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Consciousness as a structure by studying the role of Attention: An Ontological study

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ABSTRACT

Introduction: Consciousness has always been the focus of various theorists. Most of these theories have looked at consciousness as a single and indivisible entity. In this research, an attempt has been made to provide a structure and model for consciousness according to the mechanisms and components related to it (attention, working memory, senses, awareness, and quality) and also according to the basics of neuroscience. Methods: In this research, which is an ontological study. With various analyzes and arguments, it has been tried to provide a structure for consciousness within the framework of Husserl's formal ontology. Results: The results of the arguments and analyzes of this research showed us that working memory helps to form the content of consciousness by processing information as well as encoding information in working memory. Working memory also makes us aware of part of our inputs by directing the attention mechanism. Finally, our direct experience and subjectivity from this continuous flow of information leads to the emergence of consciousness as a set of qualities. Conclusion: Consciousness as a whole has parts. The presented model for consciousness shows that consciousness has levels and one of these levels is conscious attention. Also, consciousness has informational content (our processed information) as well as experiential content (qualia).

1. Introduction

Although earlier philosophers had not proposed a term under the title of consciousness, they had always paid attention to the concepts of mind and subjectivity and had given theories about them. But the modern concept of consciousness is often attributed to John Locke's Essay Concerning Human Understanding, which was published in 1690. In this work, Locke defined consciousness as "the perception of what passes in a man's own mind." (Locke, 1689/2010). Consciousness, mind and such concepts have always been considered as a singular and indivisible substance (lacking structure) throughout the history of studies that have been conducted on them. This is while the body is always considered decomposable and structured due to its materiality. For this reason, in the past, these two essences were considered separately. This study tries to argue that consciousness, despite being a continuous and subjective experience that is perceived singularly and without components, also has a structure.

We know that mind and body are somehow united in the human person, still are ontologically entirely distinct (Zelazo et al., 2007) so this study isn't about the body and its relationship with the mind, it actually is an attempt to achieve a perspective about the nature of consciousness, awareness and attention. Awareness is an outcome (a conscious state) which is linked to the mechanism of attention, in many theories (Ward, 2020) so in order to study the nature of consciousness, attention should be studied first. Historically, the concept of "attention" was the focus of philosophers and psychologists in the late 19th century. However, after that, it was less studied and discussed specially among psychologists, because the behaviorists regarded all internal processes. Attention returned to its place again following the publication of Broadbent's book –Perception and Communication– in 1958, and it has remained the focus of cognitive and philosophical studies ever since (Eysenck & Keane, 2015). Finally, in the conceptual model of consciousness, each of these mentioned components has its own place, which helps us to look at consciousness as a structure with components.

2. Methods

This research is an ontological study that aims to bring us to a knowledge of the existence and nature of consciousness as a structure. The method used in this article is the analytical method. In this article, an attempt has been made to achieve a new model of consciousness through structural analysis of the mechanisms and components related to consciousness. In this article, first, the components and mechanisms related to consciousness are explained. Then arguments have been raised that what is consciousness? And what is not? What content does it have? How is it formed? And finally, what model is useful to explain it? Finally, it should be mentioned that what is referred to as the analytical method in this study is a continuous structured and analogical approach to the variables related to consciousness and consciousness itself and providing suitable arguments to form a coherent structure for consciousness.

Formal ontology was first proposed by the philosopher Edmund Husserl. In his studies, he distinguished between formal logic and formal ontology (Husserl, 1900/1970). Formal logic deals with the truth of propositions. It deals with inference relations, consistency, proof and validity. In other hand formal ontology deals with the things and the interconnections between them, it deals with objects and properties, parts and wholes, relations and collectives (Smith, 1998). Formal ontology explores the characteristics of objects that possess a formal nature, meaning they can be exemplified by entities across all material domains of reality. Essentially, it provides a universal perspective on reality, transcending specific contexts or applications (Smith, 1989). Formal ontology, as described by Husserl, involves an axiomatized system of mereology (the study of parts and wholes) and a theory of dependence relations. These relations capture the connections between the qualities of an object and the object itself (Smith, 1982). Barry Smith (1998) explained: "Husserl's theory does not concern itself merely with what we might think of as the vertical relations between parts and the wholes which comprehend them on successive levels of comprehensiveness. Rather, his theory is concerned also with the horizontal relations between co-existing parts, relations which serve to give unity or integrity to the wholes in question."

As a result of what has been said, in this research, it has been tried to deal with the relationships between parts and the whole, the relationships between the parts in the structure of consciousness, as well as the relationships between the parts and the whole as objects with their qualities, within the framework of formal ontology.

3. Attention

As Pashler (1998) pointed out: "Attention has long posed a major challenge for psychologists.". William James says about attention: "Everyone knows what attention is. It is the taking possession of mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thoughts. ... It implies withdrawal from somethings in order to deal effectively with others." (James, 1890). Although many definitions have been presented for attention, there isn't such a specific definition for it. And unfortunately, psychologists still find attention difficult to define. The problem is that attention is not a single concept, but an umbrella term for a variety psychological phenomenon (Styles, 2006).

3.1What is Attention?

Attention is most commonly used to refer to selectivity of processing (Eysenck & Keane, 2015). Attention is a mechanism for the selection of information. Awareness in many theories is linked to this mechanism (Ward, 2020). As a result of attention performance, a limited amount of information from sensations, memories and other cognitive processes will be selected and processed (De weerd, 2003). Most psychologists agree that the brain has a limited ability to process information at once, and as a result, the brain needs a selective mechanism to function effectively, so that it can focus on specific information among the masses of received information (Banich & Compton, 2018). The main part in most definitions of attention, given in different references is that attention is a selective mechanism or means to be able to react better to the received (input) information.

3.2How does Attention work?

Attention includes not only conscious, but also unconscious processes (Nobre & Kastner, 2014). Attention allows us to focus on the stimuli that interest us and focus less on the stimuli that doesn't interest us. Heightened attention also paves the way for memory processes. It means that the selected information which we paid more attention to, will be remembered so much easier than the information we ignored (Sternberg & Sternberg, 2016). Attention acts like a spotlight. It determines what information should be focused on and responded to, and what information should be ignored for what they truly are: unnecessary or not interesting for us. Attention is a mechanism which leads both controlled and automatic processes in order to react to outside stimuli (sensations) and inner stimuli (thoughts and memories) effectively. Attention also plays a role in learning. The mechanism of attention makes learning happen by remembering everything that has been paid more attention to. Imagine you are studying in your room, if your attention is drawn to every outside and inner stimulus and you cannot focus on the material you are reading, memorizing and learning the material will never happen.

3.3The Problem of Attention

As Allport pointed out: "it seems no more plausible that there should be one unique mechanism, or computational resource, as the casual basis of all attentional phenomena than that there should be a unitary casual basis of thoughts, or perception, or of any other traditional category of folk psychology. ... Reference to attention (or to the central executive, or even to the anterior attention system) as an unspecified casual mechanism explains nothing." (Allport, 1993). As mentioned earlier, attention is not a single concept and most of the explanations that have been presented in relation to the mechanism and nature of attention have remained at the level of phenomenological studies. And as Allport also pointed out, explaining attention as a phenomenon that has a single basic mechanism does not add to our knowledge.

Although cognitive causal reduction of attention to a single mechanism or several mechanisms has always been of interest. However, the ontological reduction of attention to its components such as conscious and unconscious attention or focused and divided attention can help us understand the

nature of attention, more effectively.

4. Consciousness

Consciousness is the state or quality of being aware, which has been defined as sentience of internal, awareness, subjectivity, the ability to experience, wakefulness, the sense of selfhood, and the mind's executive control system (Van Gulick, 2004; Farthing, 1992). Consciousness is also not an easy concept to define, and there isn't a specific definition for it. The problem of consciousness, generally referred to as the mind-body problem, which has been the subject of philosophical reflection for thousands of years (Zelazo et al., 2007). Consciousness is not a single concept it actually is a psychological phenomenon, which is realized by another concept called attention.

4.1What is Consciousness, and why is it different from Awareness?

The term "consciousness" includes a huge and diverse set of meanings. It is not even obvious that there is any one 'thing' that all uses of the term have in common which could stand as its core referent (Wilkes, 1988). Some dictionaries define consciousness as an ability to be aware of self and surroundings. But these definitions are circular as it has been said, awareness is often used as a synonym of consciousness (Laureys & Tononi, 2009). In many references, the words consciousness and awareness are used as equivalent. In past some psychologists believed that attention and consciousness were the same. But now we know that some of our information processes are done without our conscious awareness (Sternberg & Sternberg, 2016). And this is the key point that shows us why consciousness and awareness are different. Becoming aware of stimuli requires their entry into short-term memory. The mechanism that causes information to enter short-term memory is attention. And this is where the role of working memory comes into play. Working memory plays a role in the formation of conscious attention by directing attention. When we transfer information from lower levels of consciousness to higher levels of it with our attention, we actually become aware of that information. But we are not aware of all the contents of consciousness. Imagine walking into a room and looking for a book. Meanwhile, on your way to the library, there are other stimuli that are in the content of your visual consciousness, but you are not aware of them. For example, there may be a cat in the room, but because you did not pay attention to it, even though it was in the content of your consciousness (it was in your visual field), you were not aware of it.

Although, consciousness could not be ontologically reduced to awareness, but it gets us to a good description of consciousness. Consciousness allows us to know our own existence (in a subjective way) and the existence of other objects and events (in an objective way). We wake up each morning to an ongoing stream of conscious events. As we come to consciousness each morning we remember the goals, plans and works we had thought about. That means we can focus our attention on a specific information that will to our consciousness. And that's how we describe being conscious (Baars & Gage, 2010). You wake up, you open your eyes, and in that moment, the visual world comes alive again. A flow of thoughts, memories and sensation processes begin, you can talk to yourself and in that moment you know that you're awake, you're conscious.

Consciousness includes both the feeling of awareness and the content of awareness (Taylor & Baldeweg, 2002). Feeling of awareness is simply understandable, usually when you are awake you feel aware. But what does it mean by saying the content of awareness? It refers to thoughts, sensations and memories which you can recall at the moment.

4.2The Problem of Consciousness

The problem of consciousness, generally referred to as the mind-body problem. Although there have been thousands of years effort to find out what consciousness (or in general, the mind) is, still the nature of consciousness is actually complex and far from clear (Zelazo et al., 2007). this is just one problem of consciousness, which as we said is asking: what's the relationship between mind and body? How does the body shape the mind? But we agreed that body and mind are ontologically entirely distinct, so another question that we shall ask now is: What is consciousness? What are the components of consciousness? This questions lead us to the ontological reduction of consciousness, which is the problem of consciousness we are going to

discuss.

As Rowlands (2001) pointed out: "Any study of phenomenal consciousness faces an immediate problem. There is no perspicuous way of defining the associated concept. That is, there is no non-circular way of specifying the content of the concept of phenomenal consciousness that does not rely on concepts that are equally obscure. Attempts to explain its content, accordingly, tend to rely on a number of devices, linguistic and otherwise." (Rowlands, 2001). Most definitions of consciousness actually provide a description of consciousness, but they do not give a detailed explanation of the nature of consciousness. These definitions may show us to recognize consciousness better by knowing its apparent characteristics, like experiencing emotions and sensory input, the ability to act and self-awareness but they do not lead us to a complete knowledge of consciousness.

Common definitions of consciousness do not seem to have been able to help us understand the nature of consciousness. Peter Hacker (2012) raised the question, have we asked the right question in the history of the study of consciousness? (Hacker, 2012). This article also tries to raise the right question, which is actually "what is the problem that common ontological methods of sciences such as physics face when dealing with consciousness?" In fact, this is the case for two reasons: First, our cognitive abilities, which are referred to in the definition of consciousness, their final product is manifested in the context of consciousness. As a result, these abilities alone are the stimuli that being aware of them as a direct and qualitative experience leads to a part of consciousness. But these cognitive abilities themselves have a different nature that is not so difficult to explain. Second, consciousness is not simply awareness, perception, or thinking, but it is a directly experienced mental quality that is constantly in flux. The basic problem is that we don't know enough about mental qualities, and since consciousness is actually our mental qualities, there are no convincing explanations for consciousness either.

4.3Conscious Attention and Cognition

What is the relationship between attention and consciousness? Baars (1997) argued that access to consciousness is controlled by attentional mechanisms. In everyday language you might hear a lot of sentences like "look at that" or "listen to that". What that actually happens here is that we "look in order to see" and we "listen in order to hear". As Baars says: “The distinction is between selecting an experience and being conscious of the selected event. In everyday language, the first word of each pair ["look"; "listen"] involves attention; the second word ["see"; "hear"] involves consciousness.” (Eysenck & Keane, 2015; Baars, 1997). When you look at something, you are paying attention to it. But if we just be a little more precise, we will find that it is actually our awareness that is drawn towards that stimulus by our attention, as if we become more aware of that stimulus. Conscious attention plays a casual role in cognition, and serves three purposes: First, it helps us interact with the environment. Second, it realizes the continuity of our memories and links them to the present moment. This makes our experience of the present moment feel more real. Third, it helps us to plan for the future based on what we know of past and what we are processing (thinking of) now (Posner, 2011). Another role of conscious attention in cognition that has not been considered is the ability to make decisions. When you make a decision, in fact, with the help of your conscious attention, you make a connection between outside stimuli (sensations) and inner stimuli (thoughts and memories) and in this way you start to make a decision.

As we said earlier, attention includes both conscious and unconscious processes (Nobre & Kastner, 2014). Even when we are asleep or we are not conscious, our attention is still active and it is working, that would be unconscious attention which leads our automatic processes to an act. For example, when you are driving to your workplace, you may think that your boss may reprimand you for being late, and this thought attracts your conscious attention, but your unconscious attention is focused on your driving, which is an automatic process in this example, and as soon as someone jumps in front of your car, your unconscious attention by directing your information processing towards an appropriate response makes you quickly put your foot on the brake, even though your conscious attention is involved in something else (in this example; thoughts).

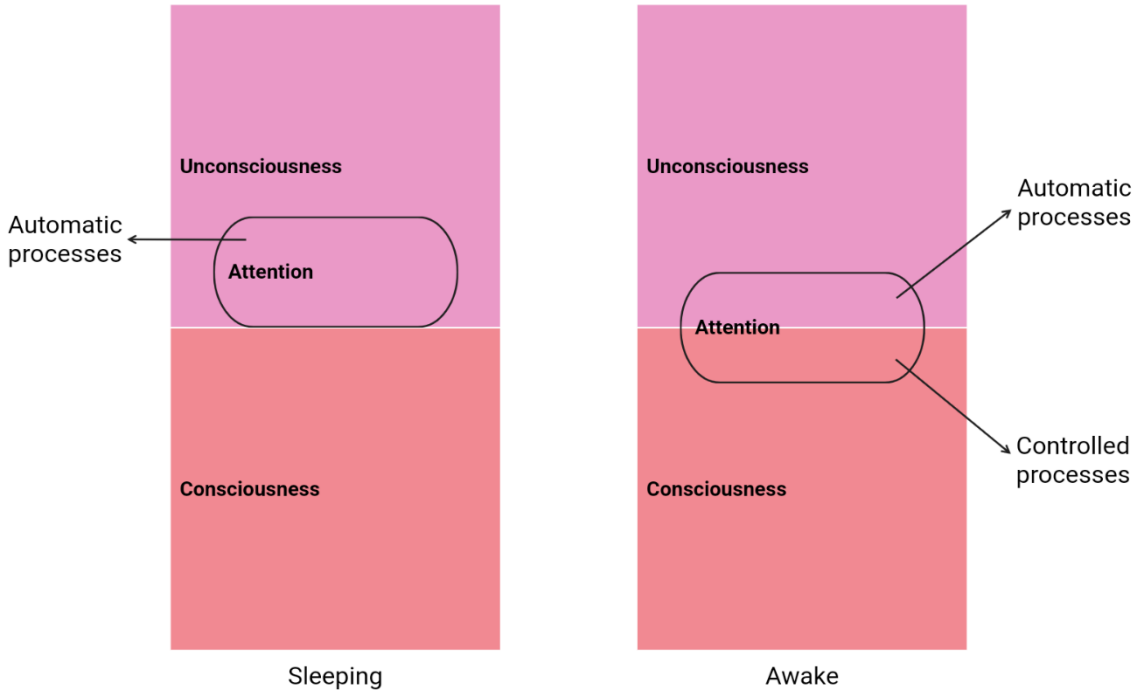

Figure 1: A suggested framework to explain the function of Attention and the emergence of Conscious attention (Awareness). Our Attention, as a mechanism controlled by working memory, makes us aware of the processed information. Our Attention is also involved in unconscious processes that lead to automatic actions. It is very important to note that we are not aware of all the contents of our Consciousness. This key point shows us the difference between Awareness and Consciousness.

4.4Consciousness explained by Cognitive Neuroscience

In order to achieve a cognitive neuroscience explanation for consciousness, we must seek to find circuits of neurons in which the flow of information leads to the emergence of an emerging feature called consciousness. The fundamental structure of the thalamocortical system is composed of three connected neurons in cortex, the thalamus, and the reticular nucleus of the thalamus. The neuron of the cortex is a pyramidal cell. These are the long-distance excitatory neurons located in the cortex, often surrounded by smaller cells. The thalamus is known as the 'gateway to cortex' and that most thalamic nuclei have a specific cortical area they interact with. Some of the thalamic nuclei, such as LGN, include relay neurons that transmit sensory information to cortical regions. Other thalamus nuclei are corticocortical, which allow attentional mechanisms of the frontal and parietal lobes to enhance sensory processing in the posterior cortex (through the pulvinar and mediodorsal nuclei of the thalamus).

Within the thalamocortical system, the three neurons of the fundamental structure create a circuit that determines the major states of the circadian cycle. A fourth cell located deep in the brain has the ability to turn this circuit on and off by releasing neuromodulating chemicals throughout large portions of the forebrain. Despite the existence of many millions of such circuits, the fundamental simplicity of this thalamocortical loop is remarkable. We can think of this loop as an oscillatory circuit composed of three oscillating units. each unit can be treated as an individual oscillator. However, the swing set itself as a whole is also an oscillating system.

Single neurons act as fast-charging and fast-discharging electrical wave generators. Neuronal circuits –a structure of three individual neurons– oscillate in more complex patterns. And the thalamocortical loop as a general set of circuits, operates differently during global brain states such as waking, slow-wave sleep, and REM dreaming (Baars and Gage, 2010). As mentioned

earlier, there are millions of circuits (made of three neurons) oscillating, which makes us conscious beings. Although these circuits seem simple, with the help of other circuits they surprisingly lead to the emergence of Consciousness.

4.5The role of Working memory in Consciousness

It is very often that working memory is described as a "sticky note" in the brain. It's a cognitive system with a limited capacity that allows us to hold information temporarily without losing track of what we're doing (Miyake & Shah, 1999). Working memory and short-term memory are often used interchangeably, but some theorists consider these two forms of memory distinct. working memory allows manipulating of stored information and processing them, whereas short-term memory only refers to the short-term storage of information (Cowan, 2008).

Baddeley and Hitch (1974) introduced the multicomponent model for working memory. This model is contained of three components: the Central executive, the Phonological loop, and the Visuospatial sketchpad. The central executive function as a central core that control the exchange of information, which actually is directing info between the two components: phonological and visuospatial (Baddeley & Hitch, 1974; Levin, 2011). The central executive plays a crucial role in cognitive processes. It directs attention to relevant information, suppresses irrelevant details and inappropriate actions, and effectively coordinates multiple tasks when they are performed simultaneously (Weiten, 2013). As mentioned, working memory, with the ability to access short-term memory and processing this information, can give us continuous awareness of the stimuli around us, the direct and subjective experience of which shows itself to us in the form of consciousness, and also leads to the emergence of behaviors in response to this information.

5. Consciousness as a structure (The Model of Consciousness)

At every moment we receive inputs from stimuli (thoughts, memory content, sensations and emotions). This information is gathered in the central executive of our working memory, as the central core of the information processor and conductor. Then, these information are continuously encoded so that when they enter the short-term memory, consciousness finds a special meaning. Which is actually that consciousness is a continuous flow of perception, but at the same time it is awareness of the history of its existence as a being with identity. A person's identity is his continuous perception of his own existence, which happens continuously. And for this reason, its continuity is emphasized because a person needs to constantly retrieve information about himself and the situation he is in from long-term memory to short-term memory in order to be aware of his existence and other stimuli. Encoding of information as well as their continuous retrieval, if necessary, shows itself to us at two basic levels: the Phonological loop (Verbal rehearsal) and the Visuospatial sketchpad. The Phonological loop and the Visuospatial sketchpad as other components of working memory show us the processed information that forms the content of our consciousness. But the content of our consciousness itself is directly and subjectively revealed to us, which is called Qualia. Actually, it is our mental qualities that we call consciousness. As it was said, consciousness cannot be considered as mere awareness, but the attention mechanism, which is guided by the central executive part of working memory, causes us to have higher processing levels than a certain part of our consciousness, which leads to awareness of them, so awareness can be considered as a product of conscious attention.

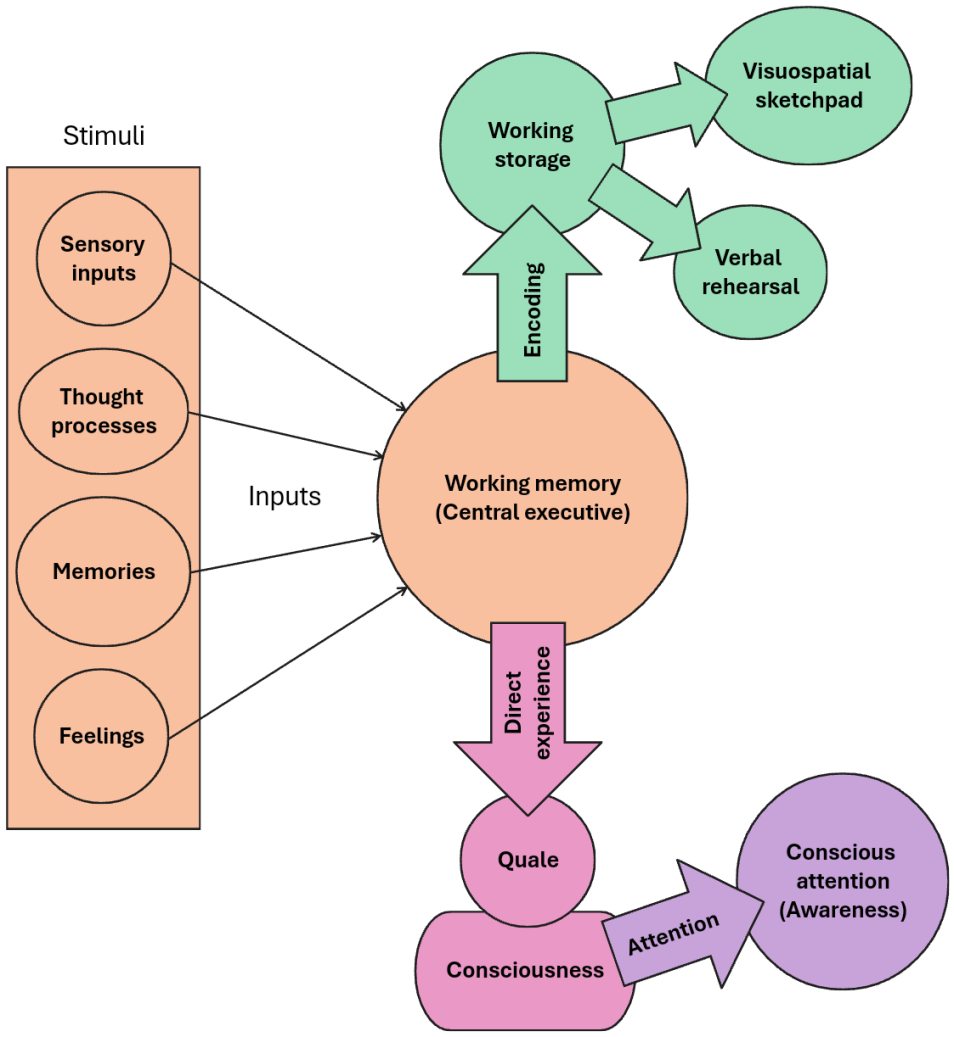

Figure 2: A suggested model of Consciousness in the framework of Husserl's Formal Ontology. This model shows us that Consciousness as a whole has two basic components. The content of Consciousness is the perceived information which is more literally the neural currents in our brain circuits. This part of Consciousness is completely material in nature, But Consciousness also has another part. The Qualia that are experienced subjectively, and show themselves only to the subject. This part of Consciousness is the quality of the other part as well as its co-existence. In the sense that Consciousness appears as a structured whole only in the presence of these two components.

6. Conclusion

Although the ontological study of attention and consciousness requires a lot of work and has a long way to reach a desired and acceptable result. In this article has been tried to answer these questions: What is attention? How does attention work? What is the right solution for the ontological study of attention? What is consciousness? What is the right solution for the ontological study of consciousness? what is conscious attention? And at last in this research, the components of consciousness and the mechanisms related to it were identified. Then, by precisely defining these variables and providing analyzes and arguments, a conceptual model for consciousness was presented. This model has a central core called the executive center, which is actually the processing and executive component of our working memory. This central part is also connected with other parts of working memory which are components of information storage. Encoding information in these parts of short-term memory constitutes the content of our

consciousness. But the experience of this content for the person himself subjectively and directly shows itself in a different way. The content of consciousness shows itself to us in a qualitative and continuous way, which is called qualia. These mental qualities of ours, which are called consciousness, are actually the result of the continuous information flow of sensory stimuli from our senses to parts of our brain. The flow of information in the relevant neuronal circuits in our brain leads to consciousness. But with the attention mechanism guided by our working memory, the part of the conscious content that has been given more attention will be processed more and the awareness of it will be more. An imprecise but helpful analogy is to think of consciousness as a large dot matrix. And consider attention as a scanner that scans different parts of this matrix with a guiding force. This driving force is analogous to our working memory that directs attention. And that part of the dot matrix that is scanned is the content of consciousness that we become aware of. Finally, the framework of Husserl's formal ontology showed us that consciousness as a whole has information content and empirical content. The information content of consciousness is actually the processed information of our inputs, which often shows itself in both visual and verbal forms. And the experiential content of consciousness that the conscious organism experiences is actually our qualia. Consciousness also has levels that are determined by the mechanism of attention. The highest level of consciousness is conscious awareness or conscious attention, which is the result of focusing attention by working memory on a part of perceived inputs. The information content and the experiential content of consciousness as co-existences that have a general-partial relationship with the conscious also have an existential dependency relationship with themselves.

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