Conceptual understanding of the relationship between consciousness, memory, and attention

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Abstract

Consciousness is really regarded as too ambiguous a concept to be understood and accepted as a mental construct without the inclusion of memory and attention in any conceptualization. However we need one criterion to count satisfactorily as an explanation of consciousness in information processing. An operational working definition of consciousness could be made in comparison of memory and attention: Consciousness would be a subjective awareness of momentary experience and also have the characteristics of an operating system performing control and consolidation information processing. This could be called a cognitive consciousness. It is possible that some distinctions between consciousness, memory and attention can be made conceptually and functionally from the perspectives of information processing.

Keywords: cognitive consciousness; memory; attention; information processing

Introduction

Consciousness could be ambiguous enough not to be understood and accepted as a psychological term. For a long time in scientific psychology, consciousness as a research topic or explanatory concept had been banned because of the too broad explanation(the lack of criteria) and poor methodological rigidity. Modern investigations into consciousness have been made based on psychological statistical and experimental studies and case studies of consciousness states and the deficits. In addition, the influential cognitive theories of consciousness are grounded in an information processing system (Atkinson, Thomas & Cleeremans, 2000; Johnson-Laird, 1993). We need one criterion for what counts as a satisfactory explanation. There thus needs to be some consensus about which concepts are well enough understood to be used in explanation.

Researches on topics associated with consciousness have been undertaken into the subjects of attention, working memory and the central executive. These concepts were precursors that facilitated the development of cognitive theories of consciousness. The close relationship between attention and consciousness and working memory had led many scholars to conflate these processes. But at the fundamental conceptual explanation level, an operational definition about consciousness could be made in the comparison of memory and attention.

This study attempts to examine the relationship between consciousness, attention and memory with the fundamental conceptual explanation level from the information processing psychology approach and try to suggest a conceptual framework of the relationships between consciousness, attention and memory in the some research results studied respectively.

Cognitive consciousness

Memory is the means by which we retain and draw on our past experiences to use this information in the present (Tulving, 2000; Tulving & Craik, 2000). As a process, memory refers to the dynamic mechanisms associated with retaining and retrieving information about past experience (Crowder, 1976). Specifically and fundamentally, cognitive psychologists have identified three common operations of memory: encoding, storage, and retrieval (Baddeley, 2000).

Attention is the cognitive process of selectively concentrating on one aspect of the environment while ignoring other things (Duncan, 1999; Motter, 1999; Posner & Fernandez-Duque, 1999). According to Fernandez-Duque and Johnson(1999), the notion of attention, involving selective attention and divided attention, is naturally highlighted as an information enhancement in the spotlight metaphor, as an information inhibition in the filter metaphor. In the spotlight metaphor, attention is different from the executive system (agent who controls the spotlight) and the awareness system (agent who sees).

Consciousness has been identified with the contents of a limited capacity processing mechanism (Posner and Boies, 1971); with the subjective state of being currently aware of something, either within oneself or outside of oneself (Farthing, 1992; Johnson-Laird, 1993); with a device that determines what actions to take and what goals to seek (Shallice, 1972); with a particular mode of information processing that affects the mental structures governing actions (Mandler, 1975); with a means of coordinating information from a number of sources, including the present, specific episodes from the past, and projections as to the future (Baddeley, 1992). Baddeley(1992) also suggests that the crucial function of consciousness allows the organism to reflect on the available options and choose a particular

action or strategy, rather than being driven by the sheer weight of past experience, and with an operating system at the top of the hierarchy in the brain (Johnson-Laird, 1993). In this context consciousness is explained in the aspects of the executive control system (Johnson-Laird, 1988, 1993; Kihlstrom, 1984, 2004; Shallice, 1978).

All these things considered, three common operations of consciousness could be identified: awareness, control and binding(consolidation). An operational working definition of consciousness could be made in the comparison of memory and attention: Consciousness would be a subjective awareness of momentary experience and also have the characteristics of an operating system performing control and consolidation information processing. This could be called a cognitive consciousness which refers to subjective awareness and an executive control system, even though those are not equivalent concepts. Cognitive consciousness could be similar to Block (1995)'s access consciousness and Chalmers (1996)'s psychological consciousness, though, even more including mental constructs like memory and attention.

The relationship between consciousness, memory, and attention.

Many studies have undertaken to make distinctions between consciousness, attention and memory (Figure 1). When it comes to the relationship between attention and memory, visual search could require minimal visual working memory resources (Woodman & Luck, 1999; Woodman, Vogal, & Luck, 2001). Attention is not critical for the retrieval of objects that are consistent with a scene's schematic content. It is possible that the memory could be in process without attention (Silva, Groeger, & Bradshaw, 2006).

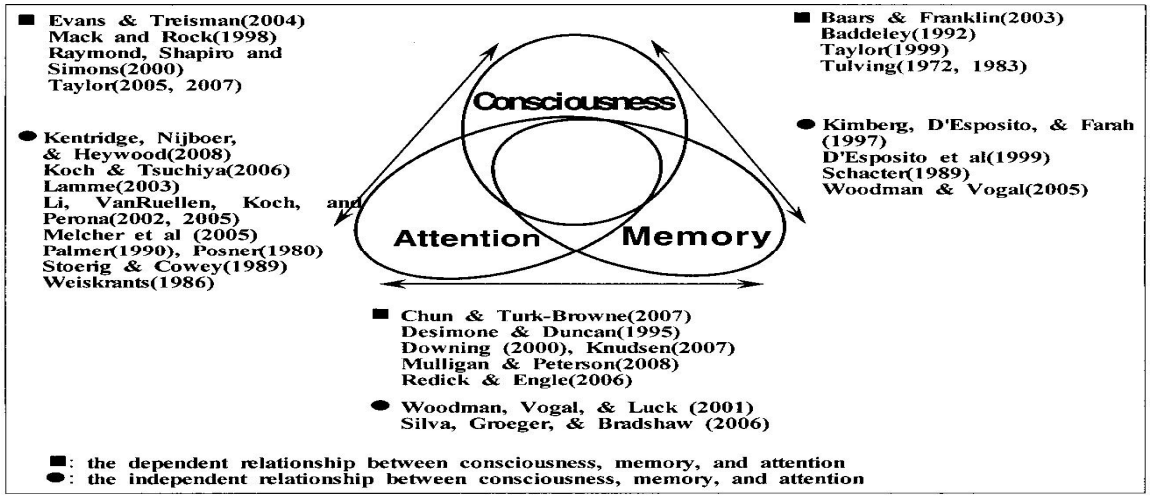

Figure 1. The relationship between consciousness, memory, and attention

As to attention and consciousness, visual attention and conscious awareness seems to be different processes (Lamme, 2003). Top-down attention and consciousness are distinct phenomena that need not occur together and that can be manipulated using distinct paradigms (Koch and Tsuchiya, 2007). Some active attentional processing of sensory information, remembered information, and cognitive information proceeds without conscious awareness (Vogel, Luck, & Shapiro, 1998). Conversely, without attention, binding and conscious awareness could happen (Braun & Julesz, 1998; Kentridge, Nijboer, & Heywood, 2008; Howe, Evans, Pedersini, Horowitz, Wolfe & Cohen, 2009; Li, VanRuellen, Koch, & Perona, 2002, 2005; Reddy, Wilken, & Koch, 2004).

Awareness of a scene on which close attention is not focused may be different than awareness of a scene on which attention is focused, but in both instances the scene is observed. In the absence of attention we could retain some visual awareness, but would be unable to form any percepts that themselves would require the binding of two or more features (Evans and Treisman, 2004; Howe et al, 2009).

As to consciousness and memory, according to an Event-Related MRI study, maintenance and manipulation of information processes engage different regions of PFC than other regions (D'Esposito, Postle, Ballard, & Lease, 1999). There may be independent mechanisms for the consolidation and the maintenance of information in working memory (Woodman and Vogal, 2005).

Judging from the results of many empirical studies undertaken from the perspective of information processing, we can argue that features that are often attributed to attention, features such as awareness and binding, may more

accurately be viewed as properties of consciousness. In the same way, features attributed to working memory, such as consolidation and manipulations, may also be viewed as properties of consciousness. Working memory's executive function, executive attentional processes that participate in the active manipulation and updating of the contents of working memory, does not have clear theoretical definition and positive experiential evidence (Kimberg, D'Esposito, & Farah, 1997; Shah & Miyake, 1999; Woodman and Vogal, 2005).

Figure 1 notes that the relationships between consciousness, memory, and attention in information processing could be independent as well as dependent. Conscious awareness could operate independently from selective attention for binding and vice versa also possible. Selective attention and working memory do not always operate together in information processing. Three mental constructs could operate dependently or independently depending on the specific tasks conditioned.

Conclusion

We have a mental life and we need to determine what we may take for granted to explain it. An explanation should clarify what we do not understand in terms of what we do understand. We need to find basic concepts to establish a common ground for discussion. Concepts in use derive meaning not from dictionary definition but from other concepts to which they are related. In this, consciousness is no exception. In this study the relationship between consciousness, memory and attention is examined from the perspective of information processing. It also provides a conceptual understanding of the distinction in the relationships of three constructs and attempts to describe a conceptual landscape of the relationship between the three as hypothetical constructs as in figure 2 below.

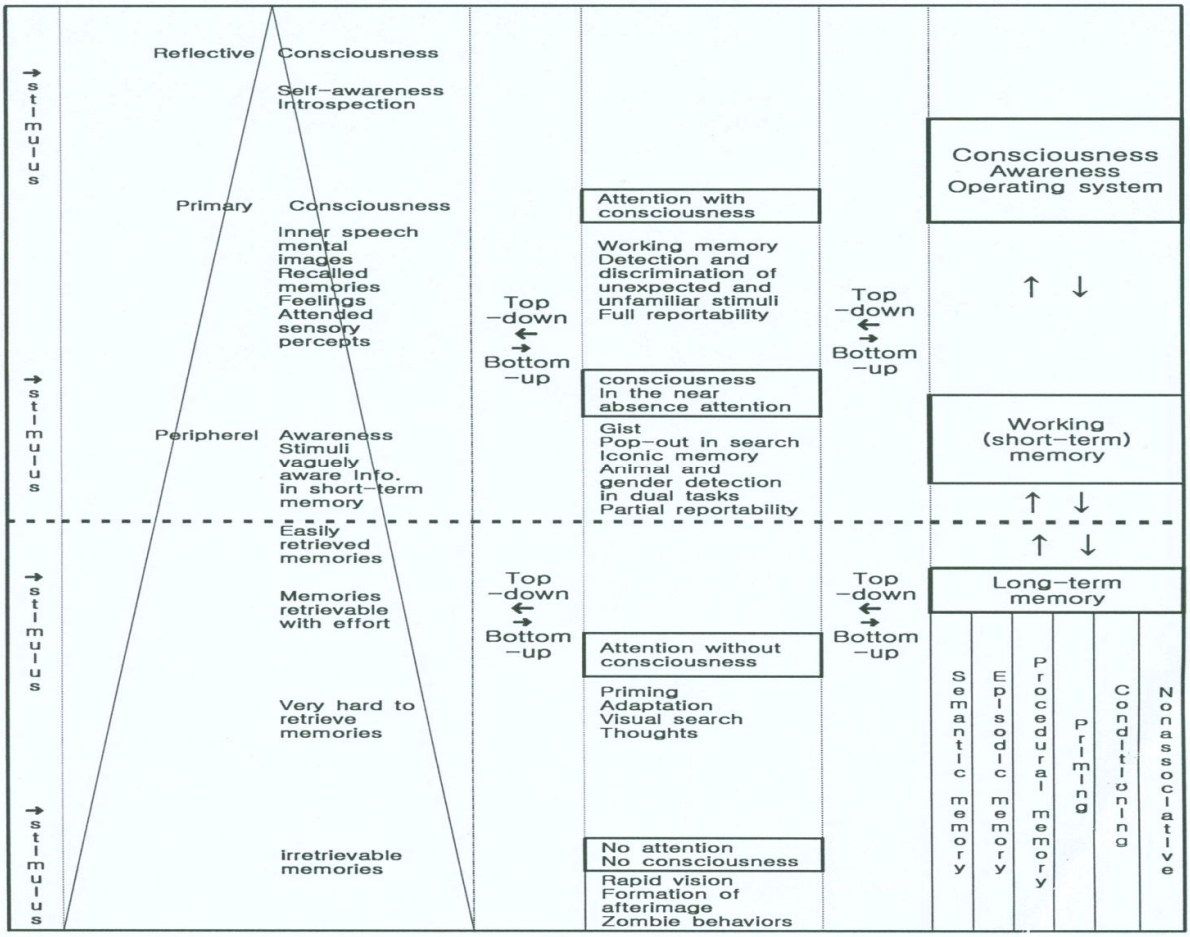

Figure 2. The conceptual relationships between consciousness, attention and memory of the research results studied respectively in Atkinson & Shiffrin (1968), Baddeley & Hitch (1974), Farthing (1992),

Johnson-Laird (1993), Koch & Tsuchiya (2007), Lamme (2003) and Squire (1993).

Farthing (1992) suggested a descriptive model that shows the relationship between different levels of the conscious and nonconscious mind. The information processing approach applied various experimental paradigms to the memory and attention studies on the conscious and unconscious processing, but not consciousness itself. But we could describe a conceptual landscape (framework) that addresses what the relationships are between consciousness, memory, and attention in the model of levels of consciousnesses

Many mental phenomena have been understood on the continuity of conscious and unconscious processes. In the model of levels of consciousness, preconscious memory would be long-term memory where information is relatively easily recalled, while unconscious refers to data that is not available during a normal conscious awareness state (Farthing, 1992). Atkinson and Shiffrin(1968) mentioned the internal structure of control processes which govern the transfer of information from one store to another, and memory processing of encoding, storage, and retrieval. In the relationship between attention and awareness there may be three kinds of possible cases; when awareness requires attention, when awareness does not requires attention and when attention does not imply awareness (Howe et al, 2009), and four kinds of phenomena: attention with consciousness, attention without consciousness, consciousness in the near absence of attention and no attention and no consciousness (Koch and Tsuchiya, 2007).

In conclusion, it is possible that some distinctions between consciousness, memory and attention can be made conceptually and functionally from the perspectives of information processing. Consciousness, memory and attention are hypothetical constructs - concepts that are not themselves directly measurable or observable but that serve as mental models of understanding how psychological phenomena work. There are many ways to conceptualize mental constructs. Psychologists also do not yet understand many things about human information processing and many of the ideas and theories about it are still quite controversial. If cognitive consciousness is postulated as a mental construct characterizing awareness, control and consolidation, the phenomena like word superiority effect (Martindale, 1990; Reicher, 1969), auditory continuity (Bregman, 1990) and object categorization (Ashby & Gott, 1988), could be understood clearly, which was not the case in the past.

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