Consciousness and Cortical Structure

The topic of where is situated conscious awareness in the brain is highly debated between scientists. In the stated assumption, it is supposed that “All processing beneath conscious awareness is carried out by subcortical structures” and in this paper we will study the arguments for and against this assumption.

But before examining these arguments, it is useful to define what conscious awareness is and what are the subcortical structures and theirs functions are.

In one hand, the conscious awareness or consciousness is the perception in humans of its own existence and the world around him. Conversely, the non-conscious includes all uncontrolled psychic elements. The notion of unconsciousness generally covers all mental processes and activities which, for various reasons, can neither be seen perceived or controlled by conscience. In biology, it includes all the processing of information as well as all the internal functioning of the body that we do not perceive and operations that we are unaware such heartbeat.

In the other hand, the subcortical structures include the areas of the brain which are anatomically located below the layer of the cerebral cortex. More precisely, they are made up of three divisions:

(i) The forebrain with the telencephalon and the diencephalon;

- The telencephalon consists of various structures; the main ones are the basal ganglia involved in motor control, the hippocampus that interacts with temporal lobe to support memory of events, the amygdala involved in emotions, fear, defensive, and aggressive behaviours; we find also other structures such as the cingulated gyrus…

- The diencephalon with the thalamus which is implicated in control of sleep and attention and relays information from the mid brain to the cerebrum and the hypothalamus which controls the autonomic nervous system and the endocrine system.

(ii) The midbrain with the optic tecta involved in the visual processing and the tegmentum involved in the control of the movement.

(iii) The hindbrain with the cerebellum which controls the movement, the pons which contains centres regulating sleep, feeding and facial expression and the medulla which regulates internal environment such as heart and respiration rate, digestive functions, blood pressure…

All this complex system works in interaction with other systems such as the endocrine system and also the neo cortex and indeed we do not have conscious of all these processes working all the time for maintaining life and internal homeostasis, especially of the processing handled by what is called the brain stem which is made up with the mesencephalon and the hindbrain and which could be seen as a genuine control tower supervising vital functions such as breathing or temperature regulation.

These processing does not even need to be conscious to work and most of the nervous system processes are unconscious.

But, the subcortical structures and especially the brainstem are not the only structures to be involved in this non conscious processing; Others structures of the nervous system of which we do not have a conscious awareness are involved. This is also the case of the processes in the spinal cord and the peripheral nervous system including the autonomic nervous systems (respiration…) and the processes called “reflexes”. The cortex can also intervene in several unconscious processes such as which can be called “automatic” behaviour (reading, driving, …), the ability of perception and localization of a tactile stimulus, the precise adjustments of movements associated with visual-motor coordination, the "decision" of the execution of a motor act or certain brain processes related to emotional reactions (fear..). Even face recognition is a process at least partially unconscious.

Conversely, the forebrain can perform conscious processing such as memory and the analysis of experimental data and clinical cases shows that cortical regions such as the thalamus or the superior colliculus could be involved in the state of “consciousness”.  
Other observations show also that after the lesion of the visual cortex, the brain is capable of locating objects unconsciously in the visual field ("blindsight"). In the case of prosopagnosia, conscious recognition of a face is impossible, but physiological responses indicate that the face is unconsciously recognized.

The most interesting experiences affect decision making. In an experiment where people have to press a button when they felt a tactile stimulus, researchers observe that  
"While 500 ms are required to respond consciously to a tactile stimulus (…), just 100 ms are needed to give a motor response (pressing a button) to the same stimulus. However, the subject will feel as if pressing the button after feeling the stimulus, referring his movement to his late conscious experience. ". (Libet & al)

All these data, from normal individuals or from clinical cases show that unconscious processing is not a specific attribute of the subcortical structures. It can be also managed by other structures in the nervous system. In parallel, subcortical structures can be involved in conscious awareness. Finally data shows that we can be unaware of information that is processed by the brain “unconsciously”.

**References**  
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