Toward an unconscious neural reinforcement intervention for common fears

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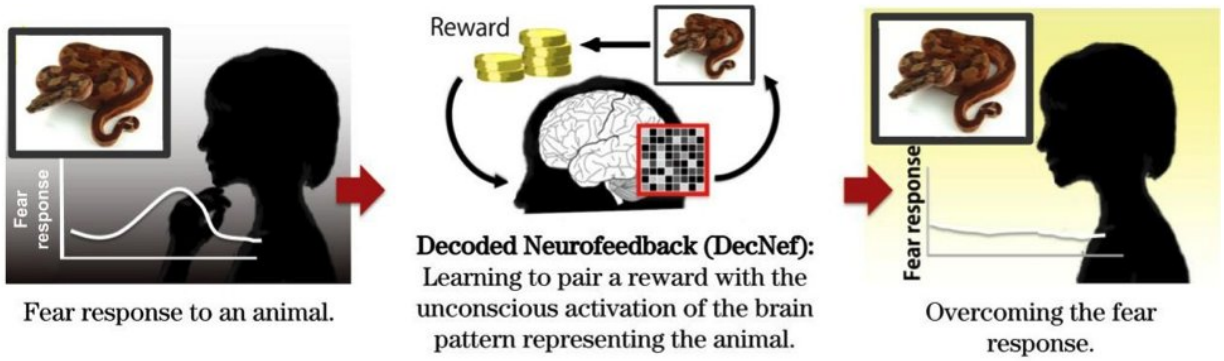

In a collaboration between researchers based Advanced Telecommunications Research Institute International (ATR), Japan, and University of California, Los Angeles (UCLA) scientists have moved one major step towards the development of a novel form of brain-based treatment for phobia that may soon be applicable to patients Credit: (c) ATR, UCLA

In a new study just published in the *Proceedings of the National Academy of Sciences* today, an international team of scientists reported that diminish phobias in subjects by directly manipulating brain activity, while completely bypassing conscious awareness. Additionally, the procedure is free from the typical subjective unpleasantness of traditional psychotherapeutic treatments.

The study is based on recent experiments conducted at the Advanced

Telecommunications Research Institute International, Japan. By using cutting-edge methods borrowed from artificial intelligence, the team was able to read out unconscious spontaneous occurrences of mental images in the brain. Specifically, the researchers were able to determine that a participant's brain was unconsciously thinking of a snake below the level of awareness, based on images acquired using conventional fMRI. By giving the participant a small monetary reward whenever this occurs, the snake was thus associated with a positive feeling, gradually becoming less frightening and unpleasant.

"We knew it could work in principle. The challenge was to figure out how to read out the snake-related thoughts from the brain images in the clinic, with actual patients rather than normal participants in the laboratory," says lead author Dr. Vincent Taschereau-Dumouchel, who is a clinical psychologist by training. "The big difference is, in normal participants we can show them many images of snakes, and let the computer algorithm learn what is the relevant pattern of brain activity from a large amount of data. But if we are to apply this procedure to patients, who are uncomfortable with seeing snakes in the first place, this becomes a problem."

The team devised an innovative solution to the problem by inferring the patterns of brain activity from other participants.

"Let's say you are afraid of snakes. To decode the patterns of your brain activity does not require that you look at snakes. I, as a surrogate of yours, can see snakes for you, as I'm not afraid of them. From there, we could computationally infer what should be your brain signature for snakes, based on mine, a method devised by the Haxby lab at Dartmouth called hyperalignment," says last author Professor Hakwan Lau.

Although different individuals have brain activity patterns with different spatial organizations, the hyperalignment method can correct for this

discrepancy. Importantly, the team realized that a patient could also benefit from having dozens of surrogate participants. They have shown that with a large amount of data from many surrogates, the procedure produces reliable results.

The team feel that now they are in a position to test the method in actual phobic patients. If successful, they are hoping that it will inspire novel treatments for a variety of related psychiatric illnesses, including post-traumatic stress disorders.

More information: Taschereau-Dumouchel V, Cortese A, Chiba T, Knotts JD, Kawato M, Lau H: Towards an unconscious neural-reinforcement intervention for common fears, *Proceedings of the National Academy of Sciences* (*PNAS*), DOI: 10.1073/pnas.1721572115

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