A Neural Basis For The Mind-Body Connection?

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Summary: Researchers have identified a neural network that connects the adrenal medulla to the cerebral cortex.

Source: UPMC.

New insights into how the mind influences the body.

Neuroscientists at the University of Pittsburgh have identified the neural networks that connect the cerebral cortex to the adrenal medulla, which is responsible for the body's rapid response in stressful situations. These findings, reported in the online Early Edition of the journal *Proceedings of the National Academy of Sciences* (PNAS), provide evidence for the neural basis of a mind-body connection.

Specifically, the findings shed new light on how stress, depression and other mental states can alter organ function, and show that there is a real anatomical basis for psychosomatic illness. The research also provides a concrete neural substrate that may help explain why meditation and certain exercises such as yoga and Pilates can be so helpful in modulating the body's responses to physical, mental and emotional stress.

"Our results turned out to be much more complex and interesting than we imagined before we began this study," said senior author Peter L. Strick, Ph.D., Thomas Detre Chair of the Department of Neurobiology and scientific director of the University of Pittsburgh Brain Institute.

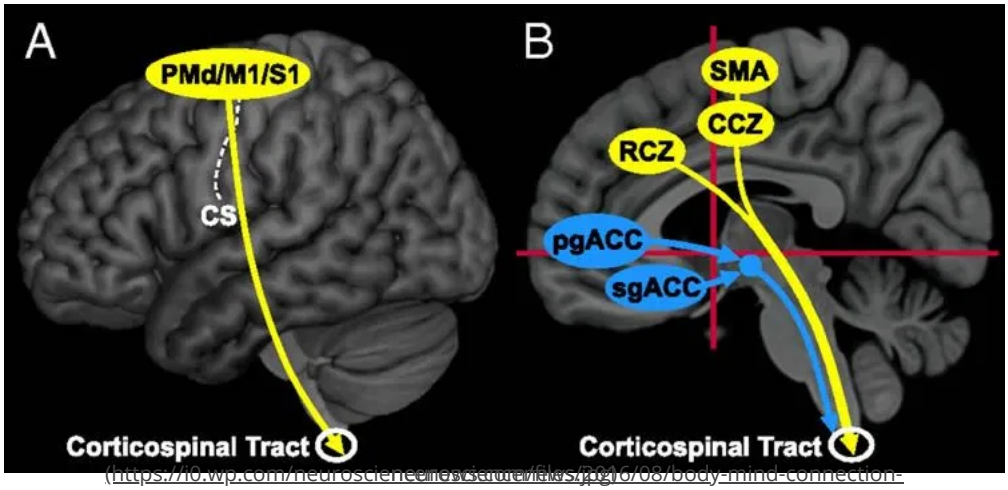
In their experiments, the scientists traced the neural circuitry that links areas of the cerebral cortex to the adrenal medulla (the inner part of the adrenal gland, which is located above each kidney). The scientific team included lead author Richard P. Dum, Ph.D., research associate professor in the Department of Neurobiology; David J. Levinthal, M.D., Ph.D., assistant professor in the Department of Medicine; and Dr. Strick.

The scientists were surprised by the sheer number of neural networks they uncovered. Other investigators had suspected that one or, perhaps, two cortical areas might be responsible for the control of the adrenal medulla. The actual number and location of the cortical areas were uncertain. In the PNAS study, the Strick laboratory used a unique tracing method that involves rabies virus. This approach is capable of revealing long chains of interconnected neurons. Using this approach, Dr. Strick and his colleagues demonstrated that the control of the adrenal medulla originates from multiple cortical areas. According to the new findings, the biggest influences arise from motor areas of the cerebral cortex and from other cortical areas involved in cognition and affect.

Why does it matter which cortical areas influence the adrenal medulla? Acute responses to stress include a wide variety of changes such as a pounding heart, sweating and dilated pupils. These responses help prepare the body for action and often are characterized as "fight or flight responses." Many situations in modern life call for a more thought-out reaction than simple "fight or flight," and it is clear that we have some cognitive control (or what neuroscientists call "top-down" control) over our responses to stress.

"Because we have a cortex, we have options," said Dr. Strick. "If someone insults you, you don't have to punch them or flee. You might have a more nuanced response and ignore the insult or make a witty comeback. These options are part of what the cerebral cortex provides."

Another surprising result was that motor areas in the cerebral cortex, involved in the planning and performance of movement, provide a substantial input to the adrenal medulla. One of these areas is a portion of the primary motor cortex that is concerned with the control of axial body movement and posture. This input to the adrenal medulla may explain why core body exercises are so helpful in modulating responses to stress. Calming practices such as Pilates, yoga, tai chi and even dancing in a small space all require proper skeletal alignment, coordination and flexibility.



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Origin and pathways for top-down influence over the adrenal medulla by the cerebral cortex. Motor areas are filled yellow, and medial prefrontal areas are filled blue. (A) Major cortical areas for top-down control on the lateral surface of the hemisphere. All of these areas send projections to the spinal cord. (B) Major cortical areas for top-down control on the medial wall of the hemisphere. The motor areas send projections to the spinal cord, whereas the output of medial prefrontal areas is likely to be mediated by various subcortical centers. CA-CP, red horizontal lines; Vca; red vertical lines. NeuroscienceNews.com image is credited to the researchers/PNAS.

The PNAS study also revealed that the areas of the cortex that are active when we sense conflict, or are aware that we have made an error, are a source of influence over the adrenal medulla. "This observation," said Dr. Strick, "raises the possibility that activity in these cortical areas when you re-imagine an error, or beat yourself up over a mistake, or think about a traumatic event, results in descending signals that influence the adrenal medulla in just the same way as the actual event." These anatomical findings have relevance for therapies that deal with post-traumatic stress.

Additional links with the adrenal medulla (https://neurosciencenews.com/cerebral-cortex-mind-body-4853) were discovered in cortical areas that are active during mindful mediation and areas that show changes in bipolar familial depression. "One way of summarizing our results is that we may have uncovered the stress and depression connectome," says Dr. Strick.

Overall, these results indicate that circuits exist to link movement, cognition and affect to the function of the adrenal medulla and the control of stress. This circuitry may mediate the effects of internal states like chronic stress and depression on organ function and, thus, provide a concrete neural substrate for some psychosomatic illness.

ABOUT THIS NEUROSCIENCE RESEARCH ARTICLE

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Source: Susan Manko – UPMC (http://www.upmc.com/Pages/default.aspx)
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Original Research: Full open access research (http://www.pnas.org/content/early/2016/08/11/1605044113.full) for "Motor, cognitive, and affective areas of the cerebral cortex influence the adrenal medulla" by Richard P. Dum, David J. Levinthal, and Peter L. Strick in *PNAS*. Published online August 15 2016 doi:10.1073/pnas.1605044113

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Abstract

Motor, cognitive, and affective areas of the cerebral cortex influence the adrenal medulla

Modern medicine has generally viewed the concept of "psychosomatic" disease with suspicion. This view arose partly because no neural networks were known for the mind, conceptually associated with the cerebral cortex, to influence autonomic and endocrine systems that control internal organs. Here, we used transneuronal transport of rabies virus to identify the areas of the primate cerebral cortex that communicate through multisynaptic connections with a major sympathetic effector, the adrenal medulla. We demonstrate that two broad networks in the cerebral cortex have access to the adrenal medulla. The larger network includes all of the cortical motor areas in the frontal lobe and portions of somatosensory cortex. A major component of this network originates from the supplementary motor area and the cingulate motor areas on the medial wall of the hemisphere. These cortical areas are involved in all aspects of skeletomotor control from response selection to motor preparation and movement execution. The second, smaller network originates in regions of medial prefrontal cortex, including a major contribution from pregenual and subgenual regions of anterior cingulate cortex. These cortical areas are involved in higher-order aspects of cognition and affect. These results indicate that specific multisynaptic circuits exist to link movement, cognition, and affect to the function of the adrenal medulla. This circuitry may mediate the effects of internal states like chronic stress and depression on organ function and, thus, provide a concrete neural substrate for some psychosomatic illness.

"Motor, cognitive, and affective areas of the cerebral cortex influence the adrenal medulla" by Richard P. Dum, David J. Levinthal, and Peter L. Strick in *PNAS*. Published online August 15 2016 doi:10.1073/pnas.1605044113

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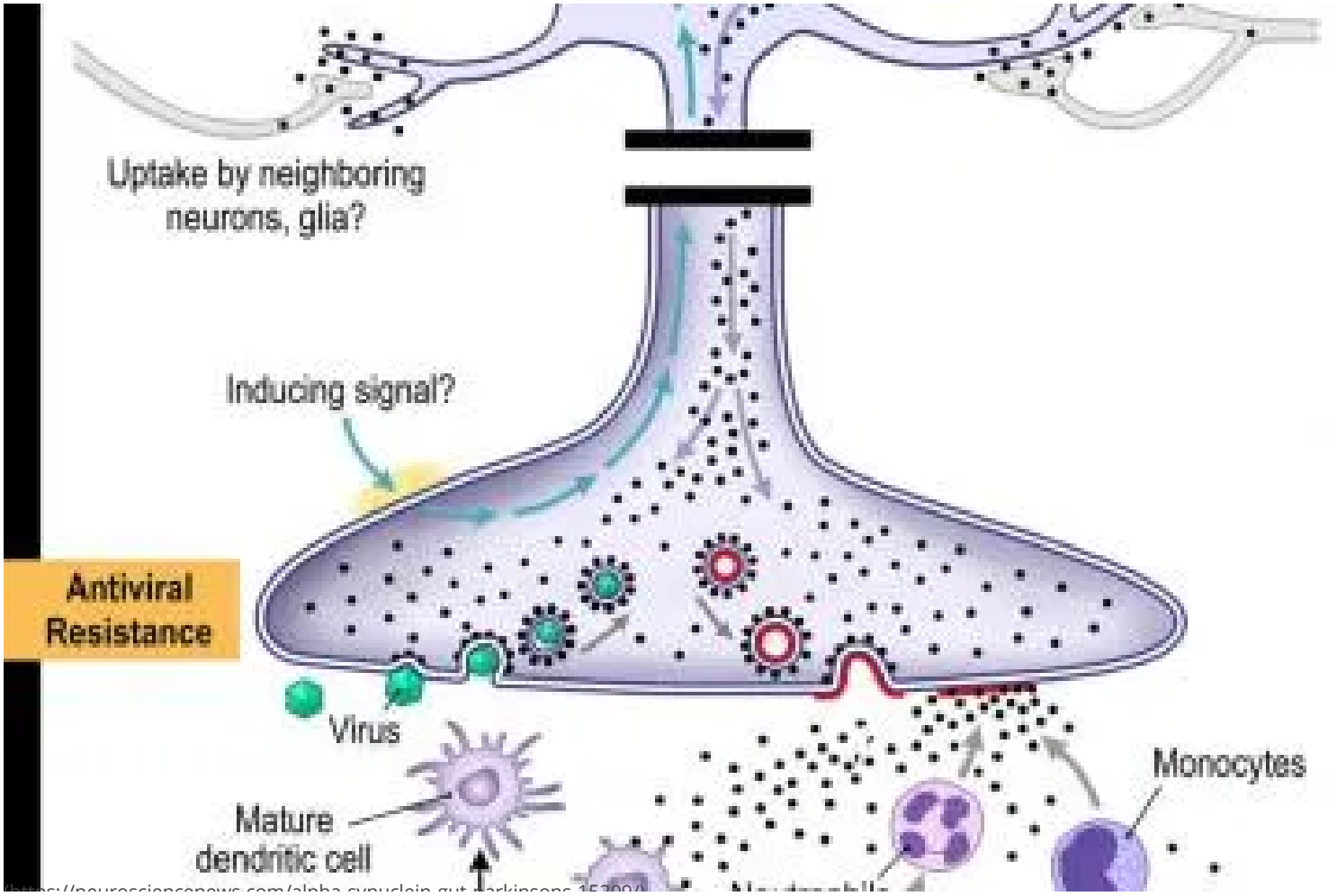

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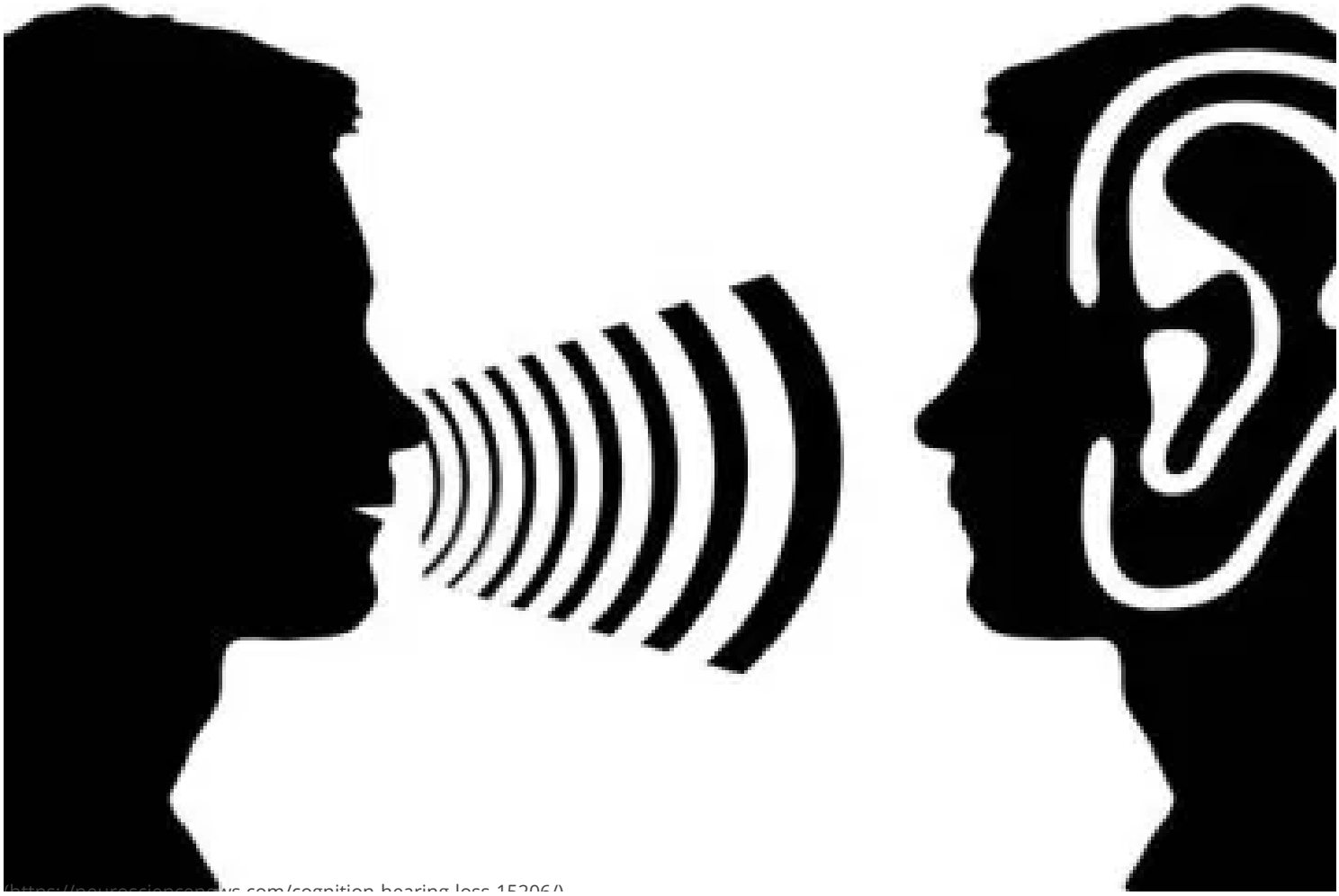

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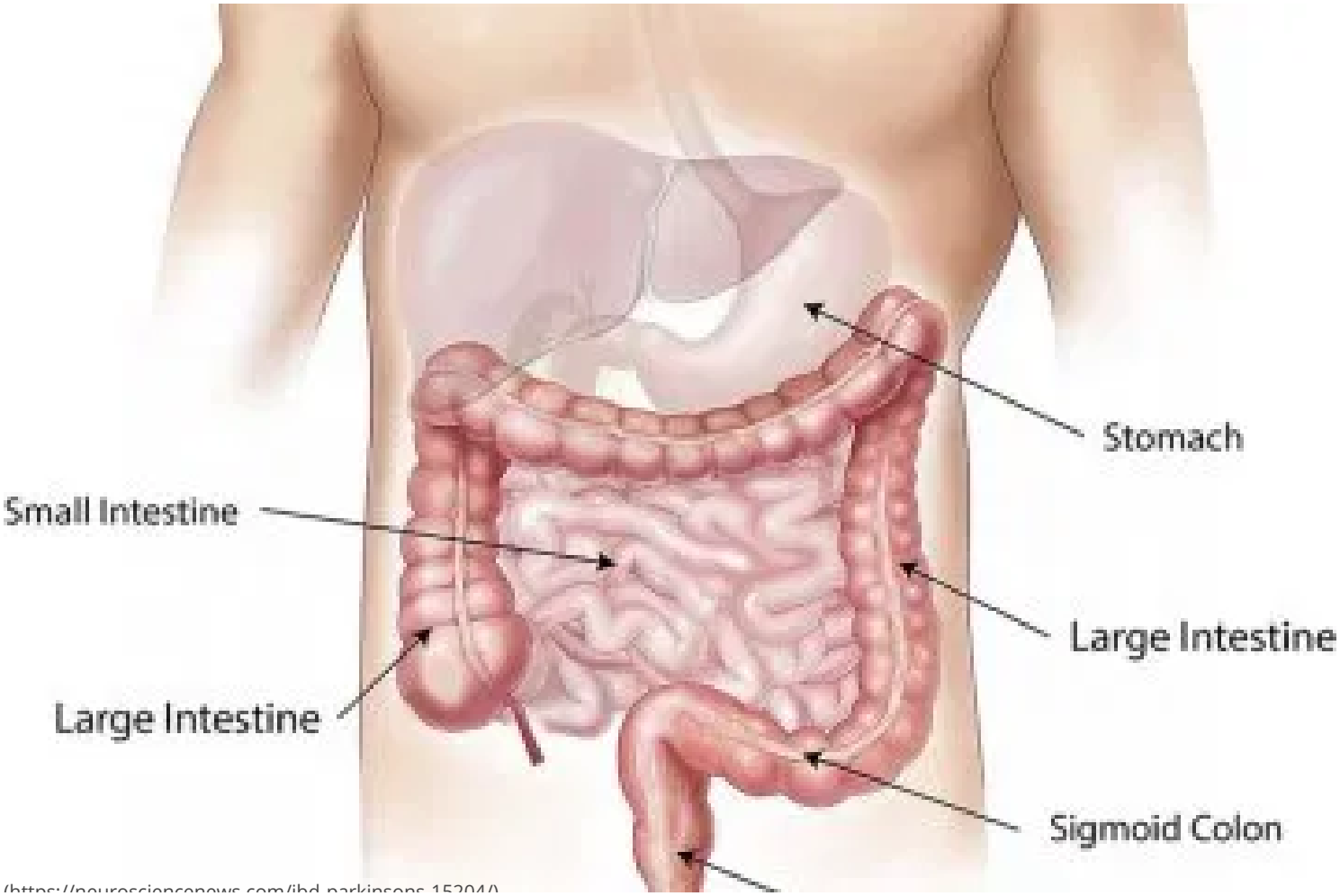

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these are not new ideas, and have been evident clinically for decades. Functional neurologist have been using the principles to treat cns disorders successfully for decades.

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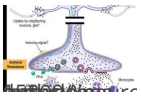

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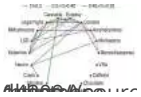

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