Listen to your heart: Why your brain may give away how well you know yourself

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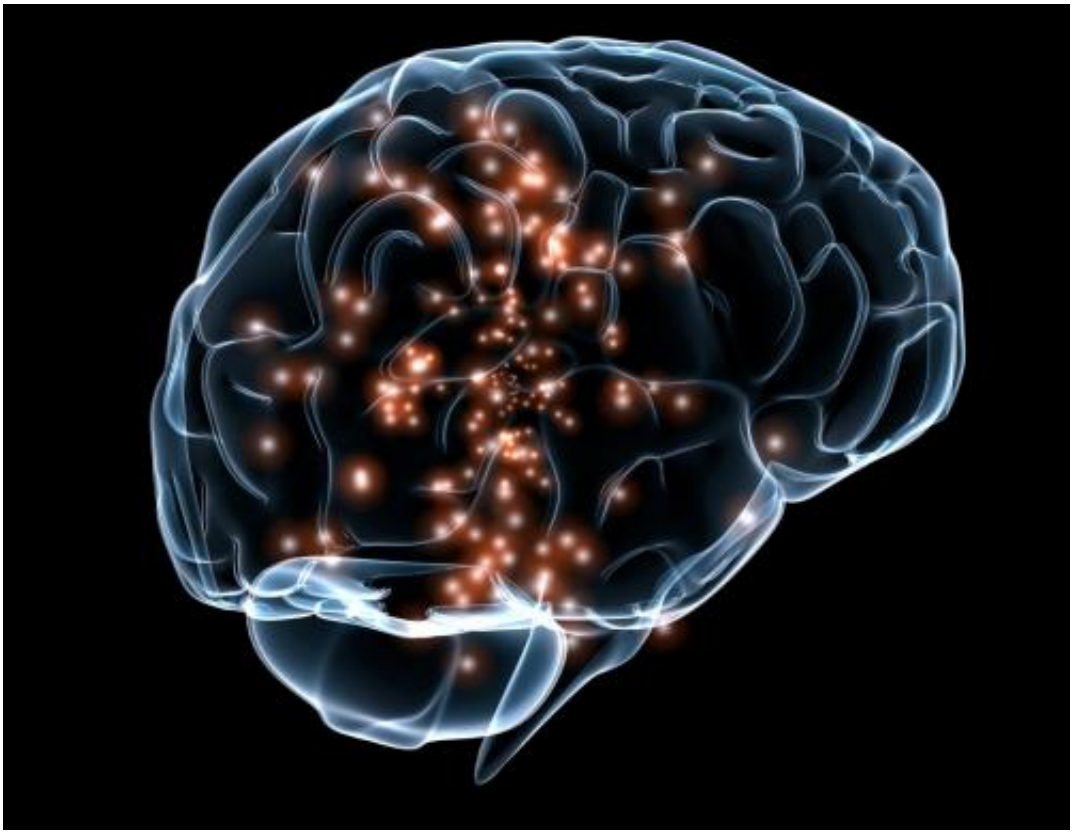

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In research published today in the journal *Cerebral Cortex*, a team of scientists led by the University of Cambridge and the Medical Research Council (MRC) Cognition and Brain Sciences Unit, Cambridge, studied not only whether volunteers could be trained to follow their heartbeat,

but whether it was possible to identify from brain activity how good they were at estimating their performance.

Dr Tristan Bekinschtein, a Wellcome Trust Fellow and lecturer in the Department of Psychology at the University of Cambridge, says: "'Follow your heart' has become something of a cliché, but we know that, consciously or unconsciously, there is a relationship between our heartrate and our decisions and emotions. There may well be benefits to becoming more attuned to our heartbeat, but there's very little in scientific literature about whether this is even technically possible."

A recent study from Dr Bekinschtein and colleagues showed that people with 'depersonalisation-derealisation disorder' - in which patients repeatedly feel that they are observing themselves from outside their body or have a sense that things around them are not real - perform particularly badly at listening to their heart. Another study from the team, looking at a man with two hearts - his natural, diseased heart and a replacement artificial heart - found that he was better able to tune into the artificial heart than the diseased one.

Other studies have highlighted a possible connection between heartrate and task performance. For example, in one study, volunteers given the drug propranolol to increase their heart rate performed worse at emotional tasks than the control group. Changing heartrate is part of our automatic and unconscious 'fight or flight' response - being aware of the heart's rhythm could give people more control over their behaviour, believe the researchers.

Thirty-three volunteers took part in an experiment during which scientists measured their brain activity using an electroencephalograph (EEG). First off, the volunteers were asked to tap in synchrony as they listened to a regular and then irregular heartbeat. Next, they were asked to tap out their own heartbeat in synchrony. Then, they were asked to tap

out their own heartbeat whilst listening to it through a stethoscope. Finally, the stethoscopes were removed and they were once again asked to tap out their heartbeat.

During the task, when the volunteers were tapping out their heartbeat unaided, they were asked to rate their performance on a scale of 1 to 10, with 1 being 'inaccurate' and 10 'extremely accurate'. Once the task was completed, they were asked how much they thought they had improved from 1 ('did not improve') to 10 ('improved a lot').

"Perhaps unsurprisingly, we found that brain activity differed between people who improved at tapping out their heartbeat and those who did not," says Andrés Canales-Johnson from the MRC Cognition and Brain Sciences Unit. "But interestingly, brain activity also differed between people who knew whether or not they had improved and those people who under- or over-estimated their own performance."

Just over four in ten (42%) of the participants showed significant improvement in their ability to accurately tap along unaided with their heartbeat. This is most likely due to the fact that listening to their heartbeat through a stethoscope had allowed them to fine tune their attention to the otherwise faint signal of their heartbeat. In those whose performance had improved, the researchers saw a stronger brain signal known as the 'heartbeat evoked potential' (HEP) across the brain.

The researchers found no significant differences in the HEP when grouping the participants by how well they thought they had performed - their subjective performance. This suggests that the HEP provides a marker of objective performance.

In the final part of the test - after the participants had listened to their heartbeat through the stethoscope and were once again tapping unaided - the researchers found differences in brain activity between participants.

Crucially, they found an increase in 'gamma phase synchrony' - coordinated 'chatter' between different regions in the brain - in only those learners whose subjective judgement of their own performance matched their actual, objective performance. In other words, this activity was seen only in learners who knew they had performed badly or knew they had improved.

"We've shown that for just under half of us, training can help us listen to our hearts, but we may not be aware of our progress," adds Dr Bekinschtein. "Some people find this task easier to do than others do. Also, some people clearly don't know how good or bad they actually are - but their brain activity gives them away.

"There are techniques such as mindfulness that teach us to be more aware of our bodies, but it will be interesting to see whether people are able to control their emotions better or to make better decisions if they are aware of how their heart is beating."

More information: Auditory Feedback Differentially Modulates Behavioraland Neural Markers of Objective and SubjectivePerformance When Tapping to Your Heartbeat, *Cerebral Cortex*, DOI: 10.1093/cercor/bhv076

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