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How the heart, lungs and brain work together to shape experience

We speak of “butterflies in the stomach,” a “racing heart,” being “choked up” or needing to “catch our breath.” Language routinely treats emotion and thought as though they inhabit the body. But why are events of the mind felt in the heart or stomach?

In a new paper published in Neuroscience of Consciousness, a UCSB-led team gets to the heart of an enduring question: are you your brain or your body? Their answer points to what happens between them.

“The brain is not simply receiving messages from the body,” said Asa Young, the paper’s first author and a doctoral student in psychological and brain sciences professor Jonathan Schooler’s lab. “The heartbeat, breath and gastric rhythm are regular, predictable signals around which groups of neurons can organize, determining when they become more or less receptive to information. They are the drumbeats that keep our proverbial orchestra together.”

Neuroscience has often treated consciousness as something produced by the brain alone. An emerging body of research expands that view, suggesting that conscious experience is shaped through a continuous, rhythmic dialogue between the brain and body.

The heart beats, the lungs breathe and the brain produces waves. Rhythm permeates the body. Just as musicians coordinate while playing different parts, brain rhythms can become organized by slower bodily cycles, Young explained. This coordination may help align neural processes involved in perception, emotion and the sense of self with the body's ongoing regulation of its internal state.

Consider the breath. People tend to inhale just before beginning the next trial of a cognitive task and exhale as they prepare to respond. Memory can also fluctuate with the breath: People are better at recognizing previously seen pictures when those pictures reappear during an inhale rather than an exhale. Frightening images can gain faster access to awareness while the heart is contracting, whereas neutral stimuli — including sights, sounds, touch and even pain — may be processed less strongly during that same phase.

What matters, then, may not be any one signal alone, but the relationship between them. Two people could have similar heart rates, for example, while differing substantially in how strongly cardiac signals influence brain activity. Measuring this relationship may reveal differences that neither signal shows on its own.

The researchers note that the value of this coordination does not follow a simple "more is better" rule. Both unusually weak and unusually strong bodily influences on brain activity have been associated with adverse states. Healthy functioning may instead depend on the brain and body remaining coordinated within a Goldilocks zone — connected enough for bodily signals to inform experience, but not so strongly that they dominate it.

"There is a popular intuition that mental illness is not solely mental, just as bodily dysfunction is not confined to the body," Young said.

Anxiety-related conditions can involve bodily signals becoming unusually salient and difficult to ignore. Depression may show a different pattern, including reduced sensitivity to some bodily signals and a diminished sense of connection to the body. Other disorders may involve atypical timing, strength or flexibility in the exchange between brain and body. Across these conditions, the issue may lie not in the brain or body alone, but in how the two coordinate.

The framework points toward an expanded view of consciousness. Many cognitive processes that characterize conscious experience — including perception, emotion, bodily awareness and the sense of self — are shaped in part by signals from within

the body.

“The findings also complicate the familiar image of a brain in a vat,” said Young. “This science-fiction brain, kept alive but severed from its body, might still generate neural activity. Yet it would be cut off from the recurring bodily signals that help give experience its visceral character and anchor it to a living self.”

So, are you your brain or your body? Young and colleagues suggest the question may be a false choice: Conscious experience emerges through the ongoing relationship between the two.

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