

Chapter 16: Consciousness

The topic of consciousness is one of the most challenging in cognitive psychology. In this chapter, we will explore issues pertaining to the function of consciousness. We will discuss evidence indicating that some decisions are prepared preconsciously in the brain some time before we are consciously aware of the decisions. Means to measure conscious experience will be evaluated, including a promising hypothesis that visual consciousness is associated with recurrent processing. The reader will be introduced to global workspace theories of consciousness, which emphasise the relationship between selective attention and consciousness. Finally, the issue of whether consciousness is unitary will be explored with reference to studies on split-brain patients.

WEBLINK: [What is consciousness?](#)

- **Functions of consciousness**

RESEARCH ACTIVITY: From intention to action (Libet)

There has been much controversy concerning the extent and usefulness of unconscious processes. Some of the identified functions of consciousness are:

- It is associated with perceiving the environment.
- It plays a crucial role in social communication.
- It has a role in controlling our actions.
- It allows us to think about events and issues far removed from the here-and-now.
- Consciousness involves integrating and combining numerous types of information.

According to Graziano and Kastner (2011), the social aspects of consciousness depend crucially on the temporo-parietal junction. Consciousness allows us to be aware of the intentions of other people. Conscious awareness of ourselves and our environments provides us with a sense of free will.

WEBLINK: [Libet's experiment on free will](#)

- **Assessing consciousness and conscious experience**

Lamme (2010) argued that *actual* conscious experience is often much richer than our *report* of that experience. Due to this, much research has focused on visual consciousness. Sperling (1960) found participants could only report a limited amount of a briefly presented visual display. However, this was due to memory limitations rather than limits on conscious awareness. Lamme (2006) noted that a failure to report conscious awareness may be due to failures in attention, memory or language rather than absence of conscious experience. Block (2012) suggested our belief that our conscious experience is richer than our reported experience occurs because *phenomenal consciousness* is more extensive than *access consciousness*. Kouider et al. (e.g., 2010, 2012), however, indicate that the reason participants believe their consciousness is richer than it is is due to expectations.

Patients in a *vegetative state* display “wakefulness without awareness”. Importantly, they show no behavioural evidence of awareness of self or the environment. However, functional neuroimaging has indicated that these patients may possess some conscious awareness. Owen et al. (2006) found a patient in a vegetative state showed similar patterns of brain activity to controls when asked to imagine playing tennis or to visit rooms in her house. The patient also showed evidence of full semantic processing of sentences.

WEBLINK: [More information about vegetative states](#)

Lamme (2010) argued that consciousness should be defined in neural terms rather than behavioural ones. In visual consciousness, presentation of a visual stimulus leads to a rapid “feedforward sweep” followed by recurrent processing. Recurrent processing involves feedback from higher to lower areas. Lamme (2010) proposed that recurrent processing is accompanied by conscious experience; the feedforward sweep is not. This may be because:

- Recurrent processing is more complex.
- There are enormous numbers of back connections in the cortex.
- Recurrent processing may play a role in learning (which requires consciousness).

WEBLINK: [Powerpoint slides of course by Victor Lamme](#)

CASE STUDY: Towards a true neural stance on consciousness (Lamme, 2006)

Recurrent processing can be necessary for conscious awareness, but it may not be sufficient:

- In *masking*, an initial stimulus is not consciously perceived when followed shortly afterwards by a second visual stimulus.
- In an EEG study, Fahrenfort et al. (2007) found that feedforward processing was intact under masked conditions, but there was no evidence of recurrent processing.
- Conscious visual perception was reduced by TMS that disrupted recurrent processing (Koivisto et al., 2011).
- When TMS is applied to the early visual cortex, conscious perception of the stimulus is suppressed only when TMS is administered 100 ms after the stimulus, disrupting recurrent processing.

There is a possibility that recurrent processing may be used as a neural marker of consciousness. However, limitations of Lamme’s approach are:

- It focuses explicitly on visual consciousness.
- It is unlikely that recurrent processing is always associated with conscious awareness.
- Recurrent processing can occur without conscious awareness (Scholte et al., 2006).

Most research on conscious experience has focused on visual consciousness. Visual consciousness has typically been assessed using behavioural measures such as verbal reports. However, a failure to report a conscious experience may be due to failures of attention, memory or inner speech. Functional neuroimaging studies suggest that even patients in a vegetative state show evidence of conscious awareness. Lamme (2006) argued that it is preferable to define consciousness in neural terms. In the context of visual consciousness, it is proposed that recurrent processing is associated with conscious experience, while the initial feedforward sweep is not. There is accumulating evidence for this claim, but it is unlikely that recurrent processing is always associated with, or is sufficient for, conscious awareness.

- **Global workspace theoretical approach**

Baars (1988) and Baars and Franklin (2007) proposed the global workspace theory. According to this theory:

- Much information processing involves special-purpose unconscious processors operating in parallel, leading to the assumption that early processing should be similar for stimuli that are and are not consciously perceived.
- Consciousness integrates information.
- Brain areas associated with consciousness vary as a function of the content of conscious awareness.
- There are very close links between consciousness and attention.

WEBLINK: [Article by Bernard Baars on global workspace theory](#)

Evidence has been collected in support of all these assumptions:

- Melloni et al. (2011) have shown that, using EEG, the early processing for seen and unseen stimuli were very similar.

- Participant groups with higher levels of conscious awareness show greater integrated brain activity than those with low levels of conscious awareness (such as in a vegetative state; King et al., 2013).
- Brain areas involved in the global workspace and conscious experience include the prefrontal cortex, anterior cingulate and content-specific areas. Disrupting the prefrontal cortex using TMS makes participants less aware of the quality of the visual information processing (Rounis et al., 2010).
- Jiang et al. (2006) demonstrated that male and female participants showed different attentional preferences to invisible male and female nude pictures. Naccache et al. (2002) found attentional processes amplified information extracted from invisible digits on cued trials without producing conscious awareness of the digit.

However, this theory focuses narrowly on the processes. Integrated brain functioning associated with conscious awareness may not be the neural substrate of awareness.

According to global workspace theories, selective attention determines the information that we become aware of. Another key assumption is that conscious awareness is associated with integrated, synchronous activity across many brain areas, especially the prefrontal cortex, anterior cingulate and parts of the parietal cortex. There is reasonable support for all the major assumptions of global workspace theories. However, there is also some evidence that conscious awareness can sometimes precede selective attention. Another limitation of research in this area is that it is unclear whether integrated brain functioning is a cause or consequence of conscious awareness.

- **Is consciousness unitary?**

WEBLINK: [Split-brain patients video](#)

Most people believe they have a single unitary consciousness. *Split-brain patients* have few connections between the two brain hemispheres as a result of surgery. Data collected from these patients led Sperry (1968) to argue that these patients have two consciousnesses. The left hemisphere constitutes the dominant stream of consciousness because of language processing in that hemisphere. Gazzaniga (2013), however, argues that split-brain patients have only a single conscious system based in the left hemisphere that tries to make sense of information available to it. This system is the interpreter that seeks explanation for events in order to produce appropriate behaviour.

WEBLINK: [Split-brain experiments](#)

WEBLINK: [Dual consciousness in split-brain patients](#)

WEBLINK: [Split-brain patients](#)

Split-brain patients generally function effectively. They ensure information about the environment reaches both hemispheres by moving their eyes around. Information from the left visual field goes to the right hemisphere and vice versa. Trevarthen (2004) discussed the abilities of the two hemispheres in split-brain patients:

- The right hemisphere performed better on tasks involving perception of complex shapes, manipulations of geometric patterns and hand explorations of shapes.
- The left hemisphere was better at tasks involving language.

Gazzaniga and Ledoux (1978) studied a patient with well-developed right-hemisphere language abilities. The patient showed limited evidence of consciousness in his right hemisphere. Gazzaniga and Ledoux argued that the patient's left hemisphere was interpreting actions initiated by the right hemisphere.

The ability to recognise one's own face is an indication of self-awareness. Uddin et al. (2005[DOI: 10.1016/j.concog.2005.01.008]; see Eysenck & Keane, 2015, p. 708) found a split-brain patient could recognise her own face equally well whether presented to her left or right hemisphere, indicating basic self-awareness in both hemispheres.

Research on split-brain patients has not fully resolved the issue of whether it is possible to have two separate consciousnesses. The most common view is that the left hemisphere plays the dominant role in consciousness because it acts as an interpreter of events. In contrast, the right hemisphere engages in low-level processing activities, but lacks its own consciousness. However, the right hemisphere also exhibits self-recognition and self-awareness. The contribution of the right hemisphere to conscious experience may be greater than assumed.

Most people believe in a unitary consciousness. Studies on split-brain patients offer insight into the issue. The left hemisphere of split-brain patients is dominant in determining conscious awareness and behaviour, in part because of the language system in this hemisphere. Gazzaniga et al. (e.g., 2008) argue for a single conscious system in split-brain patients based on the left hemisphere, which acts as an interpreter. In split-brain patients, this interpretive process is provided with only very limited information, which may lead to inaccurate interpretations. However, there is evidence that the right hemisphere also exhibits some self-recognition and self-awareness, and may also play an important role in consciousness.