



PERCEPTION: A NEURAL ACCOUNT

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ABSTRACT

In the present theoretical article an attempt is made at advancing theory in marketing science. This is achieved by proposing a model of the perceptual process that is supported by evidence from neural science. Two influential theories of perception are reviewed, namely, the constructive theory and the ecological theory. The merits of each theory are judged with respect to neural activity. It is found that the account provided by each theory is commensurate with the functionality of the two pathways of the vision system. That is, the constructive theory parallels the ventral pathway while the ecological theory is consistent with the dorsal pathway. It is asserted that a comprehensive elucidation of consumer behavior necessitates the coexistence of both theories.

Key Words: Constructive Theory of Perception, Ecological Theory of Perception, Neural Science, Dorsal Pathway, Ventral Pathway.

JEL CLASSIFICATION: D91, D87, M31

ملخص

يسعى المقال لتقديم مساهمة نظرية في علوم التسويق و هذا من خلال إقتراح نموذج للعملية الإدراكية بالإعتماد على دراسات في علم الأعصاب. سيتم التطرق إلى نظريتين للإدراك—النظرية البناءة و النظرية البيئية. نقاط قوة وضعف كل نظرية ستحكم على أساس النشاط العصبي. تم التوصل إلى أن هاتين النظريتين مماثلتين لمسار نظام الرؤية في الدماغ. في حين أن النظرية البناءة تتوافق مع مسار الرؤية البطني، هناك توافق بين النظرية البيئية و مسار الرؤية الظهري. تم إستنتاج أن دراسة شاملة لسلوك المستهلك تستدعي كلتا النظريتين لأن الواحدة تكمل الأخرى.

الكلمات المفتاحية: النظرية البناءة للإدراك، النظرية البيئية للإدراك، علم الأعصاب، مسار الرؤية البطني، مسار الرؤية الظهري.

تصنيف JEL: M31, D87, D91

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INTRODUCTION

In his classic book *Cognitive Psychology*, Ulric Neisser advances the assertion that the existent of a physical and real world, in which organisms of myriad types interact, is indubitable. Nevertheless, none of these organisms has direct or immediate access to this world and knowledge about the said world is contingent on “complex systems which interpret and reinterpret sensory information” (Neisser, 1967/2014, p. 3).

The term to which Neisser is referring is *perception* and given that people behave in the world according to what is perceived from their environment, perception is of overarching importance to marketers. In marketing “perception is the reality” (Lindsay, quoted in Ries & Trout, 2001, p. 8) and, by extension, competition takes place in the mind rather than the market. Hence, understanding consumers’ perception and how to influence it in the firm’s favor would be extremely beneficial, were a firm seeks to position new products or reposition existing ones.

It should be emphasized that the present article is theoretical in which the purpose is to advance current theory on perception. To this end, influential psychological and neural theories on perception are reviewed and a model of the perceptual process is proposed.

1. DEFINITION OF PERCEPTION

From a psychological perspective, perception is defined as: “the overall process of *apprehending* objects and events in the external environment—to sense them, understand them, identify and label them, and prepare to react to them” (Zimbardo & Gerrig, 2002, p. 135). However, from a neural perspective, perception is defined as: “a constructive process that depends not only on the stimulus but also on the mental apparatus of the perceiver—the organization of the sensory and motor systems in the brain” (Kandel, 2013, p. 372).

Both, the psychological and neural, definitions place emphasis on the fact that perception is a process and not a single response to a stimulus. The said process is constructive such that an individual builds a perception of the world by forming a representation or a percept. The percept or the subjective experience of the stimulus by an individual does not solely depend on the characteristics of the stimulus (shape, size, color, distance...) but also includes one’s “mental apparatus”, that is, neural organization of brain circuitry that is highly contingent on prior experience and knowledge (Zull, 2002). To be said differently and clearly, the construction of the percept depends, to a greater extent, on the stored knowledge. It is constructive because an individual uses the knowledge stored in memory to build a representation by which the current stimulus is apprehended. Moreover, consensus exists with regard to the number of stages of the perceptual process. The percept takes three stages to be constructed, namely, sensation, attention, and recognition (Edgar, Edgar, & Pike, 2014; Zimbardo & Gerrig, 2002).

2. THE PERCEPTUAL PROCESS

2.1 SENSATION

Before a stimulus is perceived by an individual, it must be received by sense organs. That is, sensation is a prerequisite stage in the perceptual process. Through the senses, the brain acquires the information in the individual’s environment, to which is referred as *sensory information*, and defined “as neural activity originating from stimulation of receptor cells in specific parts of the body” (Gardner & Johnson, 2013, p. 449). Each sensation is mediated by a sense organ. That is, vision, touch, hearing, smell, and taste are mediated by the eyes, skin, ears, nose, and tongue, respectively. Moreover, each sensation is associated with a separate brain structure that undertakes further processing of the raw sensory information (Gazzaniga, Ivry, & Mangun, 2014). First, the visual cortex in the occipital lobe carries out the analysis of visual stimuli. Second, the somatosensory cortex located in the parietal lobe processes stimuli in contact with the skin. Third, the

analysis of sound waves is performed by the auditory cortex which is located in the temporal lobe. Fourth, the olfactory cortex which is situated in the ventral area of the frontal lobe and temporal lobe processes smell. Finally, gustation is ensured by two structures, namely, the insula and operculum.

Besides the above-mentioned senses, three sensations are required to maintain proper bodily functioning, namely, somatic sensations, visceral sensations, and vestibular sensations (Gardner & Johnson, 2013). Somatic sensations are required for proprioception and sensations of pain, temperature, and itch. Visceral sensations are necessary for the maintenance of homeostasis. Finally, vestibular sensations are essential for the equilibrium of the body in different situations.

To sum up, sensations are the genesis of perception and perception is to endow one's sensations with a meaning. It should be noted that despite their key role in the perceptual process, sensations are not considered as a cognitive function. Further, perception may result from any sense modality, however, the modality that has been the focus of most researchers is vision by virtue of its cortical size and its importance in navigating one's environment (Eysenck & Keane, 2010). Hence, discussion in what follows will be confined to visual perception.

2.2 ATTENTION

It is an established fact that the brain cognitive capacity is limited (Simon, 1956), and consequently, the amount of information to be processed is rather small. In order to cope with this limitation, the brain is characteristically selective (Kahneman, Attention and Effort, 1973). That is, the brain selects or filters what information is to be processed and what information is to be ignored. This selectivity is referred to as *attention* and defined as:

"It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, con-centration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others, and is a condition which has a real opposite in the confused, dazed, scatterbrained state" (James W. , 1890a, pp. 403-404)

"[T]aking possession" denotes that attention is a deliberate or voluntary act. That is to say that the individual chooses what stimulus or what parts of the stimulus are to be selected to effectively deal with them and what stimulus or parts of stimulus from which to withdraw. To employ the terminology of economics, attention is a scarce resource and as a result, it must be efficiently allocated and when attention is focused on one object, the individual becomes blind to other objects (Kahneman, Thinking, Fast and Slow, 2011). Simons (2010) replicated the *The Invisible Gorilla* experiment (Chabris & Simons, 2010) in which attention blindness is perfectly demonstrated. In the experiment, a video is played in which two teams are passing a basketball and each team is composed of 3 players. One team is wearing white shirts and the other is wearing black. The participants are instructed to count how many times the players wearing white pass the ball. While the participants focus on counting the number of passes, nearly 50% of participants fail to notice a gorilla that passes through the stage as the teams are playing and also fail to notice that the curtain changes color from red to gold and one player from the black team leaves the stage (Simons, 2010). To summarize, as participants focused on counting, they became blind to other stimuli despite their distinction. This experiment corroborate the fact that attention is a scarce resource.

At times, attention is treated synonymously with *arousal* (Damasio A. R., 1999; Gazzaniga, Ivry, & Mangun, 2014). Thus, these two terms needs to be distinguished. While arousal appertains to the individual's overall psychological and physiological state, attention is not a global state but merely the selection, at different

levels of arousal, of stimuli to be processed. The meaning of arousal can be perfectly understood by the commonly used word, that is, “excitement” (Damasio A. R., 1999, p. 94). For example, one’s thoughts might be attended to the upcoming exam (i.e. attention) while laying down (i.e. low level of arousal) or one might be highly excited because his team has scored (i.e. high level of arousal) while attempting not to think of work (i.e. attention).

Inasmuch as brands compete for market share, they compete for consumer’s attention. Consequently, attention is of considerable importance to marketers because brands to which consumers are not attended will not be included within their consideration set (Roberts & Lattin, 1991). That is to say, unless attention is allocated to a brand, that brand will not be considered and, hence, will not be purchased. In that respect, what draws or captures consumer’s attention? Unequivocally and succinctly, William James asserted that “[t]he things to which we attend are said to *interest* us” (James W. , 1890a, p. 416). That is, interest in an object causes one to be attentive to the said object. “Interest” in modern terminology is referred to as *significance* or *personal relevance* (Olson & Reynolds, 2001; Phelps, 2009). If an individual perceives an object as significant or personally relevant, this simply connotes that this object bears “importance consequences for the person” (Craik, 2006, p. 426). To be said differently, significance is assigned to objects that have consequences for one’s survival or wellbeing (Damasio A. R., 1994) and objects to which significance is assigned “will attract attention, reflection, and elaborate processing” (Craik, 2006, p. 426).

2.3 RECOGNITION

The final stage constituting the perceptual process is *recognition*. In this stage, percepts are attributed with a meaning (Zimbardo & Gerrig, 2002). For example, a pointed object becomes a pen, a pencil, a rocket, a bullet, an arrow, a knife, a needle, a nail and so forth. Recognition is an integrative stage which is reliant on top down processes to assign “semantic significance” to bottom up sensory information (Albright, 2013, p. 621). To be said differently and more clearly, before imbuing the visual information with meaning, other sensory information from other modalities, emotional valence of the object, and other associations with the object are retrieved from memory, are all conflated to form a representation that answers two questions, namely, what is the object? And what does it do? (Albright, 2013; Zimbardo & Gerrig, 2002).

Further and profound insights into recognition can be obtained by examining its neural circuitry. It is firmly established that the Inferior Temporal Cortex (ITC) is the primary seat of object recognition and damage inflicted upon this area is resultant in recognition impairment to which is referred as *visual agnosia* which means visual ignorance or “without visual knowledge” (Albright, 2013, p. 624). Visual agnosia is broadly compartmentalized into two categories, namely, *apperceptive* and *associative* as depicted in the table below:

Table 1: Categories of Visual Agnosia

	Apperceptive Agnosia	Associative Agnosia
Damaged Area	Posterior ITC	Anterior ITC
Ability to Copy Visual Stimuli	No	Yes
Ability to Verbally Identify Stimuli	Yes	No
Deficiency of Object Perception	Cannot see object parts as a unified whole	Cannot interpret, understand, or assign meaning to objects
Interpretation	Unable to construct sensory representations of visual stimuli	Sensory representation is created normally but cannot be associated with meaning, function, or utility

Source: Modified from Albright, T. D., 2013. High-Level Visual Processing: Cognitive Influences. In: E. R. Kandel, et al. eds. *Principles of Neural Science*. New York: McGraw-Hill, p. 625.

Lesion studies were employed to determine the structure and functionality of the ITC. Images of objects and shapes were displayed to patients with damaged to the ITC. Next, the patients were instructed to draw and name the displayed objects (Albright, 2013). Patients diagnosed with apperceptive agnosia could not draw the images because they did not see the objects normally, that is, objects could not be seen as a whole. It has been concluded that in apperceptive agnosia impairment resides in the early stage of visual perception in which patients failed to integrate the visual information to construct a representation or a percept of the objects. Contrariwise, patients with associative agnosia could draw the presented images, yet they were unable to label the objects. In contrast to apperceptive agnosia, patients with associative agnosia were perfectly capable of constructing a visual representation, however, they fail in the second stage which is to associate the object with its meaning and function. In different words, associative agnosia results in “normal percept stripped of its meaning” (Teuber, quoted in Farah, 2004, p. 4)

To sum up, while damage in the anterior ITC results in associative agnosia, damage to the posterior area ensues apperceptive agnosia. It should be emphasized that owing to these lesion studies, a two-stage model of recognition has been proposed (Albright, 2013). In the first stage, i.e. perceptual, visual information are integrated to form a visual representation of an object and in the second stage, i.e. cognitive, knowledge from memory is retrieved to imbue the constructed representation with meaning. “Meaning” is rather a broad construct and its significance should be further clarified. With respect to object recognition, meaning denotes the utility or functions of the object which is acquired through a variety of learning types (Ormrod, 2012). Therefore, semantic significance, which is the assignment of meanings to objects, depends on one’s previous encounters with and experiences of the object (Albright, 2013; Zimbardo & Gerrig, 2002).

3. THEORIES OF PERCEPTION

Two influential theories of perception dominate literature on the subject, namely, constructive theory and ecological theory (Norman, 2002). The constructive theory has also been referred to as Helmholtzian, classical, indirect, cognitive, and mediational while the ecological theory has also been dubbed as Gibsonian, new, direct, sensory, and immediate (Norman, 2002). As it will be discussed later, these theories flatly contradict one another on every aspect, however, what is characteristically distinguishing is as to whether there is a reliance on top-down processes.

Two types of processing hierarchy needs to be distinguished, namely, top-down processing and bottom-up processing. Top-down processing, also labelled as schema-driven or conceptually-driven, takes place when one’s prior knowledge and other higher mental functions (i.e. top) are employed to make an interpretation of incoming sensory information (i.e. down) (Zimbardo & Gerrig, 2002). Contrariwise, bottom-up processing, also called data-driven or stimulus-driven, takes place when sensory information acquired by the sense organs (i.e. bottom) are sent to higher mental functions (i.e. up) to construct perceptual representation (Zimbardo & Gerrig, 2002). That is to say differently, the starting point in bottom-up processing is the senses while the starting point of top-down processing is the cortex.

In what follows, I shall endeavor to explain the constructivist theory and ecological theory of perception and their implications for marketing are considered.

3.1 THE CONSTRUCTIVE THEORY

Chronologically, the constructive theory of perception is older than the competing theory and it is attributed to *Hermann von Helmholtz*. Constructivists make a sharp contrast between sensation and perception. Helmholtz, for instance, advances the assertion that *sensations* are constructed into “*perceptions* when we form

out of them the representation of outer objects" (Helmholtz, quoted in James, 1890b, p. 33). Constructive-oriented theorists suggest that sensory information are inherently impoverished, incomplete, and equivocal. Consequently, one is unable to interpret one's surroundings by solely relying upon these raw sensory information. Rather, stored knowledge in memory must be retrieved to *constructively* build a perceptual representation based on which sense will be made of the senses. That is, prior knowledge mediates between sensation and perception.

The mediational theory of perception places substantial emphasis on the role of higher mental functions in object interpretation. Gregory (1980) argues that in constructing a percept, an individual performs inductive reasoning. That is, based on one's prior knowledge, hypotheses or predictions are formulated about encountered objects and, next, they are tested against incoming information (Gregory, *Perceptions as Hypotheses*, 1982; Zimbardo & Gerrig, 2002). For instance, an incomplete view of an object instigates hypotheses generation and a conclusion is drawn once more information have been acquired. Consequential to the contention that perception, from the point of view of this approach, is similar to inductive reasoning, it is concluded that perception is a multi-stage process in which bottom-up processes interact with top-down processes in order for the representation to be constructed.

With this in mind, it should be stressed that a failure in perception, that is, miscomprehension or misinterpretation, is due to the inappropriateness of knowledge or to its misapplication (Gregory, *Knowledge in Perception and Illusion*, 1997). To be put in different words, misperception or illusion is attributed to the knowledge used to complete sensory information for it is not suitable to the encountered object or wrongly applied.

3.2 THE ECOLOGICAL THEORY

In contrast to the constructivist theory of perception in which considerable importance is assigned to the prior knowledge, the Gibsonian theory of perception places emphasis on *action*. The theory is relatively new and it is attributed to *James J. Gibson*.

The ecological theory of perception grew out of a dissatisfaction of the constructivists' account (Norman, 2002). Gibson advances the contention that perception is direct in which further information processing is unnecessary and the acquired sensory information is sufficient, complete, and unequivocal, and based on which one is perfectly able to interact with one's environment (Gibson, 1986). To be put differently, as an object is encountered, an organism will directly and instantaneously perceive the *utility* or *use* of the object in the environment. Gibson coined the term "*affordances*" to denote what an object "*offers*", "*provides*", or "*furnishes*" to an organism (Gibson, 1986, p. 127).

The Ecological Approach to Visual Perception (1986) is the title of the book in which the Gibsonian theory of perception was proposed. The title perfectly accounts for what is central to such theory. Perception, from this point of view, is merely a means through which organisms interact with one another and with their surroundings. That is, as one encounters an object, one will immediately and automatically picks up or identifies the properties that will allow the interaction with the said object (Rizzolatti & Strick, *Cognitive Functions of the Premotor Systems*, 2013).

It should be noted that these affordances do not necessarily result in object recognition for they are not the visual characteristics of the stimulus (color, shape, size...). Rather, they only "afford specific opportunities for action" (Rizzolatti & F. Kalaska, *Voluntary Movement: The Parietal and Premotor Cortex*, 2013, p. 877). For example, the properties or affordances by which a coffee cup is grasped and manipulated are the handle, the top, and the body; while its color, shape, and size are not regarded as affordances for they permit object recognition. The identified affordances will be transformed into potential behaviors, that is, given that objects have several affordances, each affordance will resemble a behavioral option. The

abovementioned cup can be equally grasped by its handle, top, or body. In essence, “an [o]bject becomes action” (Rizzolatti & Strick, *Cognitive Functions of the Premotor Systems*, 2013, p. 421). Neuroscience evidence posits that some neurons in the parietal and premotor cortex process interaction possibilities with encountered objects (Rizzolatti & Strick, *Cognitive Functions of the Premotor Systems*, 2013) which corroborates the ecological theory of perception.

With respect to the inherent variety of objects affordances, how does one determine which affordance is most appropriate for a given situation? Central to the Gibsonian theory, the grasping immediately follows the perception of the object. However, neuroscience studies reveal that two major factors determine from which affordance an object will be grasped, namely, object *meaning/function* and one’s *intentions* or *goals* (Rizzolatti & Strick, *Cognitive Functions of the Premotor Systems*, 2013). Unquestionably, meaning are assigned and goals are selected by top-down processing, a clear violation of the central assumption of the ecological theory of perception. This point will be elaborated in profundity as vision system is discussed in a later section.

4. A MODEL OF THE PERCEPTUAL PROCESS

To concisely summarize the two theories of perception, the constructivist theory can be sufficiently described as *perception for recognition* whereas the ecological theory as *perception for action* (Edgar, Edgar, & Pike, 2014; Eysenck & Keane, 2010; Norman, 2002). Furthermore, the constructivist-oriented theorists conceive of the acquired sensory information as insufficient and in considerable need of further top-down processing while the ecological-oriented theorists regard the same sensory information as sufficient and further top-down processing need not occur and on the basis of this information alone, an action can be undertaken in one’s environment. That is to say in different words, adherents to constructivism conceive of perception as an indirect mental phenomena in which the object percept evolves through three stages, namely, sensation, attention, and interpretation. In contrast to constructivists, proponents of the ecological theory challenge perception as a multistage process and view perception as direct in which perception emerges in a single stage. With regard to emphasis of each theory, perception for action emphasizes action as it is put by Gibson (1986) “perceiving is an act” (p. 149) while perception for recognition places emphasis on prior knowledge stored in memory and past experience. As a final point of difference between the two theories resides in the purpose of perception. While constructivists endeavor to understand “*how*” percepts are constructed, the ecological theory of perception seeks to understand “*for*” what purpose is perception (Edgar, Edgar, & Pike, 2014). The following **table** summarizes the differences between the constructive theory and the ecological theory:

Table 2: Constructive Theory versus Ecological Theory

	Constructivist (perception-for-recognition)	Ecological (Perception-for-action)
Founder	Helmholtz	Gibson
Quality of sensory information	Insufficient & Equivocal	Sufficient & Unequivocal
Intervention of other mental processes	Yes/Necessary	No/Unnecessary
Number of stages	Multi-Stage (Indirect)	Single-Stage (Direct)
Unit of Analysis	Processes & Mechanisms	Stimulation/Sensory
Consciousness	Unconscious/Unconsciousness	Unconsciousness
Role of memory	Important	No Role
Purpose of theory	How Perception Operates?	For What Is Perception?

Source: Based on Edgar, G., Edgar, H. & Pike, G., 2014. *Perception*. In: D. Groome, ed. *An Introduction to Cognitive Psychology: Processes and disorders*. New York: Psychology Press, pp. 24-69 and Norman, J., 2002. *Two Visual Systems and Two Theories of Perception: An Attempt to Reconcile the Constructivist and Ecological Approaches*. *Behavioral and Brain Sciences*, 25(1), p. 73-144.

It is unquestionable that both theories of perception have merits as advanced by their proponents. Notwithstanding, with respect to what have been discussed, which theory is most appropriate to account for consumers decision making? Before answering the arisen question, the taxonomy of mental processing must be addressed.

It has been firmly established that there are two systems by which consumers undertake their decisions, namely, system 1 and system 2 (Camerer, Loewenstein, & Prelec, 2005; Kahneman, Thinking, Fast and Slow, 2011; Lieberman, Gaunt, Gilbert, & Trope, 2002). While system 2 operates sequentially in a step-by-step fashion, system 1 operations are carried out in parallel in which the held tasks are performed simultaneously. Consequently, system 1 is fast and effortless whereas system 2 is slow and demands cognitive efforts. In contrast to system 1 which is reflexive and does not require consciousness, system 2 is reflective in which consciousness is an essential component to its operations. Moreover, the lack of consciousness in system 1 makes one unable to cite reasons as to why a decision has been taken, however, system 2 permits the introspective access to one's thought since consciousness is a prerequisite condition to such thoughts. To sum up, system 1 refers to the automatic processes while system 2 denotes the controlled processes.

Most decisions undertaken by consumers are automatic for it is "the default mode of brain operation" (Camerer, Loewenstein, & Prelec, 2005, p. 18). For example, frequently purchased products that does not require much processing are bought by system 1. Hence, one is inclined to associate the ecological theory of perception with automatic processing. Nonetheless, some decisions are made by system 2. For instance, the purchase of a novel product, in which much information must be gathered and different alternatives are evaluated, demands the inclusion of top-down processing. Hence, one is compelled to associate the constructive theory of perception with controlled decisions of system 2. However, a dissatisfied customer would *automatically* remember not to buy the same brand even on sale. That is, *knowledge* is *automatically* retrieved from memory to forestall the purchase and thus the constructive theory of perception is best equipped to account for such a decision. Moreover, some *novel* situations that are relevant to one's survival may compel an individual to take *instantaneous* actions. Taken as a whole, the unified dual theory i.e. system 1 and system 2, does not fully account for the two theories of perception, despite the apparent overlap. In different words, unlike system 1 and system 2, there is no clear compartmentalization between the constructivist theory and the ecological theory.

Moreover, it can be concluded that none of the theories of perception by itself would perfectly elucidate consumer behavior and a complete account of decision making will require the coexistence of both theories as the shortcomings from which one theory suffers can be compensated for by the opposing theory. For example, were a novel situation to be encountered, the constructivist theory will prove utterly ineffective for there exists no knowledge base on which the identification or recognition will be based and, consequently, the ecological theory is best suited to account for the emerging behavior. Notwithstanding, the constructivist theory is best suited for supplementing the ecological theory with the meaning of the object and intentions for the appropriate grasping is to be selected. With this in mind, the model illustrated in figure 1 below presents my view of the perceptual process.

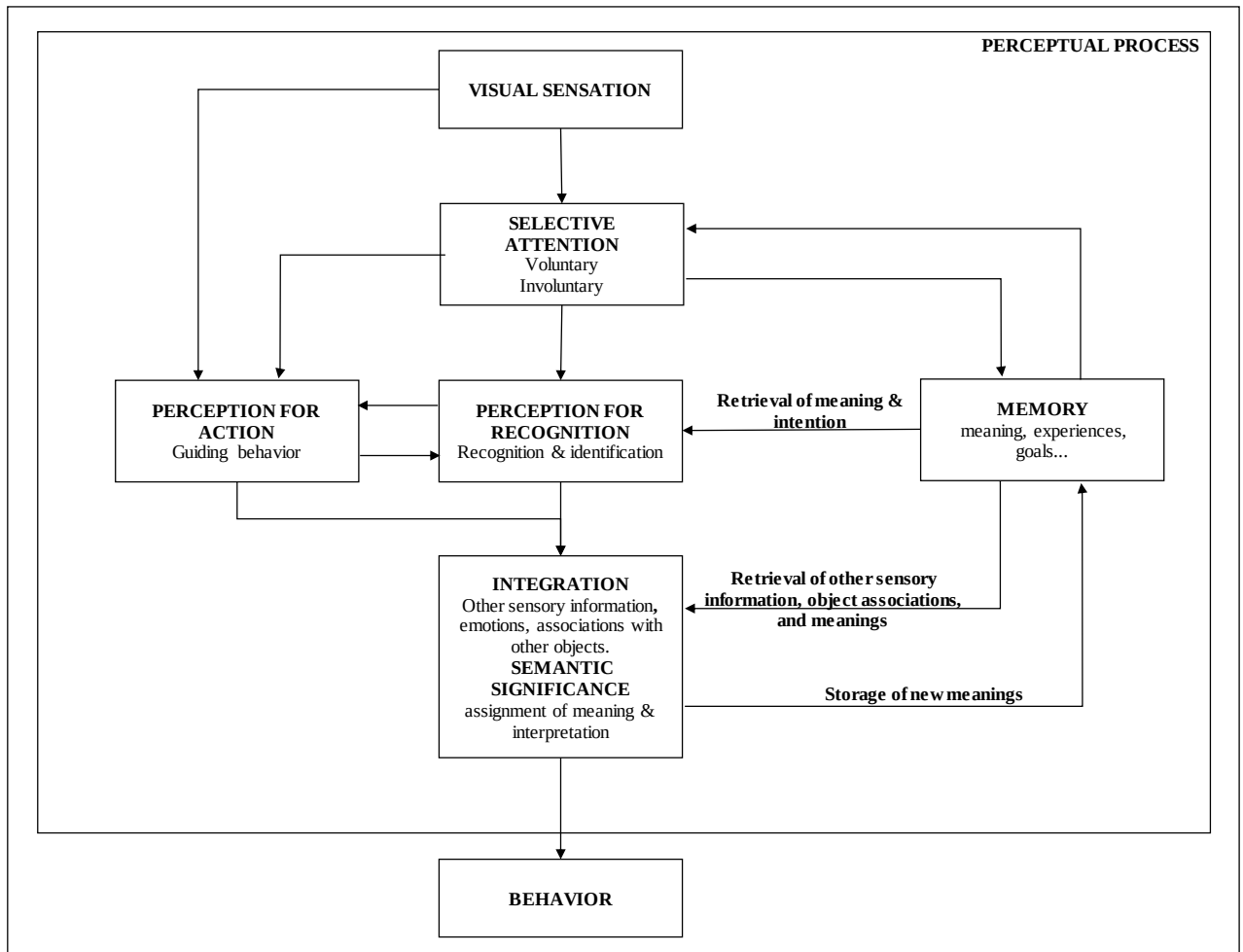
The differences and the interplay between the constructivist theory and ecological theory parallel the ventral pathway and dorsal pathway of the visual system (Norman, 2002). Further insights into the two theories of perception can be drawn as the structure and functionality of the visual system is discussed next.

5. THE VISUAL SYSTEM

Based on the representation of visual field and the functional properties of neurons, the visual areas in the brain are compartmentalized into two pathways, namely, ventral pathway and dorsal pathway (Gilbert, 2013). The labels these pathways bear is due to their location in the cortex. That is, the ventral pathway is the neural circuit that extends from the visual cortex in the occipital lobe to the temporal lobe while the dorsal pathway

refers to the neurons from the visual cortex to parietal lobe (Gilbert, 2013). As demonstrated in table 3 below, several considerable differences exist between the ventral and dorsal pathways. In essence, however, the ventral pathway uses visual information for the identification and recognition of objects in one's environment whereas the dorsal pathway uses the visual information for guiding behavior and movement in one's environment (James, Culham, Humphrey, Milner, & Goodale, 2003; Milner & Goodale, 2008; Norman, 2002).

Figure 1: Perceptual Process



Source: Personal Efforts

Table 3: Eight Main Differences between the Ventral and Dorsal Systems

Factor	Ventral system	Dorsal system
1. Function	Recognition/identification	Visually guided behaviour
2. Sensitivity	High spatial frequencies: details	High temporal frequencies: motion
3. Memory	Memory-based (stored representations)	Only very short-term storage
4. Speed	Relatively slow	Relatively fast
5. Consciousness	Typically high	Typically low
6. Frame of reference	Allocentric or object-centred	Egocentric or body-centred
7. Visual input	Mainly foveal or parafoveal	Across retina

8. Monocular vision

Generally reasonably small effects

Often large effects (e.g., motion
parallax)

Source: Eysenck, M. W. & Keane, M. T., 2010. *Cognitive Psychology :A Student's Handbook*. New York: Psychology Press, p. 48.

Consequentially to the specialization of labor, the ventral pathway is known as the “what” pathway whereas the dorsal pathway is referred to as “where” pathway (Kalat, 2016, p. 178). Second, unlike the dorsal pathway which is primarily concerned with motion, the ventral pathway is concerned with processing details. Third, in contrast to the ventral pathway whose operations hinge on memory, in which semantic significance and stored representations are retrieved from memory, the dorsal pathway does not rely on this type of memories for only working memory is required in which the sought behavior is held until its execution. Fourth, with respect to the input received by the visual system, two sources are to be distinguished, namely, parvocellular and magnocellular systems. Given that its input are originated from the magnocellular system, the dorsal pathway is faster than the ventral pathway for its input emerges from parvocellular system (Gilbert, 2013; Norman, 2002). Fifth, owing to the speed of the dorsal pathway, it is assumed that consciousness is not required for its operation. However, since the ventral pathway processes details, consciousness is an important prerequisite. Sixth, albeit both pathways process visual information about objects in one’s environment, the purpose of such processing is different and, as a result, the frame of reference changes accordingly (Norman, 2002). The ventral pathway processes information in order to identify or recognize objects which necessitates *allocentric* (object-centered) frame of reference. The dorsal pathway, on the other hand, processes information in order to execute some sort of behavior in relation to the object and, hence, *egocentric* (body-centered) frame of reference is required. Seventh, by virtue of sensitivity to the visual input, the ventral pathway is responsive to foveal or parafoveal vision whereas the dorsal pathway is sensitive to eccentric visual input. Finally, the ventral and dorsal pathways differ with regard to the extent to which they are influenced by binocular or monocular vision. In contrast to the ventral pathway which is less influenced, the dorsal pathway performance is severely diminished with monocular vision.

In what follows, some of the most important lesion studies and visual illusions experiments will be reviewed in order to uncover the relationship between the two pathways and the two theories of perception (Norman, 2002).

First, in lesion studies patients with brain damage are studied and their performance is examined and compared with normal individuals. Ideally, damage should be inflicted upon either the ventral pathway or dorsal pathway. Patients with damage to the ventral pathway should demonstrate an impairment in object identification and recognition while their guiding behavior should be intact. Contrariwise, patients with damage to the dorsal pathway should exhibit a normal object identification and recognition but an impaired guiding behavior. To be said concisely, these patients should demonstrate a double dissociation (James, Culham, Humphrey, Milner, & Goodale, 2003).

As it has been discussed above, damage to the temporal lobe in which the ventral pathway is located will result in *visual agnosia* in which a patient’s recognition abilities are impaired. When a patient diagnosed with visual agnosia is placed in an fMRI scanner in which brain activity can be observed (James, Culham, Humphrey, Milner, & Goodale, 2003), neural activity in the ventral pathway is next to inexistent when the patient was required to identify some drawings. However, when the same patient is instructed to grasp object, heightened activation is observed in the dorsal pathway and the patient could accurately grasped and placed objects. It can be concluded that this patient could use the visual information to guide behavior despite the inability to recognize objects. Unlike patients with damage to the temporal lobe, patients whose partial lobe is

damaged are diagnosed with *optic ataxia* (James, Culham, Humphrey, Milner, & Goodale, 2003; Milner & Goodale, 2008). Optic ataxic patients demonstrate the opposite pattern to visual agnostics. While they exhibited impairment in accurately guiding their behavior, they could easily identify and discriminate objects (Norman, 2002).

Second, visual illusions are extensively used in studying perception. The Latin etymology of the word illusion, *illudere*, denotes “to mock at” (Zimbardo & Gerrig, 2002, p. 142), that is, illusions arise when one’s perceptual apparatus is deceived or mocked in which a stimulus is misinterpreted. Illusions in visual perception abound, most notably, the *Müller-Lyer* illusion (also known as arrow-head illusion) in which two lines of the same length are perceived to be of different length depending on the direction of the arrowheads (fins), pointing inwards or outwards. Another prominent illusion is the *Ebbinghaus* illusion (also known as Titchener illusion). In this illusion, a circle placed in the center of smaller circles appears larger than a circle of the same size placed in the center of larger circles.

In a visual illusion experiment (Haart, Carey, & Milne, 1999) participants were instructed to match or grasp the shaft of the Müller-Lyer illusion. It was presumed that the matching task would involve the ventral pathway while the grasping task would activate the dorsal pathway. It is found that illusions are accentuated in the matching task but no illusions were found in the grasping task. From this experiment it can be concluded that in contrast to the dorsal pathway which is not affected by illusions, the ventral pathway is heavily prone to them.

In another experiment using the hollow-face illusion (Króliczak, Heard, Goodale, & Gregory, 2006) in which three experimental conditions were used, namely, a normal convex face perceived as normal, a hollow-mask perceived as hollow, and a hollow face perceived as normal due to lightening to create the illusion. Participants were required to quickly flick, slowly point, or draw the directions of targets placed on the stimuli. While the flicking and drawing task will activate the dorsal pathway and ventral pathway, respectively, the slow pointing task will activate both pathways. With respect to the illusory stimulus, results from the experiment demonstrate that participants could accurately flick the targets but their performance was impaired in the drawing task due to the illusion effect. With regard to the slow pointing task, participants’ performance was also impaired for, presumably, the intervention of the ventral pathway in the task.

6. DISCUSSION

Owing to the double dissociation of the ventral pathway from the dorsal pathway and their functions, the ventral pathway has been labeled the vision-for-perception (i.e. recognition) system and the dorsal pathway has been labelled vision-for-action system (Milner & Goodale, 2008). Not all behavioral actions are expeditiously exerted as in the flicking tasks and not all are carefully planned like in the drawing tasks. Rather, most actions require the interplay between the ventral pathway and dorsal pathway since their neural circuits directly or indirectly project to the motor cortex (Rossetti & Pisella, 2002). As discussed above, grasping demands that an object meaning and one’s intention to be supplemented (Rizzolatti & Strick, Cognitive Functions of the Premotor Systems, 2013). For example, before grasping a knife by either its handle or blade, one must first recognize it and then whether it is intended to be handed to someone else and thus grasped by the blade, or to be used for cutting something and it must be grasped by the handle. With regard to the dorsal and ventral pathways, it has been proposed that while grasping might purely depend on the dorsal pathway, the ventral pathway determines the *appropriate* grasping of an object (Creem & Proffitt, 2001). For example, the dorsal pathway that is responsible for vision-for-action picks up the affordances by which a cup of coffee will be grasped, that is, the handle, top, or body (Rizzolatti & Strick, Cognitive Functions of the Premotor Systems, 2013). Notwithstanding, the ventral pathway will decide from which affordance the cup will be grasped based on one’s intentions and goals. That is, supposedly the cup contains a hot beverage, the most appropriate affordance in this case would be the handle of the cup such that one would avoid the hot body of the cup and

if one's intention is to handle the cup to someone, the most likely affordance is the body. To be stated differently and clearly, in contrast to the dorsal pathway which selects the affordances to insure *effective grasping*, the ventral pathway decides which affordance permits *appropriate grasping* (Creem & Proffitt, 2001).

Indubitably, the dichotomous nature of the visual system into two pathways, namely, ventral and dorsal parallels the compartmentalization of perception theories into the constructive theory and the ecological theory (Norman, 2002). To be stated clearly, it would appear that the constructivist theory of perception is an account of the functionality of the ventral pathway while the ecological theory accounts for the dorsal pathway. In spite of the differences between the two pathways of vision, it should be emphasized that a normal functioning requires the synergistic interaction of the ventral and dorsal pathways (Kalat, 2016). With this in mind, it can be concluded that both theories of perception are correct, yet insufficient accounts. Consequently, these accounts should be conceived of as complementarities rather than opposing theories and both should be included in any discussion of perception.

CONCLUSION

The primary purpose of this article is to propose a model of the perceptual process supported by neuroscience findings. The two most influential theories of perception were addressed, namely, the constructive theory and the ecological theory. The validity of each theory was examined by its respected neural correlates and it was concluded that there are merits to both theories. Any endeavor to comprehensively account for consumer behavior requires the inclusion of both theories for the exclusion of either one will result in a reduced description. The assertion that the two theories must co-exist was advanced after the exploration of the structure and functionality of the visual system. The visual system is composed of two pathways, namely, ventral and dorsal. There is a double dissociation between these two pathways and each bears different responsibility. The ventral pathway mediates the construction of mental representation of the encountered object, that is, object identification and recognition. The dorsal pathway, in contrast, picks up the object affordances in order to guide one's actions and movements with reference to the said object. That is to say, there are two purposes of perception, perception-for-recognition performed by the ventral pathway and perception-for-action which is executed by the dorsal pathway. To be said differently, perception-for-recognition *plans* a behavior and perception-for-action *implements* it (Króliczak, Heard, Goodale, & Gregory, 2006). The perception-for-action utilizes visual information to guide one's action in one's environment while perception-for recognition uses the visual information to know one's environment.

Undoubtedly, more research is needed to validate and contribute to such models. Future research could identify what marketing stimuli such brand names, prices, or any purchase criteria can be considered as affordances? In a similar vein, owing to the proliferation of online purchases, in what way should the theories of perception be reviewed or adapted to account for online consumer behavior? Furthermore, growing amount of research is being undertaken to demonstrate the role of affect or emotion in decision making and this article only addressed emotion in the recognition stage as information from distinct areas of the brain are integrated. Researchers to whom emotion is of interest should investigate how emotions influence each stage of the perceptual process and to what degree each of the dorsal pathways is influenced by emotional states?

Neuroscience will be immensely influential in the future theoretical conceptualization of consumer behavior. And most, if not all, marketing scholars and practitioners would attest to the fact that marketing as a discipline is at its apotheosis. Consequently, apotheosis of a field implies its theoretical saturation and stagnation. Notwithstanding, neural science, as the present article demonstrates, can be adopted to further the theoretical development of marketing science.

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