

## Neuro Psycho Physio-Pathological and Neurochemical Aspects of Feeling Angry

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### ABSTRACT

This paper is a first approach to the relationships between our brain structures and other parts of our body which are relevant in the angry behaviors and reactions. We analyse the different parts of our brain involved in the dynamics of anger and their role, at the neurochemical and neuroendocrine levels. We also focus on some important typical body-language signs of angry people and we will develop some ideas about it, based in our clinical practice. Finally, new subject matters concerning changes in the body temperature in several emotional states will also be presented.

**Keywords:** Anger, Brain, Body-Language, Body Temperature

*"Anger is a poison that we drink but hope others will die"*

William Shakespeare

*"The anger you may have for your fellow men is a supreme testimony of mental inferiority that will, sooner or later, burn the "entrails of the soul".*

(Unknown author)

### INTRODUCTION

Since our most remote stages, emotions are a basic part of human life and have played a major role in our evolutionary pathway [1]. Emotions are an important component of our affective life, and therefore are closely linked to affects, which have been traditionally divided into two major categories, positive and negative [2-4]. Along with fear and sadness, anger is one of the most relevant in the area of the negative emotions [1,5]. In this point we should try to gain a greater insight of what is anger, what body mechanisms are involved in its dynamics and what kind of damage it may cause to us.

### Anger

Anger is, unfortunately, one of the most prevalent emotions in modern life, whether it is well hidden within us, appealing to a strong capacity for self-control, or expressing itself violently verbally, physically, surreptitiously or mixing all these components [6]. It is usually associated with other emotions or feelings, such as aggression proneness, envy or hostility [7, 8].

In these times of confinement and social restrictions, people present greater levels of irritability, higher levels of negative emotions and conflict situations appear more frequently, what leads to a great number of situations where anger is present.

Although some people say that anger is a feeling that sometimes bothers the "provocative agent", and may even cause feelings of guilt [8, 9], we think that, if that is the case, it will be true in a very small number of cases. Also, many authors indicate that anger attacks in general will not last more than 15 min [10, 11] which in our point of view is another fallacy, since in our practice we have seen crises that have lasted far beyond a quarter of an hour. Anger often goes "side by side" with other pernicious ways of feeling and acting like hatred, contempt, mobbing, bullying or envy. It can be seen as a reaction of people who are subjected to high levels of pressure, or have feelings of

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incapacity and jealousy towards successful others who surround the angry person, since (s) he cannot reach them and starts to nurture hostile feelings for these people, for not being able to level with them. And what happens in our body when the anger strikes? It is a rather complex subject, but of great interest [12]. Therefore, we will analyse what happens in our bodies, the mechanisms involved at different levels, but making clear that this is just a part of the anger phenomenon, which comprises other levels, such as the psychological features of the individuals and their personality.

### Anger and brain structures

There are several brain structures involved in anger attacks, as well as in other manifestations of marked aggression: the hypothalamus, the amygdala, the septum and the orbital prefrontal cortex [13, 14]. These structures are all intimately interconnected, and are a part of the limbic system, either in a direct way (hypothalamus and amygdala) or more indirect (orbital prefrontal cortex). The activation of these structures can occur under various circumstances, and the manifestation of anger can result from a wide variety of situations, and the behaviours associated with it do not differ essentially from those triggered by fight responses under stress situations [8, 9]. We should bear in mind that the limbic system is the root of our emotional life, but that does not mean that it is a passive system which only reacts to external stimuli. In effect, several characteristics (e.g. hostility) are closely related to anger as a trait [4, 12], and in such cases, anger responses are more frequent and have a lower threshold of manifestation.

### Neuroendocrinology of anger

At another level, the adrenal glands are also involved in anger attacks. Adrenal glands are endocrine glands surrounded by a fibrous capsule and located above the kidneys, and are a part of the HPA axis, a fundamental structure involved in response to stress. Therefore, it is not surprising that in situations where anger is predominant, these glands will secrete abundant flows of stress-related hormones as cortisol, adrenaline, noradrenaline and dopamine (if produced in excess) [10,15]. It is a well-known fact that one of the possible responses to stress is the fight, which corresponds to an attack behaviour, where aggressivity is high, and this mechanism is also activated during an anger attack.

### Neurochemistry of anger

But that is not all. Still in the field of the neurochemistry of anger, it seems that anger is modulated mainly by the nucleus accumbens, a region in the basal forebrain rostral to the preoptic area of the hypothalamus, a nucleus leaning against the septum and a part of the reward pathway[1,7]. This nucleus is

involved in a wide variety of responses, some of them generating pleasure and affectionate Behavior, while others are on the basis of impulsivity, according to stimuli and the nature of their connections[16-19]. These effects take place through the dopaminergic and glutamatergic or glutamate systems, which are the most excitatory neurotransmitters in the brain and possess high toxic power, and are controlled by others such as gamma-amino-butyric acid (GABA), which possesses a strongly inhibitory nature[17,19,20]. This way we can understand why some dopaminergic antidepressants (e.g. Bupropion) and psychostimulants (e.g. Amphetamines) given in excess can become anger enhancers and antipsychotics (e.g. Quetiapine) and mood stabilizers (e.g. Pregabalin) can exert depressant effects on that situation.

We should point out that there are much more organic phenomena which correlate with these situations of anger, from the simple tantrums to the more violent situations where physical or verbal aggression is present. Therefore, despite the limited scope of this approach, we should mention some more relevant aspects, at another level, the autonomous nervous system (ANS).

### Anger and ANS

We will now approach the fundamental role of the sympathetic and parasympathetic nervous systems in anger. It is known that in normal conditions the nerve fibres of the sympathetic and parasympathetic systems secrete two main neurotransmitters, Norepinephrine and adrenaline and Acetylcholine. Therefore, the fibres that produce norepinephrine activate adrenergic receptors and those that secrete acetylcholine activate cholinergic receptors [21]. However, on this specific matter we can say, as a "serious joke", that in a situation of anger the sympathetic nervous system becomes unpleasant since it is through its involvement in the process that "angry" individuals may be at risk, more or less, serious and even fatal [22,23]. As typical signs of this sympathetic hyper function we can see tachycardia (arrhythmia), dyspnoea, sweating, increased blood pressure, bronchial dilation, retraction of motility of the large intestine, contraction of blood vessels, increased peristalsis of the peristalsis arise oesophagus, pupil dilation and piloerection [21,24].

Almost a century ago, Walter Cannon (1927) later associated with his PhD student Philip Bard, understood that these reactions, originating in the brain, can protect us from stress and prepare us to choose a "fight or flight" reaction in the face of a threatening or stressful stimulus. However, if taken to extremes, it can become quite a maladaptive response. As an example of this, a crisis of anger where the "fight" component reigns in an exacerbated form (and not with the purpose of consciously escaping stress but to react exothermically to it), will often causing damage to others, and the neuro-psycho-vegetative whirlwind may be so intense that the individual in his reactive gallop may have an acute dysautonomia, namely in terms of cardio-respiratory

function and come to a stop which risks may increase and become irreversible causing death, especially if there would already be underlying cardiac pathology [22,24]. We shall assume, for academic purposes, that an anger crisis will not last, on average, more than 15 to 30 min. However, during that relatively short period of time, given the psychophysiological changes that take place, a multiplicity of dysfunctions occurs in the body [24,25], some of which may endanger health or even be fatal.

**Anger and body language**

Let us now consider in detail some aspects or the main body language, cardio-vascular and respiratory answers in presence of an anger response.

**Nostrils:** they open up - which allows and facilitates an additional supply of oxygen, which will serve as “fuel” for organs and muscles in case we need to fight or flee.

**Eyebrows:** The brow furrows and the eyes get smaller (mydriasis) which makes the forehead look bigger, in accordance with the fight reaction. In times of intense anger, some individuals describe loss of peripheral vision.

**Jaws:** They are closed, what is compatible with an increase in testosterone levels.

**Teeth:** They are displayed, in the manner of the apes, showing the enemy that we are capable of biting (a phylogenetic reminiscence?)

**Cardiovascular system:** Uncontrolled increase in heartbeat frequency (sinus tachycardia, pathological arrhythmia, possible cardiac arrest in extreme situations).

**Respiratory system:** Dyspnoea of variable severity.

**Neuro-Muscular Complex:** Contracture of one or more muscle groups with or without motor incoordination.

**Brain:** Several structures are activated:

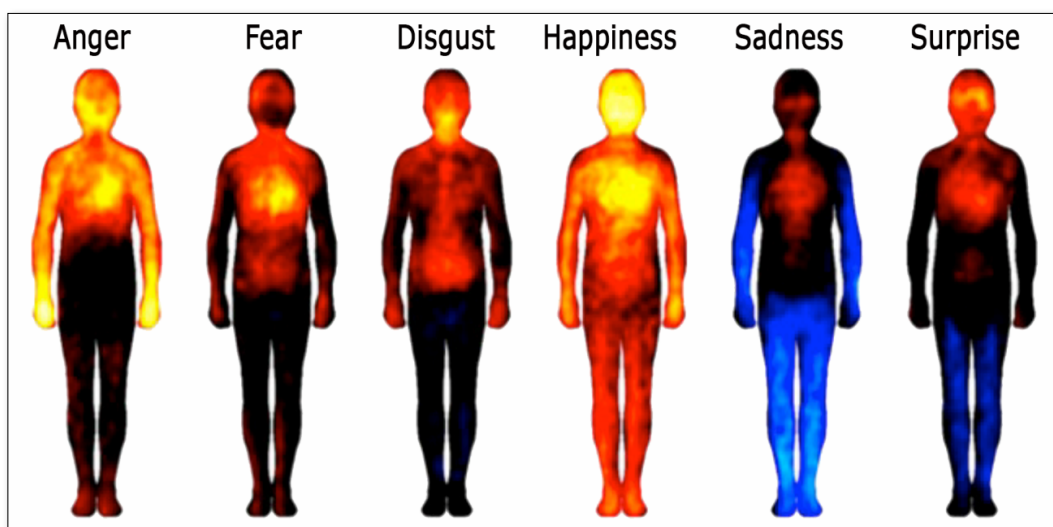
1. **Hypothalamus:** responsible for physiological responses: racing heart, sweat, red face. The blood goes to the hands rather than the legs - preparing us to fight, not to run.

2. **Amygdala:** assesses the reaction according to what was seen or heard and decide whether the individual will choose to flee or fight, the latter being compatible with situations of anger.

Pre-frontal cortex - Corrects possible errors and determines our reaction. Above all, it tries to control the most primitive responses (punches, screams) and then the most complex ones, influenced by moral issues. Rarely successful in situations of anger.

**Body temperature**

In this approach of anger, we would like to make a mention about the investigations about body thermal responses according to our emotional state [26] where anger is one of the human states contemplated. In a series of studies where infrared thermal imaging [27,28] was used, Nummenmaa and colleagues mapped the human body in terms of thermal reaction to several positive and negative emotions—anger, fear, disgust, happiness, sadness and surprise (**Figure 1**). There, it is clearly visible a manifest systemic endothermic reaction, reflecting the situations that generate anger. In our opinion, these studies, although promising, need further improvement.



**Figure 1.** Thermal mapping of emotions [26].

## CONCLUSION

In this study we tried, in the most informative and clear way to summarize the content of this complex subject, as are all those related to the human mind and its anatomical-physiological correlates. As mentioned above, there is much more to say but we hope to have settled the basis for further approaches in this area.

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