Review Article

A Critical Review of Biopsychology: The Interaction between Attention and Perception

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Abstract

Psychology continues to play a critical role in explaining human behavior. Human behavior is an activity of the biological mechanism of the behavior and involvement of mental processes, which is referred to as biopsychology. Biopsychology is that branch of psychology that studies the relations between behavior, which is the expression of the brain and the nervous system, and the body's physiological systems. Its focal point concentrates primarily on how the brain and the nervous system influence us in making sense of the world. Biopsychologists and neuroscientists have done impeccable research since the 17th century, examining people's visual perception of the world. This significant achievement has been accomplished mainly through neuroimaging, unraveling the anatomical and functional physiological processes involved in visual perception. This paper is a critical review of the existing literature. The information presented here will assist readers in understanding the nature of behavior from a biological and mental process. The objective, therefore, is to evaluate the complex nature of human behavior and show that behavior is an expression of the engagement of the brain and the physiology of humans. Evidence shows that the macula and the fovea are an important area of the retina. The fovea is an area with the highest density of cones and is responsible for perceiving fine detail. The optic nerve can then take this information into the brain. The axons of ganglion cells exit the retina to form the optic nerve, which travels to two places: the thalamus (precisely, the lateral geniculate nucleus, or LGN) and the superior colliculus. Despite this, the retina only makes up about 20% of all inputs to the LGN, with the rest coming from the brainstem and the cortex. The superior colliculus helps us control where our head and eyes move, determining where people direct our gaze. SC receives substantial input from the cortex, which provides the dominant command regarding attention mechanisms where our gaze moves precisely.

Introduction:

Humans constantly use their brains to interpret and interact with the social, environmental, and physical world, integrating biological, psychological, and social factors in their understanding of life [1]. This fact justifies why a biopsycho-ecological paradigm is best fitted to explain their behaviour [2]. The reality is that they are constantly interpreting what they see and making sense of the physical world.

The physical world is enriched with far more information than people can process [3]. For people to successfully interact with their environment, they must be able to select relevant information because of the vast array of what is and the constant changes occurring in the environment [4]. Attention must be selective as people try to understand what is [5,6]. Attention is an everyday biological activity that refers to how people actively process specific information in their environment [7]. Every day, people are encumbered with a profusion of sights, sounds, and sensations going on around us that demand our attention—the pressure of your feet against the floor, the sight of the street out of a nearby window, the soft warmth of your shirt, the memory of a conversation you had earlier with a friend [8]. A pioneering psychologist who set the stage for understanding these psychological phenomena of attention was William James [9]. He describes attention as "the art of taking possession by the mind, in clear and vivid form, of one out of what may seem several simultaneously possible objects or trains of thought. ...It implies withdrawal from some things to deal effectively with others" [10] as cited in Eysenck & Keane [11].

Perception involves interpreting sensory data in our world with our experiences [12]. Perception is the procedure by which people construe the world around us, forming a mental photographic representation of the environment. This representation is not isomorphic to the world but is subject to many correspondence differences and errors. The brain makes assumptions about the world to overcome the inherent ambiguity in all sensory data and in response to the task at hand [13].

People must have a reasonable understanding of the inner workings of the brain systems for perception and attention [14].As a result, more empirical research in psychology has givrn more attention to the brain systems involved in visual perception due to the sheer volume of vision research compared to other sensory areas [15,16]. Additionally, people look more in-depth at the anatomical and functional physiological processes associated with visual research [11].

Anatomical & Physiological Processes of Visual Perception

SHow is the input, registered by the eyes, processed by the primate brain? Patient studies suggested that there is a plethora of visual abilities, the recognition of colour [17], motion [18], or faces [19], which were extensively addressed in the work of [20]. To comprehend the visual processes in the brain, people must first examine what happens between the eye and the cortex [11,21]. The human eye is a remarkable organ that takes visual stimuli and sends this sensory information to the brain [22].

When light passes through the cornea, it is adjusted and fixated by the lens, and the cornea is placed onto the retina, a light-sensitive membrane on the back surface of the eye. Kalat [23] and Eysenck and Keane [11] classify the biological process into three parts

a) there is reception, which illustrates the absorption of energy by the receptors

b) transduction where the physical energy is converted into an electrochemical pattern in the neurons

c) coding, where there is a direct one-to-one communiqué between the physical stimulus and aspect of the resultant nervous system activity.

The receptor cells in the retina decipher the light into images. The retina has two types of receptor cells called rods and cones. There are 125 million rods concentrated on the outer region of the retina, Eysenck & Keane [11]. Rods help us respond better to low light levels; therefore, they are the cells responsible for maintaining some vision in poor light. There are six million cones in the fovea or central part of the retina, Eysenck & Keane [11]. These are responsible for our ability to detect fine detail and different colors and are the basis of our vision at higher (daylight) light levels, Guy [22]. A synopsis of how the eye processes light is illustrated in Figure 1.

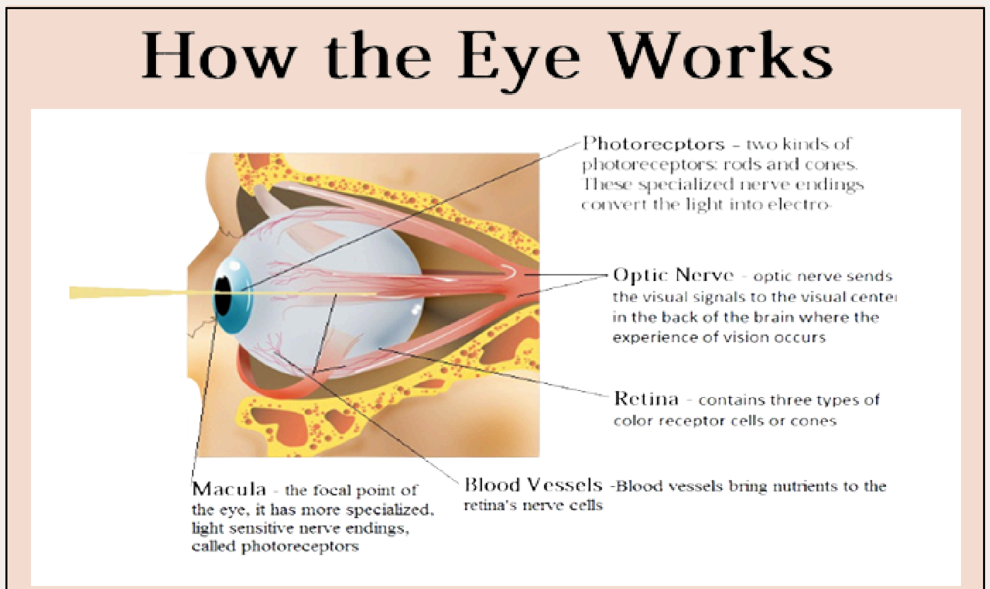

Figure 1: The Functioning of the Eye.
Credit of image: Maximo Sanz – Fotolia

An important area of the retina is the macula and the fovea. The fovea is an area with the highest density of cones and is responsible for perceiving fine detail. The optic nerve can then take this information into the brain [22]. The axons of ganglion cells exit the retina to form the optic nerve, which travels to two places: the thalamus (precisely, the lateral geniculate nucleus, or LGN) and the superior colliculus. The LGN is the primary vehicle of communication for visual information from the retina to reach the cortex. Despite this, the retina only makes up about 20% of all inputs to the LGN, with the rest coming from the brainstem and the cortex [24]. The superior colliculus helps us control where our head and eyes move, determining where people direct our gaze. SC receives substantial input from the cortex, which provides the dominant command regarding attention mechanisms where our gaze moves precisely [24]. Woodruff [24] states that visual input travels from the thalamus to the visual cortex at the rear of our brains. The visual cortex is one of the most studied parts of the brain system by a neuroscientist, and it is here that the elementary building blocks of our vision—detection of contrast, color and movement—are combined to produce our rich and complete visual perception. Figure 2 illustrates these visual processes of the eye and the cortex

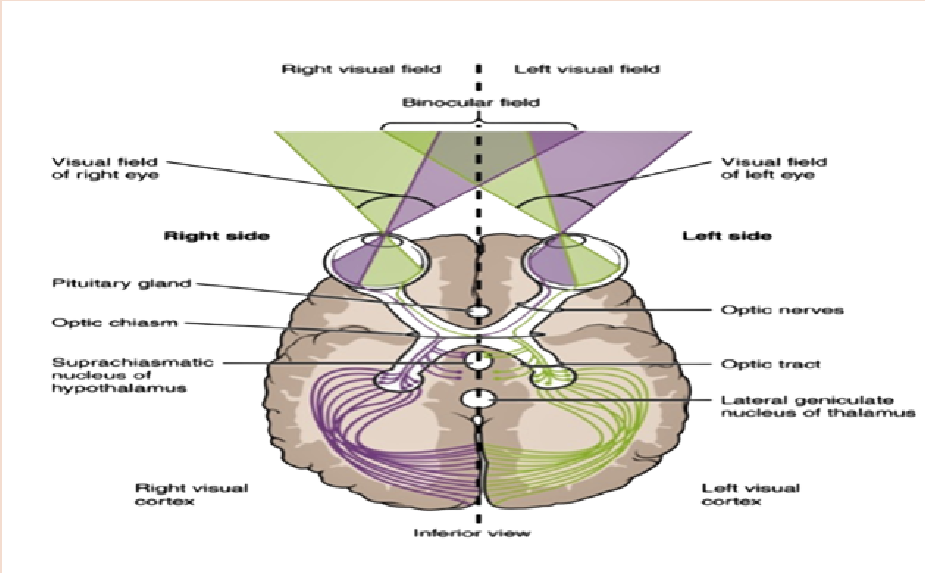

Figure 2: Evaluation of the Anatomical and physiological processes of visual perception.
Credit of image: Making Sense of the World Unit 3

The process of "seeing" is complex and poorly understood, and visual perception is still a mystery in some parts of the brain systems [11]. As the research above infers, people can confirm that brain neurons in the early visual system are tuned to stimuli with specific attributes (such as color, shape, brightness, position on the retina, etc.). Much is known about the way the cerebral cortex, the outer rind of the brain, initially analyzes sensory data, as revealed by Kalat [23], Eysenck & Keane [11], and Guy [22]. Hopefully, investigations are only now beginning to suggest how the brain moves beyond the mere extraction of physiological processes to combining sensory messages with experience and with expectation to identify both the stimulus and its meaning/interpretation of stimuli to the individual. Al.'s [25] research on perception has given us some insight into these psychological processes, but the researchers believe this is a personal perspective in visual research. Recognition must be given to the contributions of neuroscientists and biopsychologists who have shed light on many of these biological brain systems through neuroimaging between the eye and the cortex. Hopefully, it is evident from visual research that people still have far to go in understanding visual perception, especially from an affective perspective.

Theories of Visual Perception and Attention

Gibson [26] and Guy [22] propagated a direct realism theory of perception known as the 'bottom-up' theory. His bottom-up approach to perception implies that our senses can provide accurate, direct information from the external world. He says that signals received by the sensory receptors trigger neural events, and appropriate knowledge interacts with these inputs to enable us to make sense of the world. In contrast, Gregory (1970) proposed a constructivist (indirect) theory of perception called a 'top-down' theory, which suggests the construction of our world from past experiences alongside real-time visual information. Both theories have given keen insight into understanding visual perception and attention but have drawbacks. Gibson's theory of direct realism has been highlighted as unable to account for visual illusions and areas of perception where prior knowledge is more likely to have had influence, Guy [22]. The constructivist approach by Gregory has been challenged for its incapability to elucidate how our perception processes past experiences and how people from different cultures and lifestyles still similarly perceive the world [22].

Zeki [27] and Eysenck & Keane [11] engineered a functional specialization theory. Eysenck and Keane [11] articulate that one of Zeki's strong assumptions concerning his theory was that color, form, and motion are processed in anatomically separate parts of the visual cortex. Milner and Goodale (1995) and den Haan et al. [28] proposed the dual theory of two systems. The model argued for the anatomical separation and functional independence of two visual processing streams: a dorsal visual processing stream associated with vision-for-action and a ventral visual processing stream associated with object perception/recognition [29].

Arguments against Milner and Goodale's theory declare that the idea of a double dissociation between optic ataxia and visual form agnosia, as cleanly separating visuomotor from visual perceptual functions, is no longer tenable; optic ataxia does not support a dissociation between perception and action and might be more accurately viewed as a negative image of action blindsight [30]. Zeki's theory has come under criticism primarily for two things. Most of his evidence came from monkeys experimented on, also due to current research revealing that the brain areas are not as specialized in their processing as implied by his theory [29].

How the Nervous System Relates to Biopsychology

Biopsychology is a branch of psychology that analyses how the brain, neurotransmitters, and other aspects of our biology influence our behaviors, thoughts, and feelings [10]. To understand biological systems that aim to help us make sense of the world, Schultheiss & Wirth [31] and [10] stated that early biopsychologist research and experiments focused primarily on mammalian animal models, such as rats, mice, and sometimes primates, on the hypothesis that the physiological and cognitive processes are not much different from mammalian species. Later research, like the famous case of Phineas Gage, a railroad worker who suffered a devastating brain injury, also influenced our understanding of how damage to certain parts of the brain could influence behavior and functioning. Cherry [10] depicted that to understand how biopsychology relates to the nervous system, one must critically inspect three biological components: the brain, the nervous system, and neurotransmitters.

The Brain and the Nervous System

The nervous system can be divided into two major subdivisions: the central nervous system (CNS) and the peripheral nervous system (PNS), as illustrated in Figure 3 below. The CNS encompasses the brain and spinal cord, while the PNS connects the CNS to the rest of the body [32].

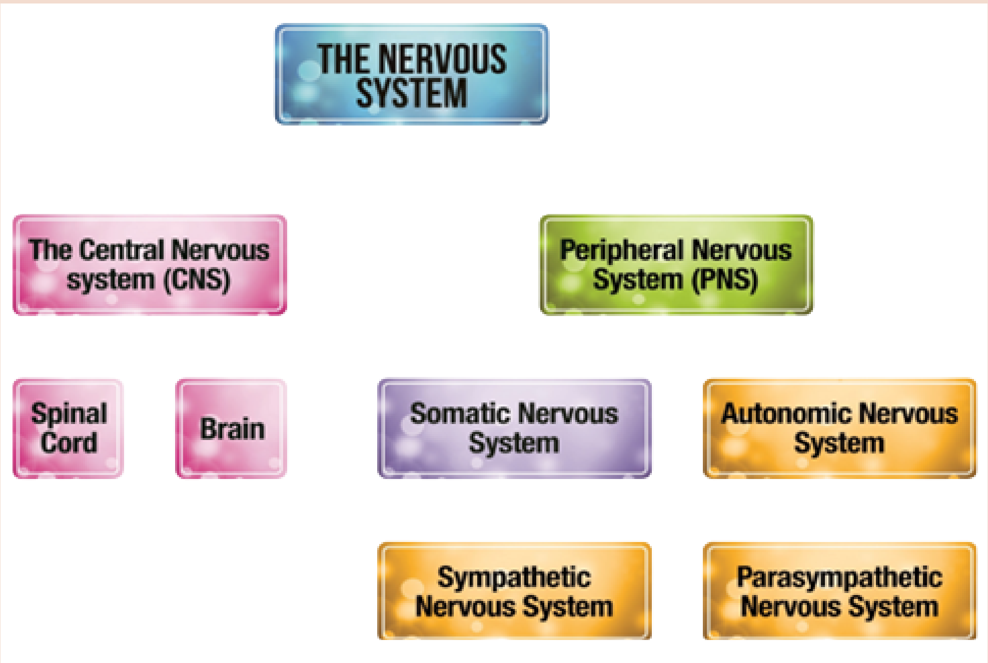

Figure 3: The Nervous system.
Credit image: TuTor 2u

Cherry [10] and The LibreTexts Libraries [32] indicate that the peripheral nervous system is made up of thick bundles of axons, called nerves, carrying messages back and forth between the CNS and the muscles, organs and senses in the periphery of the body (i.e., everything outside the CNS). The PNS has two significant subdivisions: the somatic and autonomic systems, as depicted in Figure 3 above. The somatic nervous system controls conscious and voluntary activities, including motor neurons communicating information to the CNS. The system regulates automatic functions such as heart rate, breathing, and blood pressure, Cherry [10]. There are binary parts of the autonomic nervous system: The sympathetic nervous system, which controls the "fight or flight" response. The parasympathetic nervous system brings your body back to a state of rest and regulates processes such as digestion.

Neurotransmitters

Biopsychologists have revealed that various neurotransmitters influence human behavior [33]. Neurotransmitters carry information between neurons and send chemical messages from one part of the body to the brain. Vice versa, Cherry [10] adds that neurotransmitters affect the body in different ways. For instance, the neurotransmitter dopamine is involved in movement and learning. Excessive amounts of dopamine have been associated with psychological disorders such as schizophrenia, while too little dopamine is associated with Parkinson's disease.

Conclusion

Human behavior involves the biological mechanism of behavior and the involvement of mental processes, which is referred to as biopsychology. Attention must be selective as people try to understand what is [5,6]. Attention is an everyday biological activity that refers to how people actively process specific information in their environment [7]. Every day, people are encumbered with a profusion of sights, sounds, and sensations going on around us that demand our attention—the pressure of your feet against the floor, the sight of the street out of a nearby window, the soft warmth of your shirt, the memory of a conversation you had earlier with a friend [10]. A pioneering psychologist who set the stage for understanding these psychological phenomena of attention was William James [9]. Perception involves interpreting sensory data in our world with our experiences [12]. Perception is the procedure by which people construe the world around us, forming a mental photographic representation of the environment. This representation is not isomorphic to the world but is subject to many correspondence differences and errors.

Reference

1. Harris KM, McDade TW (2018) The Biosocial Approach to Human Development, Behavior, and Health Across the Life Course. The Russell Sage Foundation Journal of the Social Sciences: RSF 4(4): 2.

2. Stineman MG, Streim JE (2010) The Biopsycho-ecological Paradigm: A Foundational Theory for Medicine. PM & R: The Journal of Injury, Function, and Rehabilitation 2(11): 1035.

3. Stroud B (1986) The Physical World. Proceedings of the Aristotelian Society 87: 263-277.

4. Chu E, Karr J (2016) Environmental Impact: Concept, Consequences, Measurement. Reference Module in Life Sciences.

5. Mahon A, Clarke ADF, Hunt AR (2018) The role of attention in eye-movement awareness. Attention, Perception, and Psychophysics 80(7): 1691-1704.

6. Stevens C, Bavelier D (2011) The role of selective attention on academic foundations: A cognitive neuroscience perspective. Developmental Cognitive Neuroscience, 2(Suppl 1), S30.

7. Cohen RA (2011) Attention. In: Kreutzer JS, DeLuca J, Caplan B (eds.) Encyclopedia of Clinical Neuropsychology. Springer, New York, NY.

8. Cherry K (2018a) How Psychology Defines Attention. Understanding the key points of Attention.

9. James W (1890) The Principles of Psychology. Cambridge, MA: Harvard University Press. 1.

10. Cherry K (2018b) What is Biopsychology? Brain & Behavior.

11. Eysenck MW, Keane MT (2010) Cognitive Psychology: A student handbook (6th ed). In: Hove: Psychology. Press Basic Process in Visual Perception pp. 35-78.

12. Albright D (2015) Perceiving. Daedalus. 144(1): 22-41.

13. Chater N, Loewenstein G (2016) The under-appreciated drive for sense-making. Journal of Economic Behavior & Organization 126: 137-154.

14. Ackerman S (1992) Discovering the Brain. In: Washington (DC): National Academies Press (US). From Perception to Attention.

15. Hutmacher F (2019) Why Is There So Much More Research on Vision Than on Any Other Sensory Modality? Frontiers in Psychology 10: 2246.

16. Purves D, Morgenstern Y, Wojtach WT (2015) Perception and Reality: Why a Wholly Empirical Paradigm is Needed to Understand Vision. Frontiers in Systems Neuroscience 9: 163471.

17. Zeki S, Marini L (1998) Three cortical stages of color processing in the human brain. Brain: A Journal of Neurology 121(9): 1669-1685.

18. Zihl J, Von Cramon D, Mai N (1983) Selective disturbance of movement vision after bilateral brain damage. Brain: a journal of neurology 106 (2): 313-340.

19. Ellis HD, Florence M (1990) Bodamer's (1947) paper on prosopagnosia. Cognitive Neuropsychology 7(2): 81-105.

20. De Haan EHF, Jackson SR, Schenk T (2018) Where are we now with 'What' and 'How'? Cortex; a journal devoted to the study of the nervous system and behavior 98: 1-7.

21. Baskin K (2025) The visual pathway from the eye to the brain: Trace vision from the retina to the visual cortex and learn about visual field loss in kids with CVI.

22. Guy F (2018) Perception Psychology. How people understand our World.

23. Kalat JW (2001) Biological psychology (7th ed.). Wadsworth/Thomson Learning.

24. Woodruff A (2018) Visual Perception. Retrieved from the University of Queensland people.

25. Ward M, Grinstein OG, Keim D (2015) Interactive Data Visualization: Foundations, Techniques, and Applications. In: Second Edition. CRC Press.

26. Gibson JJ (1966) The senses are considered perceptual systems. Houghton Mifflin.

27. Zeki S (1990) A century of cerebral achromatopsia. Brain: a journal of neurology 113(6): 1721-1777.

28. Den Haan J, Verbraak FD, Visser PJ, Bouwman FH (2017) Retinal thickness in Alzheimer's disease: A systematic review and meta-analysis. Alzheimer's & dementia (Amsterdam, Netherlands) 6(1): 162-170.

29. Haan EHF De, Jackson SR, Schenk T (2017) ScienceDirect Special issue: Editorial Where are people now with 'What' and 'How '? Cortex 98: 1-7.

30. Rossetti Y, Pisella L, McIntosh RD (2017) Rise and fall of the two-visual systems theory. Annals of Physical and Rehabilitation Medicine 60(3): 130-140 .

31. Schultheiss OC, Wirth MM (2018) Biopsychological aspects of motivation. In: Heckhausen J, Heckhausen H (Eds.), Motivation and action (3 ed.), New York: Cambridge University Press. pp. 407-451.

32. The LibreTexts Libraries (2018) Parts of the Nervous system.

33. Vijaya P (2020) Examining biological foundations of human behavior. Medical Information Science Reference/IGI Global.