**How Does the Vagus Nerve Convey Gut Instincts to the Brain?**

Neuroscientists have identified how the vagus nerve communicates with the brain.

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Vagus Nerve in Yellow

What situations make you feel nervous, [fearful](http://www.psychologytoday.com/basics/fear), or anxious to the point that you get butterflies and feel sick to your stomach? Are there people, places, or situations in your life that evoke a “fear conditioned” response? Scientists in Switzerland recently identified how the vagus nerve conveys threatening “gut feelings” to the [brain](http://www.psychologytoday.com/basics/neuroscience).

The vagus nerve is known as the "wandering nerve" because it has multiple branches that diverge from two thick stems rooted in the cerebellum and brainstem that wander to the lowest viscera of your abdomen touching your heart and most major organs along the way. Vagus means "wandering" in Latin. The words vagabond, vague, and vagrant are all derived from the same Latin root.

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In a fascinating new study, researchers at ETH Zurich have identified how “gut instincts” coming up to the brain via the vagus nerve are linked to different responses to fear. The [team](http://www.psychologytoday.com/basics/teamwork) of scientists was led by Urs Meyer, a researcher in professor Wolfgang Langhans' group at ETH Zurich.

The [study](http://www.jneurosci.org/content/34/21/7067) is titled, “Gut Vagal Afferents Differentially Modulate Innate Anxiety and Learned Fear” and was published May 21, 2014 in the *Journal of Neuroscience*.

**The Vagus Nerve Conveys Messages Between the Brain and Gut**



The Vagus Nerve Wanders Everywhere

The vagus nerve is constantly sending updated sensory information about the state of the body's organs "upstream" to your brain via afferent nerves. In fact, 80-90% of the nerve fibers in the vagus nerve are dedicated to communicating the state of your viscera up to your brain.

The terms “afferent” and “efferent” typically refer to nerves that lead into or out of the brain. Afferent signals are sent from a nerve receptor into the brain while efferent signals are sent from the brain to the peripheral body.

Visceral feelings and gut instincts are literally emotional intuitions transferred up to your brain via the vagus nerve. In previous studies, signals from the vagus nerve traveling from the gut to the brain have been linked to modulating mood and distinctive types of fear and anxiety.

As with any mind-body feedback loop, messages also travel "downstream" from your conscious mind through the vagus nerve (via efferent nerves) signaling your organs to create an inner-calm so you can “rest-and-digest” during times of safety, or to prepare your body for “fight-or-flight” in dangerous situations.

For this study, the Swiss scientists snipped the afferent nerve fibers of the vagus nerve going from the gut to the brain. Cutting the vagus nerve turned the usual feedback loop between gut instincts and the brain from a two-way communication into a one-way street. This allowed the researchers to hone in on the role that the vagus nerve plays in conveying gut instincts up to the brain.

In particular, the researchers were interested in identifying the link between innate anxiety and conditioned or “learned” fear. In test animals, the brain was still able to send signals down to the stomach, but the brain couldn’t receive signals coming up from the stomach.

Healthy vagus nerve communication between your gut and your brain helps to slow you down like the brakes on your car by using neurotransmitters such as acetylcholine and GABA. These neurotransmitters literally lower heart rate, blood pressure, and help your heart and organs slow down so that you can rest-and-digest.

**The Vagus Nerves Is Linked to Fear Conditioning**

The new Swiss study explored the consequences of a complete disconnection of signals from the vagus nerve coming up from the gut to the brain and how this affected innate anxiety, conditioned fear, and subsequent neurochemical changes in the brain.

In a fear conditioning experiment on rats, the researchers in Zurich linked an unpleasant experience to a specific sound. Interestingly, the gut instinct signal from the vagus nerve was necessary for unlearning a conditioned response of fear. Through a variety of behavioral studies, the researchers determined that the rats without a fully functioning vagus nerve were less afraid of open spaces and bright lights compared with controlled rats with an intact vagus nerve.

However, without the two-way communcation of the vagus nerve between the brain and gut the rats showed a lower level of innate fear, but a longer retention of learned fear. From this discovery the researchers concluded that an innate response to fear appears to be influenced significantly by “gut instinct” signals sent from the stomach to the brain. This confirms the importance of healthy vagal tone to maintain grace under pressure and to overcome fear conditioning.

Mark Twain addressed the backlash of conditioned fear when he said, “We should be careful to get out of an experience only the [wisdom](http://www.psychologytoday.com/basics/wisdom) that is in it and stop there lest we be like the cat that sits down on a hot stove lid. She will never sit down on a hot stove lid again and that is well; but also she will never sit down on a cold one anymore.”

In my book, *The Athlete’s Way,*I write extensively about ways to overcome learned fear and innate anxiety. If you’d like to read a sample from the book with some practical tips on how to overcome conditioned fear responses click [here](http://books.google.com/books?id=fxvsYPt8kMQC&pg=PA279&lpg=PA279&dq=the+athlete%27s+way+fear+conditioning&source=bl&ots=oVHzVrmeld&sig=dHvRNB0zEj3l-xzrA9S41yyL0J4&hl=en&sa=X&ei=Xf9-U9LgC6Kd8QHmuoDYCA&ved=0CCsQ6AEwAA#v=onepage&q=the%20athlete%27s%20way%20fear%20conditioning&f=false).

A simple mantra I've used as an athlete to engage my vagus nerve when faced with a threatening challenge is to take a few deep breaths and recite a line by Corra Harris, author of *I'd Climb the Highest Mountain*, "The bravest thing you can do when you are not brave is to profess bravery and act accordingly."

Using positive self-talk and taking deep breaths is a quick and easy way to engage the vagus nerve and parasympathetic nervous system to calm yourself from both the top-down and from the bottom-up.

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The most exciting discovery of this study is that under closer scrutiny of the rats' brains, the researchers found that the loss of signals coming up from the abdomen via the vagus nerve altered the production of both adrenaline and GABA in the brain.

When the researchers switched from a negative to a neutral stimulus, the rats without gut instincts coming up to the brain via the vagus nerve required significantly longer to re-associate the sound with the new, “safe” and neutral situation. The researchers point out that this finding is congruent with other recently published studies which found that stimulation of the vagus nerve can facilitate learning.

**Conclusion: The Vagus Nerve Has Powerful Psychological Influences**



These new findings about the vagus nerve offer exciting possibility for the treatment of [post-traumatic stress disorder](http://www.psychologytoday.com/conditions/post-traumatic-stress-disorder) ([PTSD](http://www.psychologytoday.com/basics/post-traumatic-stress-disorder)).

Stimulation of the vagus nerve might be able to speed up the process by which people with PTSD can learn to reassociate a non-threatening stimuli which triggers anxiety with a neutral and non-traumatic experience. Vagus nerve stimulation (VNS) is currently used to treat epilepsy and [depression](http://www.psychologytoday.com/basics/depression/symptoms), although the psychologcial benefits of VNS remain controversial.

In a press release Meyers concluded, "We were able to show for the first time that the selective interruption of the signal path from the stomach to the brain changed complex behavioral patterns. This has traditionally been attributed to the brain alone. The study shows clearly that the stomach also has a say in how we respond to fear; however, what it says, i.e. precisely what it signals, is not yet clear."

The researchers intend to do more research to better understand the exact dialogue between the vagus nerve and the brain which will hopefully lead to more effective treatments for PTSD and other anxiety disorders.

# Holding Loved One's Hand Can Calm Jittery Neurons

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By [BENEDICT CAREY](http://query.nytimes.com/search/query?ppds=bylL&v1=BENEDICT%20CAREY&fdq=19960101&td=sysdate&sort=newest&ac=BENEDICT%20CAREY&inline=nyt-per)

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Married women under extreme stress who reach out and hold their husbands' hands feel immediate relief, neuroscientists have found in what they say is the first study of how human touch affects the neural response to threatening situations.

The soothing effect of the touch could be seen in scans of areas deep in the brain that are involved in registering emotional and physical alarm.

The women received significantly more relief from their husbands' touch than from a stranger's, and those in particularly close marriages were most deeply comforted by their husbands' hands, the study found.

The findings help explain one of the longest-standing puzzles in social science: why married men and women are healthier on average than their peers. Husbands and wives who are close tend to limit each other's excesses like drinking and [smoking](http://topics.nytimes.com/top/news/health/diseasesconditionsandhealthtopics/smoking/index.html?inline=nyt-classifier) but not enough to account for their better health compared with singles, researchers say.

"This is very imaginative, cutting-edge science, linking this complex response to stress to different areas of the brain," said Dr. Ronald Glaser, director of the Institute for Behavioral Medicine Research at Ohio State University, who was not involved in the study.

In the study, to appear in the journal Psychological Science this year, neuroscientists at the University of Wisconsin and the University of Virginia used newspaper advertisements to recruit 16 couples from the Madison, Wis., region. The couples were all rated as very happily married on an in-depth questionnaire asking about coping styles, intimacy and mutual interests.

Lying in the jaws of an M.R.I. scanning machine and knowing that they would periodically receive a mild electric shock to an ankle, the women were noticeably apprehensive. Brain images showed peaks of activation in regions involved in anticipating pain, heightening physical arousal and regulating negative emotions, among other systems.

But the moment that they felt their husbands' hands — the men reached into the imaging machine — each woman's activity level plunged in all the regions gearing up for the threat. A stranger's hand also provided some comfort, though less so.

"The effect of this simple gesture of social support is that the brain and body don't have to work as hard, they're less stressed in response to a threat," said Dr. James A. Coan, a psychologist at the University of Virginia and the study's lead author. His co-authors were Dr. Hillary Schaefer and Dr. Richard J. Davidson of the University of Wisconsin.

Relaxing in the face of a perceived threat is not always a good idea. The brain's alarm system, which prompts the release of stress [hormones](http://topics.nytimes.com/top/news/health/diseasesconditionsandhealthtopics/hormones/index.html?inline=nyt-classifier) that increase heart rate and move blood to the muscles, prepares people to fight or run for their lives, researchers say.

But this system often becomes overactive in situations that are nagging but not life threatening like worries over relationships, deadlines, money or homework. Easy access to an affectionate touch in these moments — or to a hug, a back rub or more — "is a very good thing, is deeply soothing," Dr. Coan said.

The most profoundly comforting hand-holding was between "supercouples," whose scores on the marriage questionnaire reflected a extremely close relationship, the study found. The brain region involved in anticipating pain was particularly sensitive to this marital quality, suggesting that a touch between close partners can blunt the sensation of physical pain, which is related to the level of anticipation.

All of which also explains why the withdrawal or absence of affectionate touch can be so upsetting. In research published late last year, Dr. Glaser and his wife, Dr. Janice Kiecolt-Glaser, reported that blisters lingered longer during marital strife.

And rejection, the ultimate withdrawal of touch, registers in the brain much like an ankle shock, said Dr. Lucy Brown, a neuroscientist at the [Albert Einstein](http://topics.nytimes.com/top/reference/timestopics/people/e/albert_einstein/index.html?inline=nyt-per) College of Medicine. Fear of the shocks activated a region in the brain "that we saw activated in people looking at a beloved who had recently rejected them," Dr. Brown wrote in an e-mail message.

"Love has its risks," she added. "It can make us very unhappy," too