

# Subliminal learning demonstrated in the human brain

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Although the idea that instrumental learning can occur subconsciously has been around for nearly a century, it had not been unequivocally demonstrated. Now, a new study published by Cell Press in the August 28 issue of the journal *Neuron* used sophisticated perceptual masking, computational modeling, and neuroimaging to show that instrumental learning can occur in the human brain without conscious processing of contextual cues.

"Humans frequently invoke an argument that their intuition can result in a better decision than conscious reasoning," says lead author Dr. Mathias Pessiglione from the Wellcome Trust Centre for Neuroimaging at the University College London. "Such assertions may rely on subconscious associative learning between subliminal signals present in a given situation and choice outcomes." For instance, a seasoned poker player may play more successfully because of a learned association between monetary outcomes and subliminal behavioral manifestations of their opponents.

To investigate this phenomenon, Dr. Pessiglione and colleagues created visual cues from scrambled, novel, abstract symbols. Visual awareness was assessed by displaying two of the masked cues and asking subjects if they perceived any difference. "We reasoned that if subjects were unable to correctly perceive any difference between the masked cues, then they were also unable to build conscious representations of cue-outcome associations," explains Dr. Pessiglione.

In the next set of experiments, subjects performed a subliminal conditioning task that employed the same masking procedure, but the cues were now paired with monetary outcomes. Using this methodology, the researchers observed that pairing rewards and punishments guided behavioral responses and even conditioned preferences for abstract cues that subjects could not consciously see.

The researchers collected scans of the brain, using functional magnetic resonance imaging, to investigate the specific brain circuitry that is linked to subliminal instrumental conditioning. "The ventral striatum responded to subliminal cues and to visible outcomes in a manner that closely approximates our computational algorithm, expressing reward expected values and prediction errors," says Dr. Pessiglione. "We conclude that, even without conscious processing of contextual cues, our brain can learn their reward value and use them to provide a bias on decision making."

Source: Cell Press

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