe. The second step (obtained after the first one) is the "logic relaxation". This one would probably be responsible for explaining the other alterations in cerebral activity. Of course, these components have no specific borders, but this didactic division seems basic to correlate the future findings of brain mapping without thinking that "meditation is only an exercise of logic".

Once understood this technical sequence of events, we can note that only after an increase in the activation of the prefrontal cortex would the "keeping the anchor" exercise be fully established. The next stage to be reached is the so-called "altered state of consciousness", in which it would be configured a standard cerebral activity, characterizing the "meditative

state". These arguments are corroborated by Dietrich (2003), who presents the hypothesis of a transient prefrontal cortex deregulation, denominated "transient hypofrontality" (Dietrich, 2003). This would be the major event in the altered states of consciousness. As Dietrich says "...transient hypofrontality is the unifying feature of all altered states and [...] the

phenomenological uniqueness of each state is the result of the viability of various frontal circuits..."

Based on such arguments, we present here a schematical model that intends to establish a hypothesis concerning the probable participation of the prefrontal cortex in meditating techniques (Figure 2).

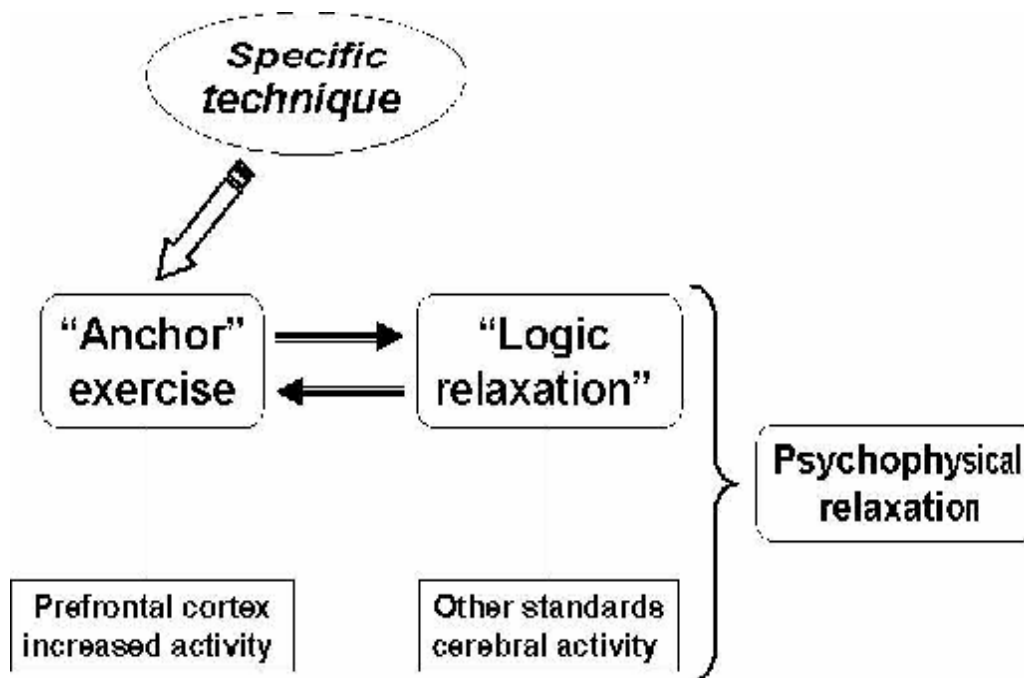


Figure 2. A schematical model, to establish a hypothesis concerning the participation of the prefrontal cortex in meditating techniques. The anchor exercise allows the "logic relaxation" (arrow to the right). Eventually, "logic relaxation" is lost. At this moment, it is necessary to concentrate the efforts in the "anchor" (arrow to the left), one more time. In these situations, the apprentice frequently lost the concentration in the anchor. These events tend to repeat, each time in more distant cycles. The psychophysical relaxation is obtained.

In accordance with this model, a meditating exercise presents the following steps:

a) Definition of the specific technique (the instructor presents a clearly explained technique to the apprentice; the explanation includes the anchor, which will be specifically used in this exercise).

b) Application of the "anchor" exercise (increased activity in the prefrontal cortex),

c) "Logic relaxation" (other standards of cerebral activity, still to be better studied).

d) Loss of "logic relaxation" (possibly associated to an imperfection in the anchor exercise).

- e) Higher effort in the anchor exercise (obtaining again the "logic relaxation").
- d) Repeated cycles of the previous events, with time intervals more and longer.
- e) Psychophysical relaxation (gradual and partially simultaneous to all the process).

Despite all these arguments, someone could still ask how the logic could help to reach the "logic relaxation"? After all, some facts presented in this paper do not seem necessarily linked between themselves. We could answer by stating that meditation is an "impossible mission". Trying to focus all the attention in the anchor, trying to focus all the logic at only one point, is something that might be impossible. In the effort to try to fulfill this outstanding task, we would achieve the modified state of conscience that meditation allows. But this would be the highest phenomenon in the meditative state. It is almost inexplicable. In this paper, we have tried to explain some psychobiological aspects of meditation. However, in final instance, the meditating

experience may be a phenomenon beyond habitual explanations; a "quantic manifestation".

Obviously, we must recognize that the term "logic relaxation" is referring to a technical stratagem and not yet to a well-recognized pattern of cerebral function.

This very simple model does not intend to encompass the cycle of studies concerning the cerebral activity during the meditation. On the other hand, we hope that such a model serves as inspiration for future researchers aiming for new information.

The increasing interest concerning meditation as a complementary procedure in Medicine, associated with the current resource of functional magnetic resonance imaging will, no doubt, open a new track in this field of Neuroscience.

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