

Fear from the heart: sensitivity to fear stimuli depends on individual heartbeats

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News

How our heartbeat impacts our perception of fear

The timing of our heartbeat influences how we respond to fear, according to new research published today (Wednesday 7 May), which may help find new solutions for those who suffer from anxiety.

Imagine what might be possible if you can turn fear on and off. In exploring how our bodies influence our emotions, Professor [Hugo Critchley](#) and Dr Sarah Garfinkel of Brighton and Sussex Medical School (BSMS), a partnership between the universities of Sussex and Brighton, have discovered that the brain's processing of threatening stimuli, and therefore how a person responds, is dependent on the timing of the heartbeat. If the person sees something just after the heartbeat, it is processed more effectively and increases the emotional impact.

This work was conducted at the [Clinical Imaging Science Centre](#), based at BSMS, in conjunction with the [Sackler Centre for Consciousness Science](#) at the University of Sussex. Professor Critchley is co-director of the Sackler Centre for Consciousness Science, along with Professor [Anil Seth](#), who is also a co-author on this work.

Their new research findings, published in the *Journal of Neuroscience*, suggest that our perception of fear is shaped by individual heartbeats: the brain's response to signals of fear, judgments of the intensity of these fear signals, and how effectively fear signals enter our conscious awareness, are all exaggerated when the heart is making a beat (at systole), as opposed to in between heartbeats (at diastole).

Fear processing in high-anxiety individuals was less influenced by cardiac timing effects: anxious participants were less able to use their heart to reduce fear processing. This suggests a weakened heart-brain-emotion pathway may be the cause of heightened and persistent fear responses that are characteristic of anxiety.

Seeing fear in another person's face is a potent emotional signal, activating fear responses in our own brain and body. The research therefore measured participants' responses to fearful stimuli by looking at the part of the brain that makes emotional reactions, the amygdala, under fMRI scanning, while at the same time



Dr Sarah Garfinkel, BSMS



Prof Hugo Critchley

monitoring the timing of their heartbeat. Those seen just when the heart beats, when pressure sensors in blood vessels leaving the heart fire signals to the brain, are considered to be more intense than when seen between heartbeats, when there are no pressures. Fear faces are also better detected just when the heart beats, rather than between beats, as tested when participants were shown a single image hidden within a number of distracting images.

Professor Critchley said: "Our own subjective experience of fear and our ability to see fear stimuli are enhanced when our heart has just made a beat."

Professor Critchley and Dr Garfinkel also demonstrated that fear processing in high-anxiety individuals was less influenced by cardiac timing effects.

"Anxious participants had a reduced capacity to use this internal response pathway to dampen fear processing," said Dr Garfinkel. "Anxiety disorders are characterised by heightened fear states, coupled to stronger bodily reactions, and this work provides intriguing initial evidence that this pathway linking the heart to the brain may be impaired in individuals with anxiety symptoms."





Professor Critchley said: "This work details how our hearts can communicate with our brains and minds to influence what we see and what we feel. Specifically, we demonstrate that our conscious perception of fear, and the intensity with which we feel fear, are influenced by the timing of fear stimuli in relation to our individual heartbeats."

As part of a grant from the European Research Council, Professor Critchley is leading the [BraveHeart project](#), which involves a team of scientists investigating the nature of how the heart affects emotion processing in patients with anxiety symptoms, and ways of using pharmacological manipulations to understand more about the chemistry of neurons (nerve cells) of this effect.

The aim is to provide new approaches to treat anxiety disorders, which affect more than 69 million people in Europe, at an annual cost of €74.4 billion.

Posted on behalf of: BSMS and Sackler Centre for Consciousness Science

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