The motivation of non-sentient living beings seeking pleasure. The concept of life.

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Abstract

Introduction

The question of the motivation of living beings has interested people since ancient times, but most research is dedicated to human motivation. It is likely that understanding human motivation requires starting with the study of the motivation of the simplest forms of life, and only then moving on to evolutionarily more complex organisms.

Discussion

This work describes a theory of motivation based on the pleasure principle, a functional model of the motivation organs of living beings, and the probable structure of the pleasure indicator in living biological organisms. The theory is developed based on considerations of the functioning mechanism of the hedonistic motivation system for non-sentient organisms, whose only form of pleasure is physical enjoyment. The foundation of this theory includes the 'Pleasure Principle' of Sigmund Freud and the 'Law of Effect' of Edward Thorndike.

Results

A comprehensive theory of motivation for non-sentient beings has been developed, explaining the mechanisms of memory formation and instinct control in non-sentient beings.

Within the framework of the theory, the following hypotheses are described:

- Hypothesis of 'Motivation Based on the Pursuit of Pleasure'. Explains the relationship between pleasure and motivation in this theory.
- Hypothesis of 'Pleasure'. Explains the mechanisms of pleasure.
- Hypothesis of 'Motivation'. Explains the mechanisms of motivation in non-sentient living beings as a whole.
- Hypothesis of 'Increasing Priority'. Explains the mechanisms of memory consolidation of a being's response that led to achieving the goals of motivation.
- Hypothesis of 'Decreasing Priority'. Explains why non-sentient beings change their reactions to external stimuli if these reactions do not achieve the goals of motivation.
- Hypothesis of 'Motivation Based on Pleasure' for Biological Organisms. Explains the curved shape structure of the hippocampus in non-sentient beings. This curved shape is necessary for indicating pleasure by measuring the decrease in the frequency of impulses entering the hippocampus.

Theoretical background

1. Hypothesis of 'Motivation Based on the Pursuit of Pleasure.'

To describe the theory, subjective definitions of concepts are used:

- Pleasure – Positive feelings caused by satisfying needs. It is the goal of motivation from the perspective of hedonism[1].
- Motivation – The operational scheme of an organism to achieve motivational goals[2].
- Motivation based on pleasure – The operational scheme of an organism aimed at obtaining pleasure.

Thus, when discussing motivation based on pleasure, we are talking about two concepts or operational schemes:

- The scheme of pleasure indication, as the organism must determine that it has received pleasure.
- The motivation system that changes the behavior of the organism after receiving pleasure in order to apply the proven scheme of achieving pleasure in similar situations in the future.

Furthermore, if such schemes exist and operate in living beings, there must be parts of the central nervous system responsible for this. Let's call them:

- Pleasure Indicator;

- Motivator.

1.1. Hypothesis of 'Pleasure'

Pleasure – Positive feelings caused by satisfying needs.

Sigmund Freud's well-known pleasure principle states that all living beings instinctively seek pleasure and avoid pain.[3]

This principle aligns with the main principle of Hedonism[4], which states, 'pleasure is the highest good and the purpose of life,' if only considering humans. Since this work exclusively concerns non-sentient beings, the concept of 'moral pleasure' is beyond its scope. Understanding physical pleasure is better through examples when we experience pleasure:

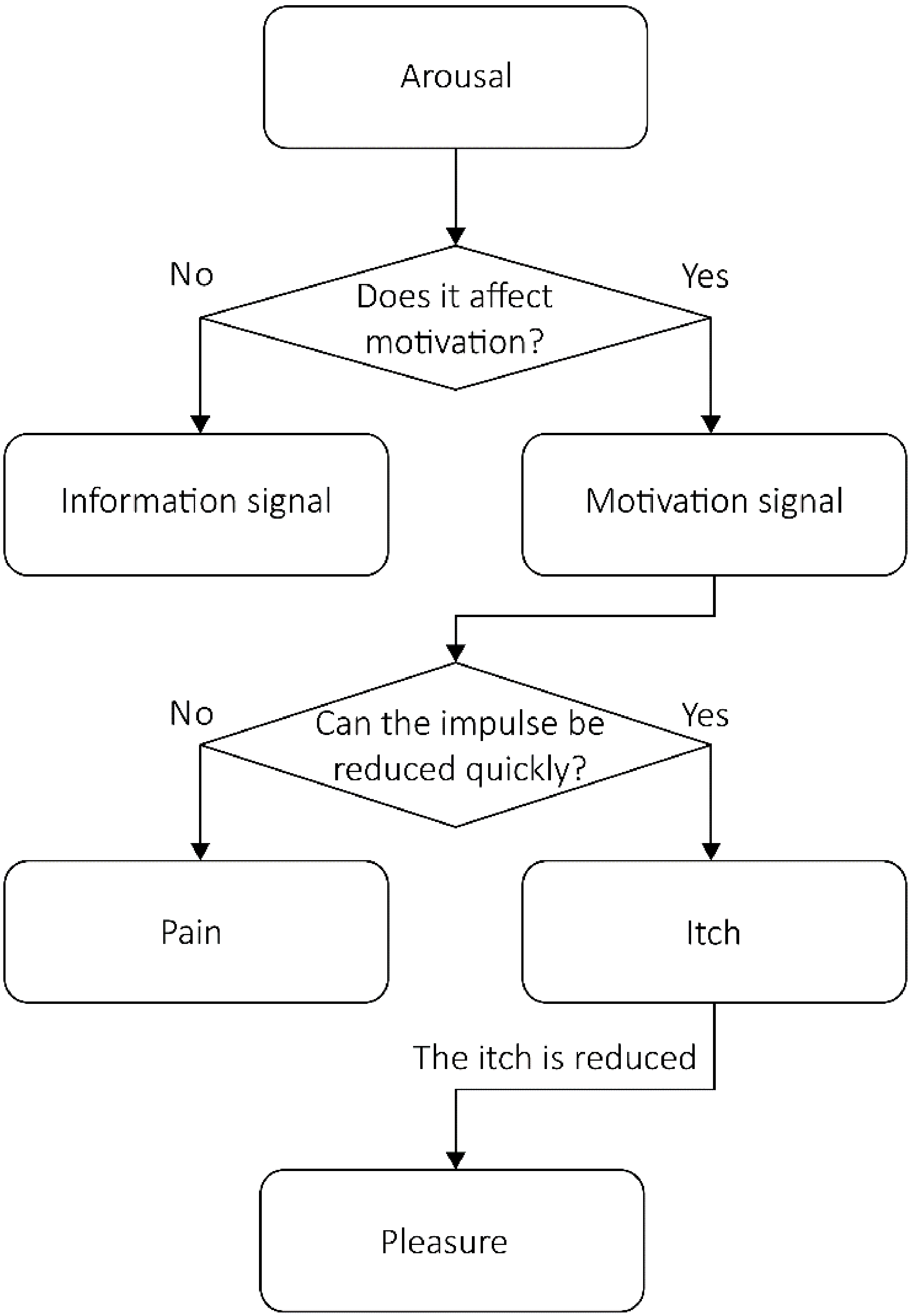
Pleasure from eating when we are hungry;

Pleasure from inhaling after a long breath hold;

Pleasure from scratching a mosquito bite.

In all cases, pleasure is a process associated with the cessation of a certain irritant. From this, we can conclude that there are irritations (receptor impulses) that can be reduced, and the process of reducing them is called physical pleasure. If there are receptor impulses that can be reduced by acting on them, it is logical to assume that there are impulses that cannot be reduced by acting on the source of irritation. Such impulses cause negative sensations and are called 'pain.' Impulses that increase upon acting on the source of irritation or on their own are commonly referred to as 'acute pain.' For example, doctors may perform palpation of a patient to find the source of pain. Acute pain is a result of the increase in receptor signals to the motivation organ. It is also logical to assume that there exist impulses that are not initially irritating – informational impulses. For example, impulses received from sensory organs. Such impulses do not change the behavior of the organism on their own, but only through acquired experience. However, at a high level (very bright light), informational impulses can become a source of irritation or pain.

In general, the impulse scheme based on the 'pleasure principle' looks as follows (Fig.1):


Arousal
No
Does it affect motivation?
Yes
Information signal
Motivation signal
No
Can the impulse be reduced quickly?
Yes
Pain
Itch
The itch is reduced
Pleasure

There are 3 types of arousal:

1. Informational (does not affect motivation);
2. Itch (can be reduced quickly);
3. Pain (cannot be reduced quickly).

The process of reducing itch brings physical pleasure.

That is, if pain is an unreducible receptor impulse, then pleasure is the result of reducing a receptor impulse. This is why pain can be very prolonged, and pleasure from a specific action relatively quickly ends.

Prolonged pleasure can be a result of repeatedly reducing the signal of recurring itch, for example, the pleasure from scratching a mosquito bite. After the action, the impulse decreases, but after a second it returns, sometimes with greater intensity.

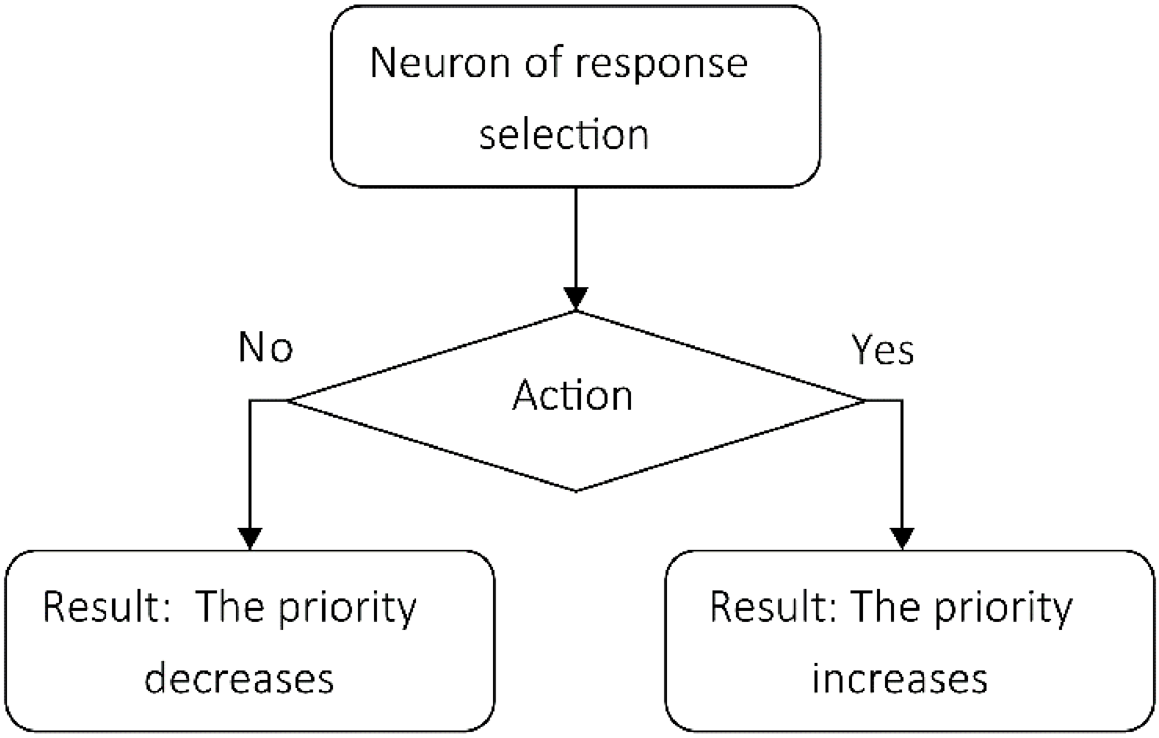
1.2. Hypothesis of 'Motivation.'

Motivation – The operational scheme of an organism to achieve set goals[5].

To describe the concept of motivation, Edward Thorndike's 'Law of Effect' is used, which states, 'Responses (schemes) that produce a satisfactory effect (achieve set goals) in a particular situation are more likely to occur again in that situation.[6]

To describe the increase in priority, E. Thorndike uses the concept of 'Reinforcement' in his work. If the scheme does not achieve the goals of motivation, then a decrease in priority occurs (In Edward Thorndike's work – 'Extinction'). The result of decreasing priority influences the choice of an option in such a way that the likelihood of its execution under the initial conditions is reduced.

Operational Scheme of Motivation Based on the 'Law of Effect' (Fig.2):



1.2.1. Hypothesis of 'Increasing Priority.'

The result of increasing priority – This influences the choice in such a way that the likelihood of its execution under the initial conditions is increased. This means that the organism must remember this scheme better than before the reaction. Since long-term potentiation mechanisms are responsible for memory, this means that increasing priority is the strengthening of long-term synaptic connections that participated in implementing the scheme. [7]

1.2.2. Hypothesis of 'Decreasing Priority.'

In his work, Edward Thorndike writes that if you train a rat to get food by pressing a lever and then disconnect the lever, after some time, the rat will press the lever less often. Or, for example, if a creature needs to get to food, it is likely to try to go directly first. If this attempt was not successful, then the likelihood of another direct attempt should be reduced, and the creature should try other schemes to solve the problem. Repeated mechanical repetition of actions without changing the context, aimed at achieving a result but not yielding results, may indicate the absence of action options or the absence of a mechanism for decreasing priority.

If a non-sentient living organism has no response scheme to a specific stimulus, then the motivation system may suggest engaging all known schemes in a trial-and-error order.

2. Hypothesis of 'Motivation Based on Pleasure' for Biological Organisms.

Thus, to avoid changing already adjusted schemes, increasing or decreasing the priority, depending on the results of the scheme's operation, should only affect those neuronal connections that were involved in the implementation of a specific scheme. That is, if a being experiences pleasure, it should retain in memory all recent actions by transforming short-term memory into long-term memory. Considering that the neuronal connections involved retain short-term synaptic plasticity, we are talking about changing short-term synaptic plasticity to long-term synaptic potentiation[8].

Summarizing everything described above, if a living biological being uses the achievement of pleasure as motivation, then it must have an organ that changes short-term potentiation of synapses, which were used immediately before achieving the goals, i.e., could participate in the implementation of the scheme, to long-term potentiation.

If biological living organisms have an organ indicating pleasure, then it is possible to try to describe the part of the functional system responsible for its operation:

The organ should give a signal to the motivation organ when indicating pleasure, i.e., there must be at least one input for impulses and at least one output.

This organ may be present in a single number. It is also possible that there are several such organs. In this case, all copies of the organs must have a similar structure, and the result of the influence of each part must be spread to all impulse outputs. Otherwise, the overall interaction scheme of effectors will not be able to operate with any receptors, and only those receptors associated with this pleasure indicator will be available to it.

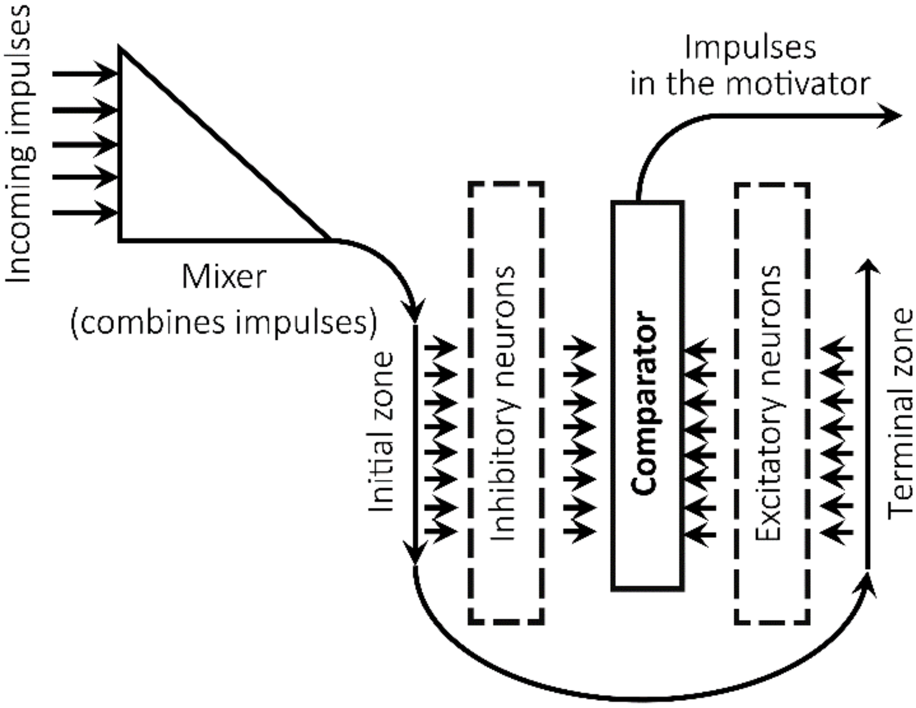
Since the same action can cause a different result of receptor activity, reducing itch in one area and increasing pain in another, this organ must measure the change in the overall strength of the total impulse of all incoming impulses.

Since measuring the strength of impulses from a large number of axons compared to one is difficult to implement, the first part of the organ should be a kind of mixer that sums all incoming impulses and outputs a general impulse to the pleasure indicator. Given that all synaptic impulses in the brain have approximately the same indicators in terms of voltage, when adding them up, they will output an impulse with higher voltage, which can lead to cell death. It is logical to assume that this mixer should combine impulse frequencies, rather than their voltage. For example, if there are 10 synaptic connections at the input, each transmitting one impulse per second, then there should be one synaptic connection at the output with a frequency of 10 impulses per second. It is possible that the impulses from nociceptors are transmitted more frequently than those from informational receptors. Ultimately, we end up with a bundle of unidirectional neurons transmitting an impulse from one part of the chain to another.

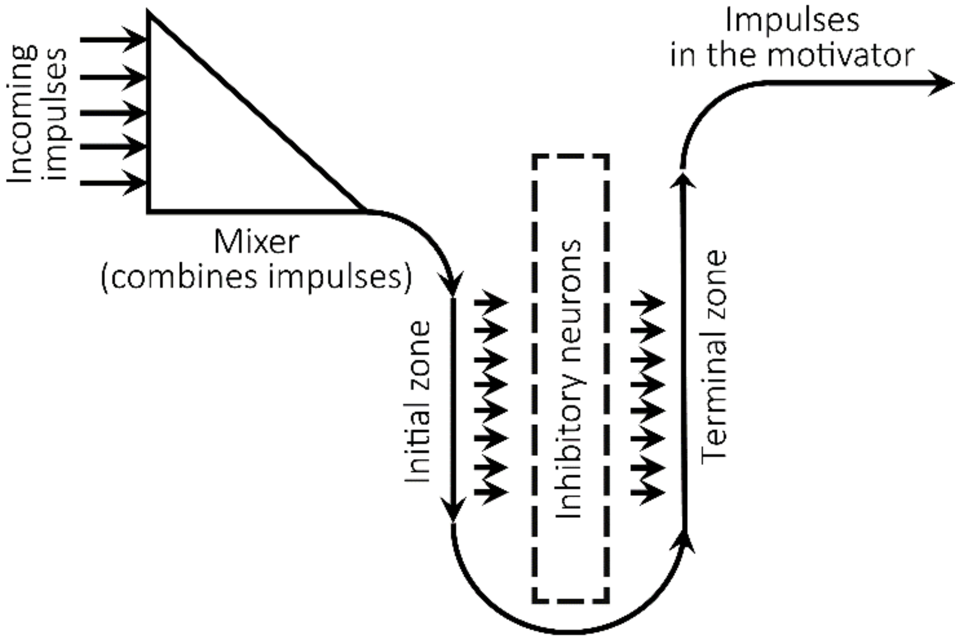
To measure the change in impulse frequency in different parts of the chain, it is easiest to bend it into a loop, then the initial and final parts of the chain will be opposite each other.

To measure the frequency of impulses between two chains of neurons, it is necessary to place some kind of frequency comparator between them, the indicators of which will increase from the impulses of the final part of the chain and decrease from the impulses of the initial part of the chain. When reaching a positive value, this organ should send a signal to the motivation organ. A simpler evolutionary variant is possible if an inhibitory effect of the initial section on the final one is created.

Approximate Scheme of the Pleasure Determination Organ (Fig. 3):

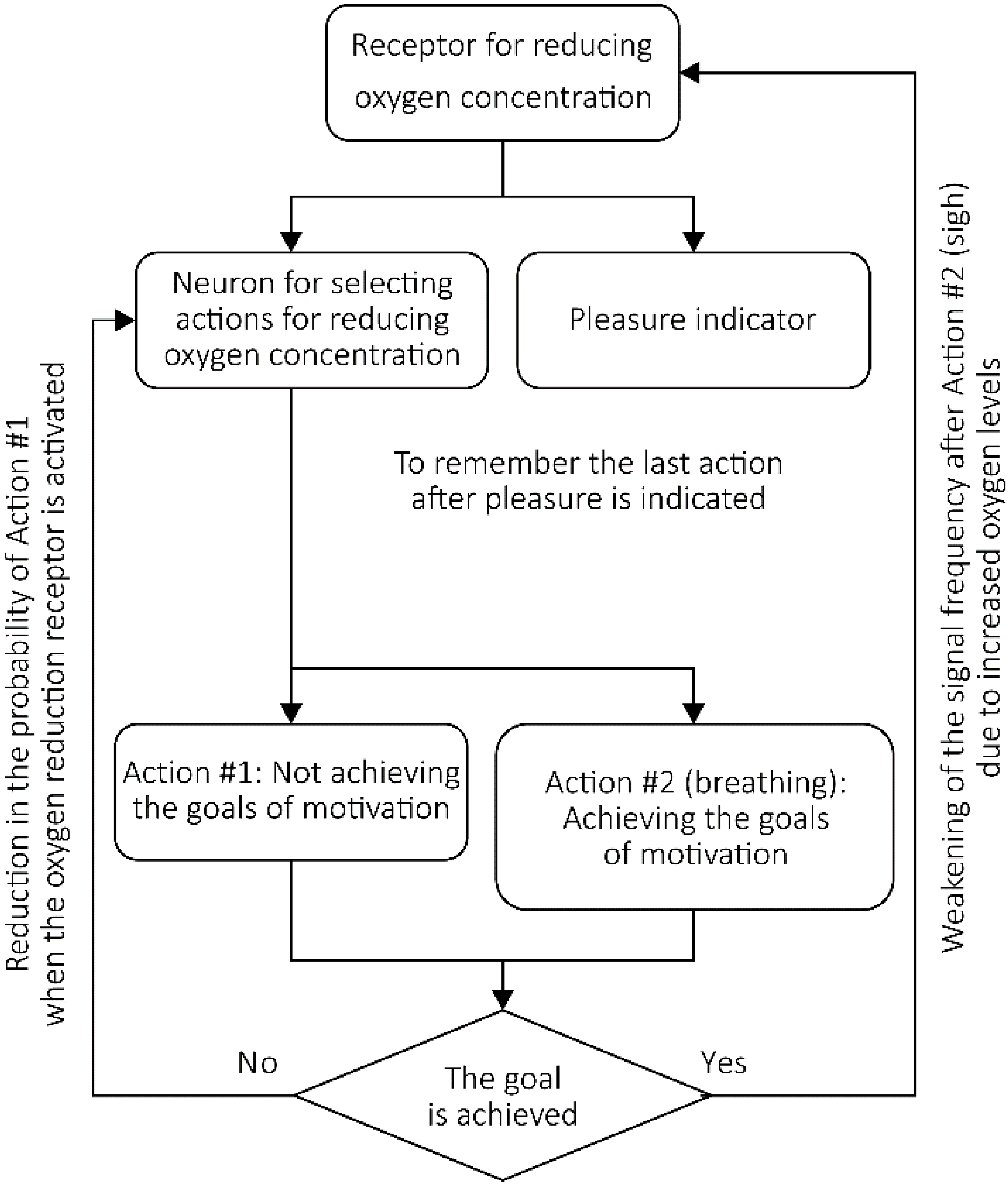


A simpler evolutionary variant:



2.1. Modeling the Operation of the General Motivation Organ.

A simplified theoretical model based on a single neuron of the motor cortex with one dendrite from a receptor for lowering oxygen concentration and two axons to effectors, one of which activates the inhalation muscles (Pic. 5).



Iteration №1 (not leading to the desired result):

- When the oxygen level in the blood decreases, the low oxygen level receptor starts sending signals to the CNS.
- The CNS activates action №1.
- The pleasure organ does not note a change in the signal.
- Over time, fatigue from action №1 occurs, and its priority in the action choice neuron is reduced.

Iteration №2 (leading to the desired result):

- When the oxygen level in the blood decreases, the low oxygen level receptor sends signals to the CNS.
- The CNS activates action №2, as its priority has become higher than action №1.
- The pleasure organ notes a drop in the signal and gives a signal to fix the instinct or reflex.

2.2. Searching for Biological Analogs of Organs.

If this theory is correct and there are organs of motivation based on pleasure in the bodies of animals, it can be assumed that the ‘motivator’ is the dopamine system. Recent research indicates that the dopamine system[9] can change short-term potentiation to long-term potentiation. The hippocampus, which controls the dopamine system[10] and along with the dentate gyrus, has a curved shape[11], can be the ‘pleasure indicator’. In addition, the hippocampus responds to high-frequency stimulation[12]. To confirm the hypothesis that the hippocampus functions as an indicator of pleasure, additional experiments are needed to study its response to a sharp decrease in the frequency of stimulating impulses.

Conclusions

A motivation system for living organisms based on the pleasure mechanism has been developed, which involves finding ways to reduce receptor signals and reinforcing those methods that lead to this reduction. Despite the fact that this theory is only applicable to non-sentient beings, it opens up the possibility of integrating a motivation system into existing neural networks. The discovery of CNS parts responsible for pleasure and motivation, or proof that the hippocampus serves as a ‘pleasure indicator’ and the dopamine system as a ‘motivator’, will mark another milestone in the study of motivation in living organisms and lead to the exploration of the next evolutionary stage – the motivation of sentient beings.

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