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(Review Article)

Phenomenology of perception, from stimuli to their interpretation

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Abstract

Receptors systems are our window on the world, the tools that relate us to the outside world and allow us to orient ourselves in all the activities that are fundamental for our survival.

Thanks to the receptor systems we have the awareness and consciousness of human beings and have acquired the knowledge of the world in which we live.

Receptors have a fundamental role to play in the birth of culture and the science of peoples.

In addition to having an informative function of environmental conditions, the receptors perform an important protective and defensive activity for the living.

In fact, they have the ability to make us recognize useful substances from harmful ones based on their organoleptic characteristics, color, smell, flavor, favoring the consumption of the first, preventing that of the second.

They also form a second protective barrier at the level of the cell membrane by selecting the entry of unnecessary and potentially harmful substances and preventing their absorption through selective cellular channels.

By means of channel proteins and ion exchange proteins (for example sodium-potassium), they maintain the optimal concentration of solutes in the cell.

Finally, they guide the intra and interspecific relations between all living beings, from plants to man.

We owe our existence to the reception systems.

In this article we are going to examine the receptor systems describing the importance they have had in the evolution of the living and we are going to critically discuss the most recent theories proposed by quantum mechanics to explain their functioning.

Keywords: Biology and quantum mechanics; Wave systems; Stimuli and sensory systems; Receptor molecules

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1. Introduction

1.1. The limits of quantum biology

To discuss the theories on which quantum mechanics is based to describe at the molecular level the functioning of sensory systems it is necessary to know the fundamental laws and postulates that form its rational framework.

The fundamental quantities that form the matter of quantum physics, space, time, magnetism, electric charge, gravitational field, electromagnetic waves, etc. are immaterial entities, of which we can feel the effects, but they are not immediately materializable in the real world.

We feel the sound waves, we see the electromagnetic waves of the visual spectrum, just as we feel the gravitational waves in the weight of material objects, but we cannot grasp them, manipulate them.

Quantum physics has defined them as fundamental quantities and forces, and postulates them as the causes of perceived physical phenomena.

The laws and formulas that form the corpus of quantum physics, are consequently transpositions of natural phenomena adapted to the language of mathematical formulas, to the cognitive and technological resources we have, to be processed and used at our convenience.

The immanent dualism between the events of the material universe and their mental representation through quantum mechanics, is the basis of the inconsistency and abstraction of the human sciences, as the story of epistemology tells.

The long path of scientific discoveries, is paved by this eternal conflict between natural events in continuous evolution and their mental representation, and by the impossibility of describing them with rules and "laws" able to materialize them, measure and reproduce them faithfully [1] .

How it is possible to represent immeasurable quantities and to establish dimensions, properties, structure and temporal evolution, only by means of their perceived manifestations, only quantum physics believes it can do it, but it does it again, representing them in arbitrary language, abstract, self-referential mathematical formulas produced for its use and consumption.

The path of scientific research,has followed a different path from the real world, creating two parallel and separate dimensions, which like the geometric lines, also postulated and never proven, will never meet .

Therefore mathematics, physics and the exact sciences in translating natural phenomena and the results of experimental observations into theories, must follow a different and transient path than the real world, and be willing to modify laws and theories formulated, to adapt them to the results of new experiments.

There is nothing so transitory and changeable as the laws of nature, and it is the unexpected events and discoveries that force us to review and correct the theories accepted up to that moment, and that is what happened with the last revolution in quantum mechanics.

It’s incredible that scientists don’t have the awareness of the huge gap, and even today never surpassed, between scientific theory and the reality of the continuous becoming of the physical world.

The reality of the material world precedes and surpasses fantasy and theory.

There are also many insuperable barriers that hinder our ability to know the universe, one is inherent in the universe itself, with the infinite degrees of variation and the continuous expansion that manifests.

The other is related to our technology, which is not able to provide us with sufficiently powerful tools, to examine and know the universe in its essence.

Finally, the more difficult last barrier, impossible to overcome, is inherent in the limits of our biological constitution, in our sensory systems and systems, brain included, which are the only channels that can relate to the physical world, and as ineffective tools cannot return its true essence.

I have challenged any theoretical physicist or scientist to prove otherwise.

In access epistemological/ scientific debate on the properties of matter, the only viable way is to attempt an empirical approach, more anchored to material reality and based on the description of natural events as we perceive them.

Matter and energy are complex real entities and as such, not reducible to simple abstract quantities or describable with mathematical formulas, from which they would seem instead to draw life and substance. The equations of quantum mechanics can allow, but only theoretically, the formulation of physical phenomena, but certainly cannot replace them.

Within such a conception there is no room for determinism, everything is indeterminate and strictly unpredictable, only probabilistic theory can be useful in examining random events.

Assuming that all physical phenomena are subject to the domain of variously postulated magnitudes and fields, as they support quantum mechanics and general relativity, they must necessarily act by means of effector material entities, to make them possible.

According to this assumption, then the fundamental role in the mechanism of natural phenomena is played by these material entities, postulated as particles immersed in the fields in which they manifest themselves.

1.2. Molecular biology and the basics of life

We have defined life as the behaviour of complex molecular systems.

Atoms and molecules or macromolecular complexes report their presence as they interact with other material entities.

But in order to interact they must exist and take on properties that are physically recognizable both as unitary elements and in the form of complex multiple aggregates.

Every single material entity must be able to be characterized and recognizable by its own morphological and energetic content, which is unique specific and unmistakable. This characteristic that we could define as the "molecular mold" or "footprint or morpho-energy code" unit, can be assimilated to the footprints left on different materials from the fossil remains that reproduce the faithful structure of ancestral organisms, Figure 1. To the unique molecular footprint for individual molecules, also corresponds their frequency color, taste, odor that produce to be recognized by the specificity of receptors.

Figure 1 Example of a Paleolithic cast -Ammonite -From Wikipedia

Thus characterized material substances can interact, and take different shapes and sizes in an infinite number of combinations.

And that’s what we see in the universe.

But universal matter is not immutable, precisely because it can interact and eventually aggregate with different material entities, is constantly changing and able to generate new combinations and experience states of aggregation with unpredictable properties and characteristics.

It is in this way that celestial bodies, galaxies, etc. of the universe were formed.

On our planet, the same material entities have created a particular form of matter that can reproduce, evolve and maintain a constant homeostatic balance with its environment to which it must continually adapt, with the continuous exchange of substances.

Molecular complexes that respond to the properties described with these characteristics have been named Life [1].

2. The molecular elements that make up living systems.

We have distinguished some complex molecular systems present in all living, are Proteins, Carbohydrates, Lipids, Nucleic Acids, Water, Trace Elements.

All these molecular systems share the same characteristic, they are formed by a set of equal or different molecular units for each class of belonging (monomers), which with their aggregation can give rise to a number of infinite combinations (polymers).

So for example proteins are formed by the combination of 21 amino acids, carbohydrates are formed by the combination of simple sugars (Aldosis, ketosis), lipids derive from the esterification of different fatty acids, etc.

Living forms from the most elementary to the most complex are formed by the combination of the molecular systems described.

The reason for their necessary co-existence in living systems depends on the activities which each of them must exert on the others in order to produce functionally effective unitary sets.

Let us examine individually only the essential molecular complexes that form the structural part of receptors, biological membranes and associated proteins, leaving out the other classes of compounds as less directly implicated.

2.1. Lipids and biological membranes

Lipids perform essential functions in the living, in addition to representing one of the most important forms of food and energy reserve, are fundamental in the formation and maintenance of internal and external cell walls and represent the substrate organizer of protein complexes immersed inside [2]. They also perform the task of protection recognition and communication within and between cells. [3], [4] .

Sufficing it to mention their essential role in nerve transmission and conduction.

The cell membranes are formed by a double phospholipidic layer Figure 2, assume within biological systems the role of containers, organizers and dynamic stabilizers of the protein molecules they carry, to form functional complexes. Within the cell membranes proteins can be arranged in sequences ordered to perform individual metabolic stages that together ensure the functional homeostasis of living.

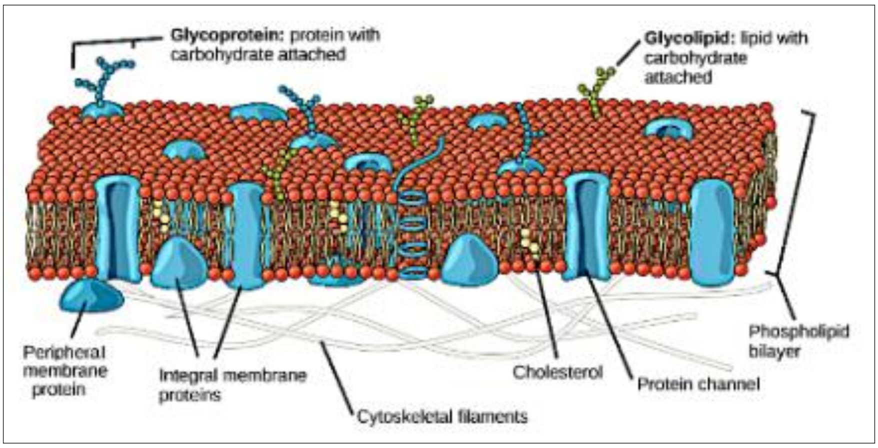


Figure 2 Scheme of cell membrane - From Khan Academy

The two phospholipid layers have an asymmetric conformation, not static but dynamic, with the possibility of sliding of one phospholipid layer on the other, according to the functional needs they must fulfill.

The bond between proteins and the membrane can be very strong so as to form functional units that can group into functional contiguity in separate areas of the membranes.

Cellular membranes are elastic and have the ability to incorporate substances or eliminate them using specific invaginations, endocytosis, exocytosis.

2.2. Protein

Proteins with their structure express the maximum degree of morpho-functional freedom possible, by virtue of the constituent elements, the amino acids, and the type of covalent bond that they form, the peptide bond, which allows infinite combinations Figure 3 .

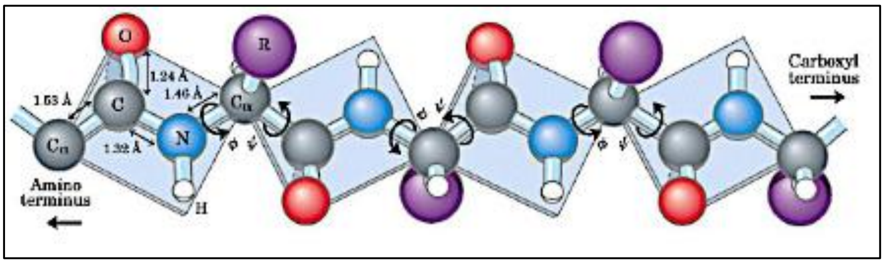


Figure 3 Peptide bond - From structure of protein on web

The conformational structures that can assume are two: alpha-helix and beta sheet.

Due to their high structural and conformational formability, they are able, better than any other molecular complex, to adapt to environmental stresses, and to other molecules with which they enter in functional combination, for example, in receptor complexes.

They also have the ability to adapt to complex functional systems of which they form an integral part, as in cell membranes, in enzyme complexes, in structural constituents (cytoskeleton) and countless other examples that could be mentioned.

A fundamental aspect of their plasticity is due to the fact that their spatial conformation, (secondary structure, tertiary and quaternary) simply changes by replacing any amino acid with another, or by changing the sequence of the same amino acids Figure 4.

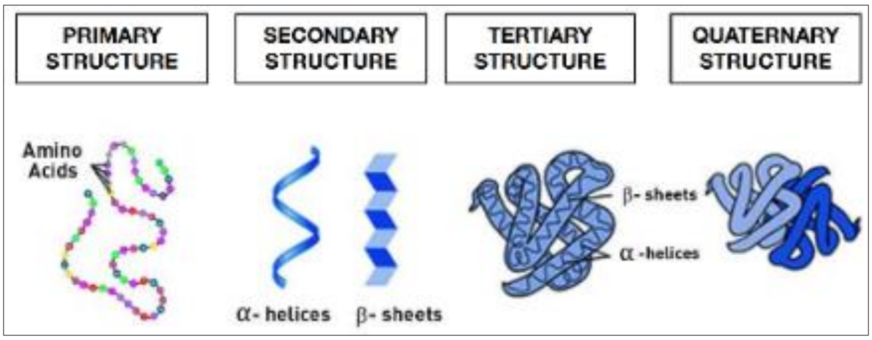


Figure 4 Schematic representation of protein structures - From toppr, Biomolecule
https://www.toppr.com/guides/chemistry/biomolecule/structure-of-proteins/

Functioning at their best, proteins enter the constitution of morpho-functional complexes normally linked to cell membranes, for example, in the cell membrane form receptors and ion channels, in the endoplasmic reticulum form ribosomes, in the inner membrane of the mitochondria form the respiratory chain, etc.

By their presence they have characterized the functional properties of the cell membranes to which they bind. Moreover, as we are going to see below, they have the property of adapting structurally and functionally to the stimuli from which they are solicited. For example, the various receptors present on different cell membranes, light, sound, pressure,etc. or to chemical stimuli, hormones, neurotransmitters, odorous substances, etc., and with their conformational change, they transmit information to the effector organs.

The long evolutionary history of living systems has produced the specialization of the different protein structures present in the cells, to respond effectively to environmental stimuli, and facilitate the exchange of substances with the external environment.

3. Evolution of sense organs

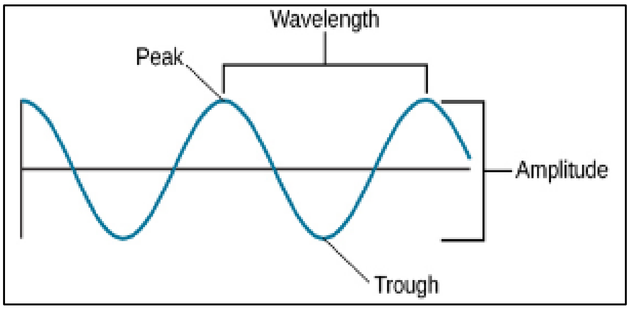
The fundamental transmission system adopted for information at the universal level is wave-like, as quantum mechanics claims.

Waves have the property of transmitting the maximum amount of information contained within a single physical size.

The information contents of the waves are: amplitude, length, frequency, energy, direction (have an origin and follow directions in all dimensions of spacetime).

The types of waves present in the universe are electromagnetic waves, sound waves, and gravitational waves . Each of which is able to transmit specific information based on the size and properties of the material that produces it. Figure 5.

In their essence they are vibrations that originate from molecular aggregates and are transmitted according to the quality and intensity of their energy-wave content and the space-time direction.



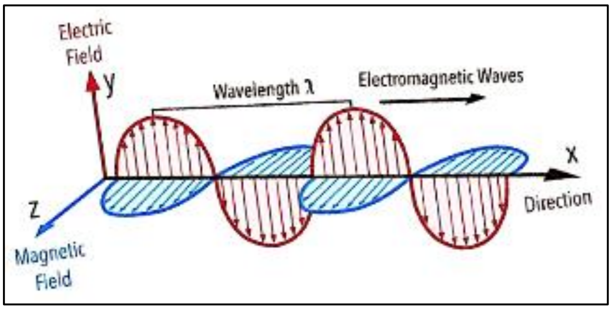


Figure 5 Drawings of Waves - sound (left) and electromagnetic (right)

Thus the electromagnetic waves have transmitted information already described (length, amplitude, frequency, direction) plus the energy associated with the particles carrying (electrons, neutrons, photons, gravitons), sound waves have dimensions and energy content of a mechanical type that depend on their origin and the medium in which they propagate, finally gravitational waves have an energy content dependent on the total mass from which they originate (stars, planets, planetary systems, etc.) .

The large celestial bodies present in the cosmos, stars and planets, emit both electromagnetic waves and gravitational waves.

4. Organoleptic properties of substances and receptor systems

4.1. Sensory organs and protein receptors.

Each atom have a unique structure different from all the others, consisting of the infinitesimal space that occupies the surrounding environment and we can associate it to a mold, the imprint that imprints in space, which we have already talked about.

Another unique property that every atom possesses and emits an electromagnetic spectrum, due to the vibrations produced by the kinetic movements of the atomic structure that characterize them.

In fact it is possible to record for each atom a typical electromagnetic emission spectrum, in the absence of atoms or subatomic particles no electromagnetic spectrum can exist.

In the updated description of sensory systems, modern biologists and physicists have adopted the laws borrowed from quantum mechanics, to provide a suggestive and exhaustive interpretation of the intimate mechanisms that regulate its operation.

In truth the interpretation has been provided only for some of the sensory systems, and the fundamental rules of their functioning have been defined, as for the chlorophyll synthesis, for the mechanism of vision and smell, or that of the orientation of migratory birds and even for consciousness, the higher cognitive function of man, has been explained in quantum terms, etc. These theories have represented a remarkable qualitative leap compared to molecular biology, that has not been able to explain any of these phenomena [5-8].

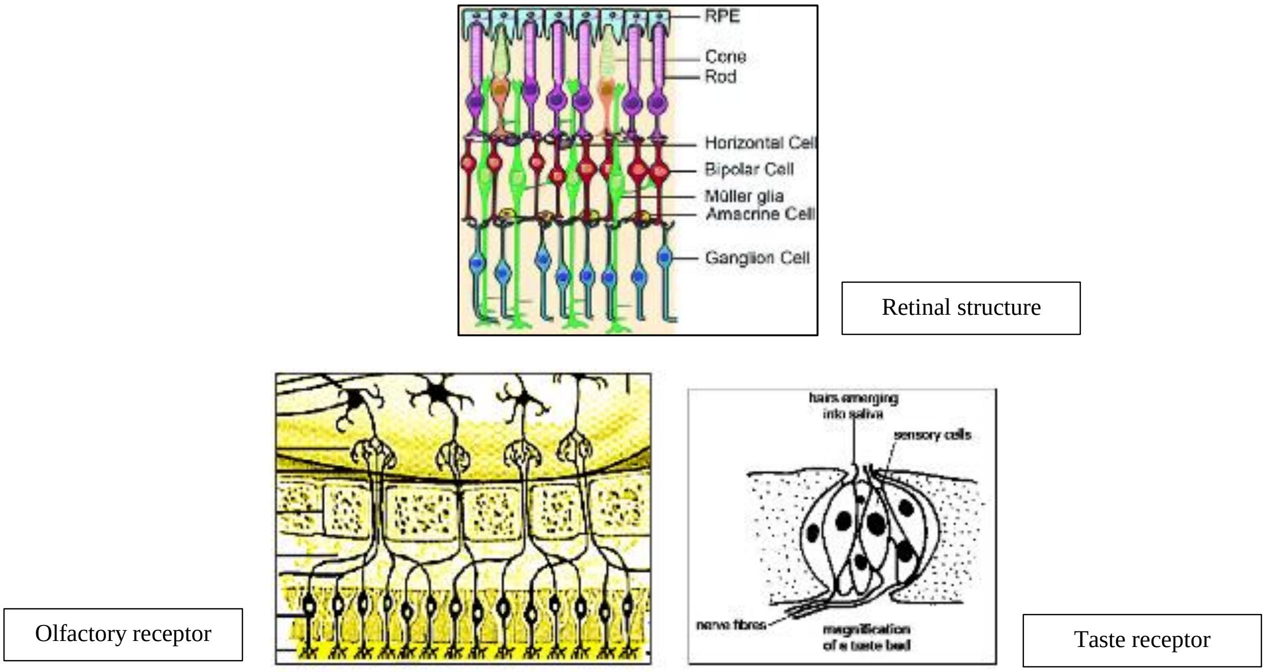


Figure 6- A schematic diagram of different receptors

The basis of the theoretical basis of these phenomena is the alchemical division between waves and particles, in the sense that the properties of the processes described are attributed to the frequencies that enter into resonance between emitting molecules and receiving molecular complexes.

Various resonant molecular complexes that come into play in different communication systems have been called into question, from time to time, such as the terrestrial magnetic field on the *cryptochromic* bird receptors [9-10], the microtubules of neurons [11] Chlorophyll structures and so on.

Some studies have shown the presence of olfactory receptors also in ectopic tissues [12].

The hypothesis proposed with this article is that protein receptors represent the true functional core of the sensory organs, in the form of molecular complexes are able to change their conformational state in response to the wave/particle type stresses they receive and produce the start-up of the relevant biological effect, channel opening-closing, signal transduction, activation or inactivation of enzyme complexes, etc.

The sensory organs are formed by specialized cellular structures that constitute the scaffold that collects and conveys environmental stimuli to specialized receptor proteins, the final effectors, capable of translating stimuli into nerve transmission. Receptor proteins perform this task by modifying their conformation in response to specific wave stimuli.

This category includes the receptors of chemical stimuli within the body (hormones, neurotransmitters, metabolites, etc.) or external to it (odors, tastes, etc.) Figure 6

Observing the receptor molecules present in living beings, one is astounded by the degree of structural specialization achieved to respond to specific stimuli, Figure 7.

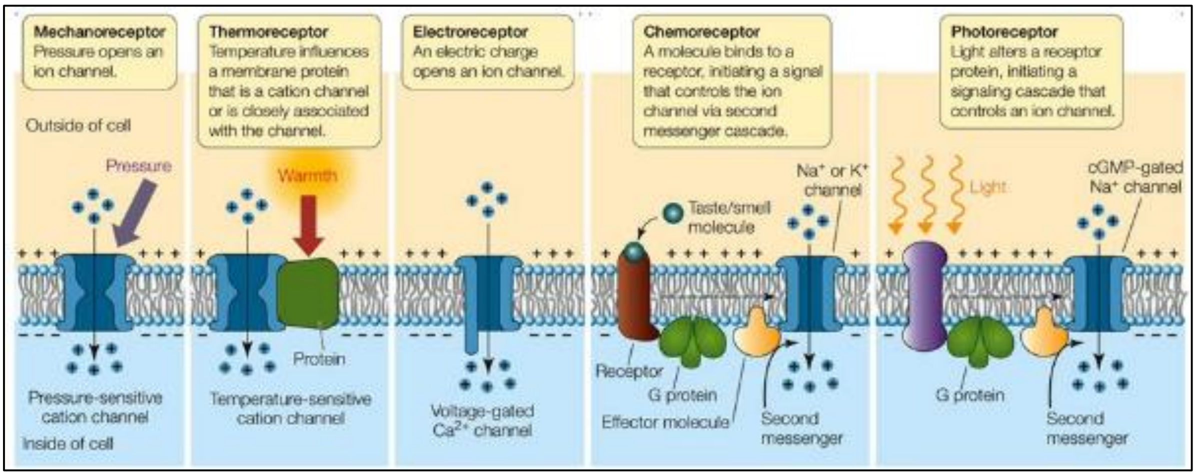


Figure 7 Schematic diagram of specialized receptor molecules to respond to various stimuli

And you understand why they play the fundamental role of the sensory transmission system.

As mentioned above, these proteins have adapted extraordinarily to the stimuli they must receive, whether of an electromagnetic or mechanical nature, by transmitting the information to the parts of the cell or nervous system that must process it.

In addition, they are under the strict control of the genome, and a point mutation in the genetic code on which their synthesis depends is enough to irremediably compromise their function.

Recent studies have confirmed the nature and fundamental importance of receptor proteins, an entire issue of the journal Biochemistry and Biophysics Acta has been devoted to this topic [13].

In this regard, I am going to report what was said in an interview by Annika Barber, biologist at Rutgers University on the interactions between receptors and ligands: "First of all, something must enter a certain protein site precisely, then the arrangement of the protein atoms is changed, which then does what it has to do."

This is a further confirmation of the corpuscular nature of stimuli, which with their molecular footprint, take on a fundamental aspect equal to or greater than the frequency spectrum they emit.

This explains why evolution has selected such specialized forms of receptor proteins and why they are perfectly complementary to the stimulus they need to recognize, so that during their coupling they can perfectly adapt to the seat where the contact takes place. The mechanism is similar to that of substrate enzyme interaction, with which the substrate adheres sterically to the active site of the enzyme.

In addition to the qualitative aspect of stimulus-receptor coupling, there is also a quantitative relationship both with the number of receptors activated and with the intensity of the stimulus, and is the reason for the increasing density of receptors recruited in the sense organs in response to growing stimuli.

This is the general rule for all sense organs, to the intensity of the stimulus, which is a function of the amount of molecules that produce it, corresponds to the density of the receptor areas recruited to be better recognized. It is an important rule known and described by the physiology of receptors.

In conclusion, whatever the nature of the stimulus, it must be mediated by specialized receptor molecules to be transduced into signals recognizable by living structures.

4.2. Interpretation of quantum mechanics

4.2.1. Molecular stimuli

Quantum mechanics and the biology that is inspired by it and has borrowed its laws and formulas, provide an interpretation based on the wave-like nature of stimuli and receptor responses.

Although the importance of wave systems in all information transmission phenomena can be shared, the fundamental role of the particles associated with them must be recognized and underlined, as I have repeatedly stated throughout the article.

As an example, I am going to report what these theories propose for odorous substances and olfactory receptors.

According to this conception, olfactory sensory activity is dependent on the electromagnetic frequency that odorous substances emit, and not on the structure of the molecules that produce it, as the conception of classical neurobiology wants.

For example, in their article Ilia A. Solov'yov, Po-Yao Chang, and Klaus Schulten:

- *"This ...... summarizes the theoretical description for the vibrationally assisted mechanism of olfaction. We derive key equations and explain the principle observables used to validate the mechanism in vivo or in vitro." [14].*

This hypothesis contrasts with what we know about the double corpuscular-wave nature of atoms and subatomic particles postulated by quantum mechanics itself, which also considers the presence of the corpuscular component necessary for any event to be perceived.

If not, we should be able to reproduce odorous sensations simply with the emission of specific frequencies, but this is impossible, because it is impossible to separate the corpuscular component from the wave component.

4.2.2. Receptor systems

Understanding the function of the receptor systems it is necessary to understand what information they must transmit.

Information that is related to the environmental conditions, on which the survival and conservation of the species depends, and include climatic variations, the presence of adverse events, geological events, fires etc. and the presence of prey or predators.

For each of these conditions, natural evolution has selected and developed in the living sensory organs specific to the stimuli to be recognized, in addition to having equipped the living with the necessary motor equipment to escape the dangers present in their ecosystem.

In this way with the environmental information function, the receptors perform an important protective and defensive activity for the living that can distinguish useful stimuli from harmful ones according to their organoleptic characteristics and adopt the correct answers for survival.

At the cellular level they form a second protective barrier because they distinguish the necessary substances from those useless and potentially harmful, allowing or hindering their entry.

They are therefore also essential for the selection and consumption of food.

There are countless examples of the adaptation achieved for this purpose by plants and animals.

From chloroplasts used by plants adapted to particular climatic and light conditions, to the smell developed by vertebrates to recognize preys and predators or to the choice of sexual partners for mating, so for the particularly acute hearing of some mammals, and still exceptionally developed sight in predatory birds. For humans, receptors have assumed a fundamental role in social relations.

Electromagnetic waves with the double corpuscular-wave nature are used for visual, gustatory, olfactory receptors, while mechanical waves act on acoustic, tactile-thermal and balance receptors.

Also for touching and hearing the same wave-like phenomenon occurs, by means of the contact between the waves emitted by the molecules of the material to be tested and the waves produced on the receptor molecules.

I've already talked about the specific frequencies emitted by each subatomic particle, atomic or molecular, and how sensory communication occurs through these frequencies.

4.3. Molecular structure and organoleptic properties of sensory stimuli.

As for the nature of sensory stimuli, they can be divided into two categories: chemical stimuli (Molecular smell and taste) and physical (Electromagnetic radiation, sound waves, mechanical vibrations).

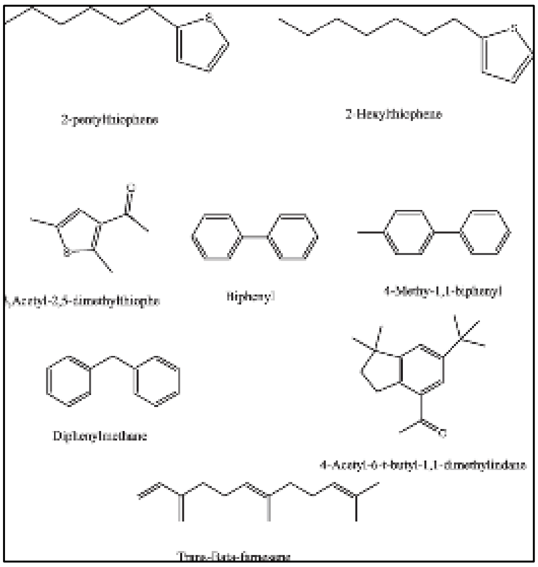
Most odors are composed of several odor molecules, each of which activates several olfactory receptors. This leads to a combinatorial code that forms a special "olfactory harmony", something similar to the colors of a mosaic. This is the basis of our ability to recognize and form the memory of many different smells [15-18].

There is also a correlation and overlap between odorous and gustatory stimuli for their neuronal recognition.

If we examine the chemical structure of molecules with organoleptic properties we notice that many of these molecules have a particular chemical structure:

Examples of odorous molecules are reported in Table 1

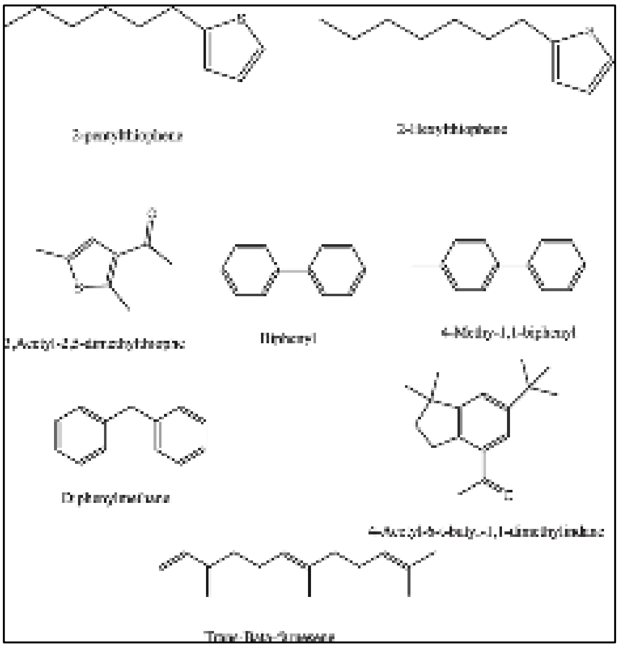
Table 1 Chemical structure and functional groups of some fragrances



Functional group	Source	Example	Smell
Alcohol -OH	Plant	Geraniol, Linalool Menthol Aroma -active alcohol > c3	Fresh , floral Mint Sweet or pungent
Aldehyde ; Ketone -CHO; > C=O	Fat Milk products	Diacetyl	Like butter
Acid (C1-C12 -COOH	Cheese	Formic acid Capric acid	Pungent Like goats' milk
Ester , Lactone -COOR	Solvent Fruit	Ethyl acetate Methyl/ethyl butirate	Glue Pineapple
Pyrazine aromatic =N-	Roasted , cooked Fermented foods	2-isobutyl-3-methoxypyrazine 2-acetyl-tetrahydro-pyridine	Earth , spice , green Pepper , Popcorn
S-compounds Aliphatic , Aromatic	Vegetable	Diallyldisulphide 1,2-dithiolane-4-carboxylic acid	Garlic Asparagus
Phenols (Mono- , poly-)	Smoked food	Guaiacol Cresol	Wood smoke Tarry

As for the taste of substances, an important contribution to the organoleptic characteristics of flavors is also attributed to lipid substances in foods [19].
FlavorDB2 (https:///cosylab.iiitd.edu.in/flavordb2/)
Examples of taste receptor molecules Table 2:

Table 2 Structure of some molecules with flavor- From: Nishant Grover et al; FlavorDB2: An Updated Database of Flavor Molecules, arXiv:2205.05451v1 [q-bio.QM] 10 May 2022

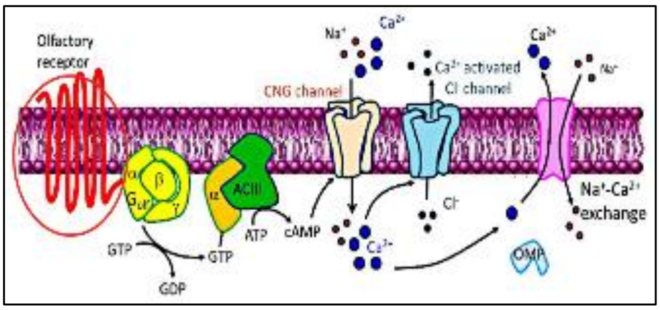


	CELL TYPE	RECEPTOR(S)	AVAILABLE 3D STRUCTURES	EXAMPLES OF TASTANTS
SWEET	II	TAS1R2 + TAS1R3	No	- Natural sugars (glucose, sucrose, sucralose, maltose) Artificial sweeteners (aspartame, neotame, monellin) - Sweet proteins (brazzein, monellin, thaumatin, curculin) - D-amino acids (D-Phenylalanine, D-alanine, D-serine)
UMAMI	II	TAS1R1 + TAS1R3, brain-mGluR1, brain-mGluR4, taste-mGluR1, taste-mGluR4, GPRC6A, CaSR and GPR92	No	Amino acids (aspartate, L-glutamate, L-AP4, glycine, L-amino acids) - Dipeptide and tripeptide (short peptides) Nucleotide enhancer (IMP, GMP, AMP) - organic acids (lactic, succinic, propionic acids)
BITTER	II	25 TAS2Rs	BitterDB (TM)	Diphenidol, Lupolon, Quinine, Benzoin, Adhumulin, Noscapine, Quassin, Artemisin, Caffeine, Arglabin, Absinthin, Cucurbitacin B, Coumarin, Chlorpheniramine, Papaverine, Adlupolone and polyphenolic compounds (Vescalagin, Castalagin, protocatechuic acid).
SALTY	I*	ENaC, CALHM1/3	RCSB ENaC: 6WTH	Sodium chloride (NaCl), lithium chloride (LiCl)
SOUR	III	OTOP1	RCSB 6NF4, 6NF4, 6O84	Acids (citric acid, tartaric acid, acetic acid, hydrochloric acid)

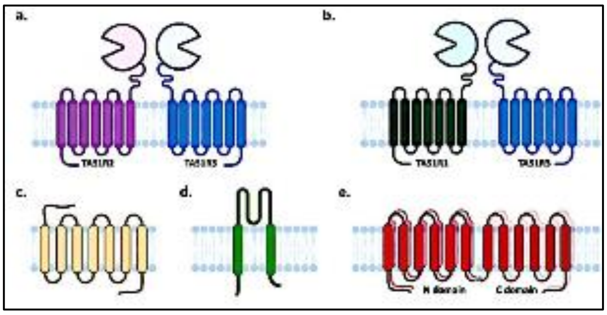
It's interesting to note that many of these chemicals have an aromatic structure or resemble molecules that have conjugated dienes with double-simple-double bonds alternating with each other.

We have known for a long time that many amino acids that form stereoisomers taste different, as do the glucose enantiomers L and D and mannose anomers taste different, [20-23] .

As for the nature of the receptor proteins and the method of transduction of the stimulus they receive, they vary greatly according to the sensory stimulus, we report for example, the scheme of proteins of smell and taste in Figure 8:



A) Olfactory receptor



B) Taste receptor

A From: NaNa Kang & JaeHyung Koo; Olfactory receptors in non-chemosensory tissues, BMB reports · _November 2012 (Open acces); B: Schematic representation of the main receptor candidates for each taste, (a) sweet (TAS1R2-TAS1R3, GPCR of class C), (b) umami (TAS1R1-TAS1R3, GPCR of class C), (c) bitter (TAS2Rs, GPCR of class A/class F), (d) salty (αENaC), (e) sour (OTOP1). From Lorenzo Pallante et al.; On the human taste perception: Molecular-level understanding empowered by computational methods - Trends in Food Science & Technology 116 (2021) 445–459

Figure 8 A schematic diagram of olfactory signal transduction

In addition to fragrant substances or with taste, there are some completely devoid of smell and taste, or whose organoleptic properties are not perceived by all living in the same way.

We know that some odorless molecules for humans are perfectly perceived by other animals.

5. Conclusion

The receptor systems have played a leading and irreplaceable role in the evolution of the living, which thanks to the receptors are able to recognize the environmental conditions to which they had to adapt for their survival.

We found traces of these structures also in the oldest prokaryotes, the Archea and in other elementary organisms such as bacteria.

All sense organs have reached their important biological role, associating with cell membranes, with which they have formed an indissoluble symbiosis and have achieved a synergy and efficient functional coordination.

With biological membranes molecular receptors have reached an important evolutionary milestone, adapting to their scaffold, and have formed together a system of protection and selective separation from the external environment, with the possibility of recognizing and obtaining essential substances for adaptation.

With the evolution towards more complex forms of life, the receptors have gradually been perfecting and specializing to respond as closely as possible to different environmental stimuli, and although they do not perceive the true essence of the real world, provide the essential information for survival.

All these observations allow us to conclude and recognize the key role that wave systems have had in directing and shaping intermolecular communication between environmental stimulants and sensory receptors to enable the living evolution in the universe they inhabit.

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