Unifying Theories of Consciousness, Attention, and Conscious Attention

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Abstract

One of the more challenging research areas in cognitive science is the attempt to understand how the brain supports consciousness. This historically philosophical endeavor is now actively studied in the sciences, with research on visual attention being an especially promising area that can further our understanding of consciousness. A major problem with this cross-disciplinary pursuit, however, is that for philosophers and scientists, the terms consciousness, attention, and conscious attention are ambiguous and used differently even by those within the same academic discipline. The goal of this paper is to begin laying the groundwork for a unified study of consciousness by delineating common terminology for attention and consciousness and by identifying the relationship between the two within the study of conscious attention. This includes categorizing current theories according to a spectrum of theoretical complexity.

Keywords: attention; consciousness; conscious attention; philosophy of mind; perception.

Introduction

Although the relationship between consciousness and attention has been at the center of recent discussions in cognitive science, the proposals for this relationship are based on assumptions that are problematic. For instance, it is often assumed that the terms "attention" and "consciousness" unambiguously describe specific types of mental phenomena that can be identified experimentally. There is empirical evidence, however, that there are different types of attention, with different neural correlates that cannot be reduced to one another (Parasuraman, 2000), which complicates the attempt to establish a clear relationship between attention and consciousness. Furthermore, while many authors think that it is plausible to define "attention" in terms of several basic types of attention, other theorists think that defining "attention" is hopeless (see Allport, 1993; Johnston & Dark, 1986).

Similarly, some theorists think that there are at least two types of consciousness (e.g., Block, 1995), and that only one of them is strictly related to the subjective experience of conscious awareness. Other theorists think that the "hard problem" of consciousness (i.e., the study of phenomenal or subjective experience) makes the empirical study of consciousness, unlike the study of perceptual attention, intractable (e.g., Chalmers, 1996; Nagel, 1974). Finally, there are theorists who think that the hard problem of consciousness is just a pseudo-problem, and that consciousness can and *must* be studied empirically (e.g., Churchland, 1996; Dennett, 2005). These contrasting opinions and approaches have complicated the study of consciousness in relation to attention, often resulting in a gridlock of concepts between opposing theories. It is possible, however, that many of the current theories on consciousness are not necessarily in opposition, since there may be semantic ambiguities producing these disputes.

Because of the polysemy of the terms "attention" and "consciousness", one should avoid stipulating definitions without first delineating empirical and theoretical constraints that such definitions must satisfy. It is crucial to determine whether the different theoretical perspectives refer to the same types of attention and the same types of consciousness. Based on empirical findings and a theoretical classification of the possible views on this topic, we propose definitions for forms of consciousness, forms of attention, and forms of conscious attention in order to provide a foundation to compare and move forward different theories.

Another goal of this paper is to offer a brief account of recent theories on consciousness, with a focused consideration of how empirical research on attention can provide the grounding for an empirically-driven account of consciousness. One way to do this is by analyzing recent theories on consciousness and attention by categorizing them according to a spectrum of theoretical complexity, starting with the theories that impose the strictest requirements on the interpretation of empirical findings to those that allow the widest range of possible interpretations. For instance, Jesse Prinz (2012) has defended the view that consciousness is just attention. This "strict" view entails that there cannot be any finding about attention that is not a finding about consciousness and vice versa.

Although an identity approach is parsimonious, since it reduces that kinds of cognitive processes associated with consciousness and attention to a single type, it creates the problem of reducing significantly the room for interpretation. For example, the desideratum of empirical adequacy seems to demand more theoretical leniency for the interpretation of research findings that indicate disassociations between attentional processing and conscious awareness. Should it not be possible that some form of attention exists without consciousness, even if consciousness cannot occur without attention? Michael Cohen and colleagues (2012) argue in favor of this possibility. At the extreme opposite of the spectrum, one

finds the view that consciousness and attention can be fully dissociated (i.e., there can be forms of consciousness without attention and vice versa) advocated by Koch and Tsuchiya (2007) and Lamme (2003), among others. This range of possible theoretical complexities provides insight to the approach one can take in studying conscious attention. Due to the diverging views, a meta-analysis is crucial for advancing this field, and future work should focus on such an in-depth analysis. We present a brief overview of the development of the views described above and outline the start of a such meta-analysis.

Problems of Consciousness

Thomas Nagel (1974) said that the problem of conscious experience is what makes the mind-body problem both interesting and intractable. The problem of how the mind connects with the world would lose its allure, and even become trivial or irrelevant, if one had no idea how solutions to this problem would explain consciousness. Once the theoretical and empirical options to account for consciousness are carefully assessed, however, it becomes clear that they are all problematic. The best way of formulating the intractability of this problem is in terms of what David Chalmers called the "hard problem" of consciousness, that is, why would anything physical have conscious experiences and what is the relationship between physical brain processes and the subjective experience of consciousness? Much has been written about this problem, and there is now widespread consensus that it is not only a difficult philosophical problem, but also one of science's more difficult unsolved puzzles.

Access vs. Phenomenal Consciousness

Although the problem of consciousness is remarkably intricate, a great deal of progress has been made on the theoretical front. A significant amount of conceptual clarity has been achieved with respect to the question of why functions for cognitive processing may explain some forms of conscious integration required for working memory (what Ned Block, 1995, calls *access consciousness*), but may not suffice to account for the qualitative aspects of conscious experiences (what Block calls *phenomenal consciousness*). Access consciousness provides a "workspace" for concepts and multi-sensory information to be accessed for the purposes of reasoning and performing complex actions. These do not necessarily need to reach awareness (i.e., reach a cognitive state where one can report experiencing it). Another theory, by David Rosenthal (2002), proposes that a *higher-order thought* (HOT) is required for one to be conscious of mental states. These are thoughts about *mental states* (resulting from sensations or memory retrieval) that allow us to be conscious of them. The relationship between access and phenomenal consciousness (between thoughts and higher-order thoughts in awareness) is one area where attention research may help, for example, by clarifying how thoughts move from access to phenomenal consciousness.

Self Consciousness

Another source of problems concerning treatments of conscious perception is the role of the self in phenomenal experience. A number of intricate questions originate from this topic. Can one be conscious of something (an emotion, a perceptual representation, etc.) without also being conscious that one is conscious of it? Is the "self" constitutive of every possible experience without itself being experienced? How should we understand consciousness, self-awareness, and the conscious self? One problem with an emphasis on the "self" view is that it seems to demand too much to account for all conscious creatures and because of this reason, it seems to be empirically implausible. Christof Koch (2012), for instance, argues that the self is not necessary to have conscious experiences. He criticizes the mirror test, which infants and most animals fail, as a test for consciousness (although it seems to be a good test for self-awareness). The reasoning is that infants and many animals must have some kind of consciousness (of the phenomenal kind) because they experience pain, feel emotions, etc. They may not have self-consciousness but, the claim is, they do have phenomenal consciousness.

Plausible as this criticism is, however, the relationship between consciousness and self is much more intricate than first appearances suggest. In a passage where Koch is defining the scientific problem of consciousness, he uses two incompatible interpretations of the word "self" when criticizing the conclusion that failure to pass the mirror test indicates the lack of consciousness. One notion of the "self" is the higher-order self that recognizes a particular thought as hers (the *recognitional self*). Koch seems justified in claiming that the recognitional capacities associated with this kind of self may not be necessary for consciousness. But how to interpret the more primitive "self" that Koch associates with experiences of "flow" (the *phenomenal self*)? This is a central question that needs to be answered in order to understand the relationship between higher forms of self-awareness and phenomenal consciousness.

Unconscious Processes

The progress on the experimental front in consciousness research has been dramatic. The situation changed from being one in which the problem was completely ignored (perhaps because it seemed an intractable problem) to one in which substantial resources are spent in research laboratories, producing valuable empirical evidence about the nature of conscious awareness. What paved the way towards this progress was the experimental research on *unconscious perception* and *unconscious cognitive processing*. Bernard Baars (1988), for instance, used well-known unconscious processes (with established research methodologies) to probe the contours of conscious processing. The comparison between the neural correlates of conscious and unconscious processing has already produced crucial insights into the nature of conscious awareness. For example, the thesis that consciousness is the result of a highly integrative process that occurs in a "global

workspace" (Baars, 2002) has been confirmed with neuroscientific evidence (e.g., Dehaene & Naccache, 2001; Di Lollo, Enns, & Rensink, 2000).

Another area of advancement is the range of related topics that are studied experimentally with the goal of better understanding consciousness. Experiments on conscious and unconscious perception, binocular rivalry, and mental imagery have expanded our knowledge of perceptual awareness. Additionally, research on the distinction between conscious inclinations for action and the unconscious processes that guide motor control has shown that the processes that reach awareness are indeed just the tip of the cognitive processing iceberg (Rosenbaum, 2002).

Contents of Consciousness

An important philosophical development that has taken place in the last few years is the incorporation of insights made by psychologists and phenomenologists concerning the content of conscious experience. Susanna Siegel (2006), for example, uses the notion of *phenomenal contrasts* (a change in how one experiences something) in order to account for the content of conscious vision. This topic in the philosophy of perception concerns our understanding of the difference between conscious perception, illusions, dreams, and hallucinations.

In the history of cognitive psychology, ambiguous images have been considered a paradigmatic case of such contrasts. In the Necker cube (a geometrically ambiguous image that appears to point upward or downward) or the "duck-rabbit" drawing (a semantically ambiguous image that can look like a duck or a rabbit), the stimulus—or perceptual content—does not change but the subject experiences it in one of two alternative ways at a time, and never both at the same time. It is an established finding in vision science that these images alternate at a constant rate, regardless of the intentions of the subject. At first, one interpretation is salient, then it recedes and the other incompatible interpretation becomes the salient one. The subject can also direct her attention, however, and "flip" the interpretations, for example, by focusing on one of the inner corners of the Necker cube (e.g., focusing on the lower inner corner where three edges meet will encourage the ambiguous drawing to be perceived as an upward pointing cube). These attentional contrasts with phenomenological implications show that voluntary and involuntary forms of attention interact with consciously experienced contents in analogous ways.

Other phenomenal changes seem to depend fundamentally on attention, rather than represented content. In discussing the implications of findings on visual attention by Marisa Carrasco and colleagues (e.g., Carrasco, Ling, & Read, 2004; Carrasco & Yeshurun, 2009), Block argues that the phenomenal changes in experience, based on changes in attention, are not dependent on either external changes or changes in conceptual aspects of the stimuli (such as semantic ambiguity or expertise). He notes that the quality of these experiences (which he calls "mental paint") feels "unreal", similar to visual experiences concerning afterimages. Block contends that these findings cannot be explained as illusions because the percept relies on how attention is *allocated* rather than being a true misrepresentation of the stimuli. The "subjective unreality" of these changes, Block (2010) claims, has not received any empirical investigation. They also remain unaccounted for in a broader theoretical treatment of consciousness. Here is where the study of attention can provide important insights.

What Is Attention?

Attention research in cognitive psychology is quite active and covers a range of processes—from low-level perceptual systems to high-level cognitive systems. These processes act as "selection" mechanisms to determine what information reaches higher-level cognition, including conscious awareness. In this discussion, we are mainly referring to *visual attention*, which has the most active research. It is accepted in the scientific community that there are several types of attention comprised of distinct cognitive systems, which have been identified and supported through studies in neuroscience. For example, Posner and Petersen (1990) argued that there are at least three systems that are individually responsible for alerting, orienting, and target detection or executive function (e.g., the top-down processes of visual search). These classifications have held up over years of research, although there is recent evidence for additional attention networks for self-regulation and self-control (Petersen & Posner, 2012). It is crucial to identify the implications of the various forms of attention on cognition, especially to understand how attention and consciousness are related.

Bottom-up vs. Top-down Attention

Attention can be stimulus-driven and automatically guided toward important external events that involuntarily catch the focus of attention, or it can be voluntarily guided through willful selection. This distinction is commonly conceived as *bottom-up* versus *top-down* processing (see Theeuwes, 2010). That is, attention can be thought of as a process that is *exogenous*, data-driven, and beyond our control in a cognitively impenetrable manner (bottom-up). This includes pre-attentive mechanisms that are reflexive in nature, such that salient features bias the neural activity for selection into higher processes and can affect behavior without reaching conscious awareness. Alternatively, attention can be described as being *endogenous* and more deliberate, which biases the competing neural activity in lower-level cognition based on the goals of the current task (top-down). This dichotomy has been challenged recently because there are other forms of attention that do not neatly fall into these categories, such as when learned rewards or habits influence attention (Awh, Belopolsky, & Theeuwes, 2012). Nevertheless, there are many attentional processes that fall under one of these two descriptions.

Effortless vs. Effortful Attention

Effortless attention, like bottom-up attention, is thought of as an involuntary, sensory form of attention and does not always reach conscious awareness. These "effortless" processes serve to obtain information from the environment for higher-level representations (which often require more effort to maintain). On the other end of this spectrum is *effortful attention*, which, like top-down attention, can be described as focused, deliberate, voluntary, or goal-driven and produces the subjective feeling of expending effort. Some complex attentional processes, however, can be so engrossing that they produce the subjective feeling of being involved in a task effortlessly such that one loses a sense of time (Bruya, 2010). It is this latter version of effortless attention that is particularly insightful, which may be related to expertise and is suggestive of how memory systems can interact with attention to influence the perception of effort and time (it is not a straightforward process).

Varieties of Attention

Beyond the distinctions described above, attention has been characterized under several "varieties". Attention can be *feature-based* (see Maunsell & Treue, 2006) and drawn to types of features, generally organized according to specialized regions in the brain that process certain types of sensory information (such as color, motion, or segment orientation). It can also be *object-based* (Scholl, 2001) and drawn to things in the world that display object-like properties (e.g., cohesion, symmetry). Feature Integration Theory and Object File Theory describe how object-based attention can operate via "object file" representations (Kahneman, Treisman, & Gibbs, 1992; Treisman & Gelade, 1980). This is a two stage process that requires the individuation of objects (a bottom-up process) and the identification of the object after a selective attention binds and maintains the features in an object file. This exemplifies the interaction between low-level and high-level forms of attention that makes the study of attention so complex.

Another influential model for attention is the "spotlight model" (Posner, Snyder, & Davidson, 1980), where attention can be *focused* on a specific region, or it can be *distributed* and more diffuse to cover more area (with less detail). This *spatial attention* operates on empty space or objects in space, and also can quickly determine the "gist" of the information present. *Covert attention* is a particularly insightful form of attention and refers to the voluntary shift of attention outside the center of one's gaze (Wright & Ward, 2008). This has been shown through various tasks where a subject views a center of a stimulus display but shifts the focus of attention to the periphery without moving their eyes (or making other physical movements). This type of attention may correspond to the ability to attend to certain thoughts from memory or other mental states that are not immediately linked to sensory information.

Additionally, research on attention has identified peculiar phenomena such as blindsight, inattentional blindness, and the attentional blink. All these describe occasions when attention fails to perform as expected, particularly because focused attention overlooks targets (e.g., during a search task). The failures may be due to the relevant information not being detected by low-level sensory receptors or could be higher up where it fails to reach awareness. This exemplifies the complexity of the systems that make up the broad term of "attention", which all have the common goal of selecting perceptual information for cognitive processes.

Conscious Attention

A problem in the empirical study of consciousness is how to identify and explain all the nuances of the theoretical understanding of consciousness at the neural level. For example, even if the experimental evidence confirms that consciousness correlates with a specific pattern of neural activation, what would that finding signify? Could we be able to distinguish access consciousness from phenomenal consciousness? Could it be that the pattern of activation is literally just correlated with consciousness and it neither explains nor identifies what is truly unique about it (i.e., it corresponds to the integration of information but not to the integration mechanism)? Much has been said about this issue, and we will not provide a metaphysical thesis here about the relevance (or lack thereof) of attempts to identify the neural correlates of consciousness. Despite the difficulties underlying the metaphysics of consciousness, we believe that the progress on the experimental front has been substantive. By focusing on the largely unexplored issue of *conscious attention*, we can outline the general features of an adequate theory of consciousness that would successfully guide future empirical research.

One way of clarifying the relationship between consciousness and attention is by examining the relationship responsible for successful reductions. The spectrum of views that are possible, from most to least restrictive, include: 1) Identity between consciousness and attention, with specific definitions of the kinds of consciousness and attention at stake; 2) Dissociative views of consciousness and attention, where there are several forms of attention without consciousness, but only one form of conscious attention, and attention is a necessary condition for consciousness; 3) Dissociative views that indicate all forms of consciousness are of the same type but that attention is not a necessary condition for consciousness; 4) Dissociative views that indicate there are forms of attention without consciousness but no possible form of consciousness without attention, although there may be many forms of conscious attention; and 5) Full dissociation between consciousness and attention.

The *identity thesis for consciousness and attention* is the most restrictive of these views and is akin to the reduction of questions about "life" to questions about DNA. According to this view, consciousness just is attention (e.g., Prinz, 2012). There are advantages of this view, but there are also major problems, both theoretical (Koch & Tsuchiya, 2007) and empirical (Kentridge, 2011). Many of these problems are best understood as possible responses to

two different questions. 1) Are all forms of attention forms of conscious attention? The intuitive response is yes, but the empirical evidence is not clear-cut. 2) The inverse question: are all forms of consciousness forms of conscious attention? Here, things are much trickier and no obvious response seems without problems. The leading intuitions have epistemic or metaphysical flavors, but no leading intuition clearly commands the inquiry. Furthermore, this concerns only theoretical issues—when one looks at the empirical evidence, things are equally tricky. Despite its intuitive strength, the identity thesis is too simplistic to account for such intricate issues as identifying the various systems supporting consciousness and attention—but full dissociation seems to be too strong and so a landscape of options emerges. There seems to be attention without consciousness, for example, as in the case of blindsight. How prevalent are these forms of unconscious attention (i.e., to what extent do they guide cognitive processing)? There may be consciousness without attention and the same consideration about scope is pertinent. Depending on the degree of dissociation, one can envision several possibilities with critical theoretical implications.

What are the possible outcomes? Suppose the degree of dissociation is insignificant. In this case, one could distinguish a few forms of consciousness without attention (or vice versa), but they would be rare cases of little consequence such that one could almost identify consciousness with attention. Yet, even in this case several questions remain. Why would these forms of consciousness without attention (or vice versa) exist? All issues of scope are relevant here. Suppose that all forms of attention are forms of conscious attention but that there are a few cases of consciousness without attention (or attention without consciousness). This possibility would suggest that these forms of consciousness could not be easily integrated with attentional processes, where some forms of consciousness are more resilient to cognitive integration with other processes than others. Or perhaps it is strictly due to there being two fundamental kinds of consciousness.

Suppose, on the contrary, that the degree of dissociation is severe (we focus only on these polar opposites in this paper). Some cases of conscious attention could be associated with what Block calls mental paint, and be highly if not fully dependent upon subjectively unreal attentional contrasts. Other cases of conscious attention could be highly representational and depend on specific mental contents (as attention is generally understood). Finally, other cases of attention could be directed to the conscious self. Of course, there will be many cases in which attention is not accompanied by consciousness (at least phenomenal consciousness) and there will also be cases in which consciousness is not accompanied by attention. The main result would be that consciousness and attention are integrated in some cases, but operate independently from one another. Based on current empirical evidence, however, there is only weak support for consciousness without attention, because there are several types of attention that must be examined when testing for the presence of consciousness without attention, and studies that claim this dissociation have failed to do so (see Cohen, et al., 2012). Also, this dissociation is unlikely if one accepts the premise that the purpose of attention is to determine what information reaches conscious awareness.

Examining the findings in neuroscience should help clarify the relationship between attention and consciousness. It is accepted that different areas of the brain support different forms of attention. For example, it seems that the cerebellum and other more "primitive" areas of the brain are not necessary for consciousness (Koch, 2012), and yet the cerebellum is crucial for navigation and thus has several areas devoted to attending to features of the environment. Areas associated with emotion, perception, and motivation, which were thought to be deeply related to phenomenal consciousness, are also unnecessary for conscious awareness. So based on the neuroscientific findings, one can make a very plausible case for dissociation. This conclusion has to be evaluated in conjunction with the considerations that led theorists to propose the identity thesis. Furthermore, innovative theories on how consciousness emerges, for example, from recurrent processes in the brain (Lamme, 2006), must be considered in this work.

To advance the understanding of conscious attention, one must provide an integrated account of consciousness and attention based on the latest psychological and neurological findings. By doing so, we can elucidate theoretical distinctions fundamental for an adequate understanding of the conscious mind, such as the distinction between higher forms of self-awareness (e.g., the recognitional self) and more minimal ones (e.g., the phenomenal self). Also, higher forms of attention and consciousness may be associated with the emergence of social interactions within species. That is, as social interactions become more complex (e.g., monogamous mating, social hierarchies, ability to follow gaze), a more sophisticated cognitive system is necessary and this may be correlated to consciousness. Research considering such a social account is also warranted.

Conclusion

In order to advance the empirical study of consciousness and attention, a concerted effort must be made to unify the two areas in terms of language and goals. Attention research is a promising area for understanding consciousness, especially by clarifying the relationship between consciousness and attention via conscious attention. A main insight from the research findings on attention, which should guide future inquiry, is that attention is mainly concerned with connecting cognitive processing with objects in the external world by processing selective information—it is more analytic and selective in nature than consciousness, which is highly integrative. The past attention research in cognitive psychology, however, presents a challenge for integrated accounts with consciousness, such as the one we pursue here. Most psychologists working on attention had, because of the

intractability of the problem of consciousness mentioned above, either no interest in consciousness or no way to connect their findings with such considerations. Findings on focused attention, divided attention, failures of attention, and other aspects of attention shaped the field without making it explicit how they were compatible with theories of consciousness. Making these connections explicit is another crucial goal for future work that will inform our understanding of conscious attention, and can only emerge from a unified theoretical and conceptual understanding.

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