

Can the Way You Breathe Affect How You Remember Things?

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STORY AT-A-GLANCE

- › The way you breathe affects how you memorize facts, according to a study published in Nature Communications
- › Cognitive changes, including attention deficit, difficulty learning, poor memory and brain fog, are common symptoms of low CO₂ caused by overbreathing
- › Brain changes, in turn, tend to trigger disinhibition where emotions – oftentimes anger or fear – are discharged; this release of emotions reinforces overbreathing, which many then come to depend on as a coping mechanism
- › Most breathing exercises, or techniques, aren't a long-term solution because they don't address the habits contributing to dysfunctional breathing
- › To get to the root of the problem and learn proper breathing, breathing behavior analysis learning techniques are typically necessary

For most people, breathing happens without much thought to technique or strategy. Yet, a study published in Nature Communications¹ may cause you to consider the way you breathe when you're trying to learn new ideas. People looking for clues about your mood or stress level may study how you breathe since it's intricately related to your whole body.

When a person is feeling anxious or stressed, it's almost instinctual to tell them to "take a deep breath." But deep breathing and belly breathing may actually cause more harm

than good. Fortunately, breathing, unlike many other involuntary bodily functions, operates automatically yet allows for voluntary modifications.

You have the ability to adjust your breathing rate and depth, for instance, and can opt to breathe through either your mouth or nose. Such decisions can result in both physical and cognitive changes, for better or worse. Many also aren't aware that dysfunctional breathing habits are often the result of emotional trauma.

When you become stressed, your breathing pattern and rate change naturally, but it's important to be conscious of how triggers like this change your breathing habits – and what to do to resolve them. Now researchers have found that how you breathe even affects how you memorize facts.²

The Way You Breathe May Affect Your Memory

For the Nature Communications study, researchers controlled the activation of the brain's primary inspiratory generator – PreBötzinger complex (PreBötC) – which is a small cluster of cells inside the medulla oblongata.³ Although it's known that this is the breathing control center in the brain, the details of neurological control remain unclear.

The study involved genetically modified mice to evaluate how breathing might impact the formation of important memories during object recognition and fear conditioning tests. Optogenetic manipulation – a method of controlling neuronal activity using light in genetically altered mice – was used to control breathing.

The researchers induced apnea when mice were encoding new information, which impaired the detection of novel objects. The pauses in breathing affected areas of the hippocampus, which is important to memory storage. When the researchers forced irregular breathing patterns, the memories improved but when breathing slowed, memory recall worsened.

The same team published a 2018 study⁴ that revealed transitioning from expiration to inspiration at the start or middle of a memory task made people less accurate when recalling information. Next, the researchers used human participants and brain scans to

link poor memory performance with the deactivation of the temporal parietal junction in the brain, an area that handles information processing.⁵

The next step was the featured animal study, which led the researchers to suggest that breathing exercises may help in therapeutic ways beyond lowering stress levels.

Neuroscientist Nozomu Nakamura, from Hyogo Medical University in Japan, and part of the research team, commented:⁶

"Breathing is a fundamental action in life support in mammals. Although details of respiratory function on brain states remain unclear, recent studies suggest that respiration may play an important role during online brain states.

The determination of detailed roles of respiration and molecular mechanisms in the brain is a subject to future research to understand effects of stress tolerance. The way of breathing manipulation and application of breathing exercises will be crucial for treatment and therapy of depression and neuropsychiatric disorders."

The problem with most breathing exercises, or techniques, however, is that they don't address habits contributing to dysfunctional breathing. Your body knows how to breathe but can get into trouble when you unconsciously override it with a learned breathing habit that throws your system out of whack.

Overbreathing Is a Common Cause of Poor Memory, Brain Fog

It's not surprising that research shows the way you breathe affects memory, as cognitive changes, including attention deficit, difficulty learning, poor memory and brain fog, are common symptoms of **low CO₂** – also known as hypocapnia – caused by overbreathing. But not only can the way you breathe affect the way you think – the opposite also holds true in that the way you think can affect how you breathe.

In my **discussion with Peter Litchfield**, Ph.D., a breathing expert with a deep understanding of respiratory physiology and its impact on your health, he explains that your CO₂ level is regulated by automatic reflexes.⁷

There are receptors in your brain and arterial system that are sensitive to CO₂ concentration and the pH of various extracellular fluids, such as blood plasma and interstitial fluids (surrounding cells). There are receptor sites in the arterial system, which are sensitive to oxygen concentration but, surprisingly, not in the brain.

This system wasn't designed to get thrown off just because you get stressed. Provided you haven't learned bad breathing habits, your breathing optimizes respiration regardless of most circumstances, for example while talking. Overbreathing, however, which is breathing that results in a CO₂ deficit, can trigger a wide variety of physical and psychological changes, including:

- Loss of blood in the brain
- Loss of oxygen
- Loss of glucose
- Electrolyte changes in the brain that set the stage for lactic acidosis in neurons

These brain changes, in turn, tend to trigger disinhibition where emotions – oftentimes anger or fear – are discharged. This release of emotions can serve you by allowing you to cope with a challenging situation or environment. In this way, overbreathing is reinforced, as it serves you by acting as a "solution" to a perceived problem. Many then come to use overbreathing as a coping mechanism.

Quite simply, Litchfield says, you don't engage in a habit unless it serves you or your physiology in some way. This is why it's so important to form a partnership with your body and explore your habits – and how or why you learned them in the first place. Fortunately, such patterns can be reversed by implementing breathing behavior analysis learning techniques.

Poor Breathing Habits Are the No. 1 Reason for Low CO₂

The No. 1 reason for hypocapnia is a poor breathing habit in response to habit triggers, such as stress. This is why learning a specific set of breathing techniques isn't a long-

term solution, as they don't address the habit and habit triggers. To solve the problem, you need to understand why your breath gets dysregulated and how new habits can be learned. In addition to cognitive changes, low CO₂ brought on by overbreathing may also result in:⁸

Headaches	Nausea and vomiting
Abdominal symptoms and bloating	Fatigue
Muscle pain and weakness, tetany, hyperreflexia, spasm, tingling in the hands and lips, numbness, trembling and difficulty swallowing	Cardiovascular changes like palpitations, tachycardia, arrhythmias, angina, ECG abnormalities
Symptoms involving consciousness, such as dissociation, disconnecting from your environment, disconnecting from people, fainting and hallucinations	Emotional changes associated with the reduction of blood flow in the brain
Personality and self-esteem changes	

While you can accurately measure your CO₂ concentration with a tool called a capnometer, a good test to tell if your symptoms are due to a CO₂ deficiency is breathing into a paper bag. If the symptoms disappear, you know hypocapnia, and hence overbreathing, is the problem.

Never use a plastic bag, as it can cause suffocation. Always use a paper bag, about 6 inches by 15 inches. If it's too small or too large, it won't work. Place the paper bag over your nose and mouth and hold it in place with your hands as you breathe into it. The CO₂ will accumulate in the bag, thereby raising your CO₂ level as you breathe it in.

However, to get to the root of the problem, breathing behavior analysis learning techniques are typically necessary. Litchfield explains:⁹

"We're interacting with the person around their physiology, and they're seeing what's happening while they're behaving in the way they are. So, we explore that together. And then we do all kinds of testing together depending on who the person is and what the issues are.

A good example might be, we'll have them overbreathe on purpose. Now, this isn't as simple as it sounds. You need to do it the right way. There's a real right way to do it, and there are wrong ways to do it. We have someone overventilate on purpose. And what happens when you do that, they start to get symptoms, and they start to get deficits, and they're there and they're focusing on their experience.

They're not talking. I'm the one who's doing the talking. I'm asking them questions to think about the answers, not to interact with me, but just to think about the answers to the questions.

I'll ask questions like, 'Are there any emotions coming up right now? Are there any memories that are being triggered right now? Does this remind you of anything in your current life circumstances? Does this remind you of something that happened to you in the past?'

And I have a lot of information before I do this. I have this form. So they're not just random questions. They're really specific. They're about that person and their lives and what we've uncovered together. And then what often happens is, they're trapped. They can't get out. They're breathing that way and the CO₂ level simply does not come up no matter what they do. And this is what happens in their real life situation when they get trapped ...

As I work with them, I use certain kinds of experiential paradigms that I implement so they can raise the CO₂ level. The symptoms go away and they're amazed."

A Simple Way to Increase Your CO₂ Level

While it's essential to become aware of the improper breathing habits that can unconsciously sabotage your health, mouth breathing also lowers your CO₂ level and negatively impacts oxygen utilization at the cellular level. **Breathing through your nose** helps maintain your health, even during exercise.

It might be tempting to breathe through your mouth during physical exertion, but try to avoid this tendency. Limit your exertion to the extent that you continue to breathe through your nose most of the time.

This is just temporary as your body adjusts to a slightly increased CO₂ level and you find you can increase your exertion level and still breathe through your nose. The following steps will help your breath become lighter, so the hairs in your nose barely move.

This type of light breathing helps you enter and remain in a calm, meditative state while lowering your blood pressure and reducing nasal congestion for easier breathing. You may feel a slight air shortage at first, but this should be tolerable. If it becomes uncomfortable, take a 15-second break and then continue.

1. Place one hand on your upper chest and the other on your belly; feel your belly move slightly in and out with each breath, while your chest remains unmoving.
2. Close your mouth and breathe in and out through your nose. Focus your attention on the cold air coming into your nose and the slightly warmer air leaving it on the out breath.
3. Slowly decrease the volume of each breath, to the point it feels like you're almost not breathing at all (you'll notice your breath getting very quiet at this point). The crucial thing here is to develop a slight air hunger. This simply means there's a slight accumulation of carbon dioxide in your blood, which signals your brain to breathe.

After three or four minutes of air hunger, you'll start experiencing the beneficial effects of CO₂ accumulation, such as an increase in body temperature and an increase in saliva. The first is a sign of improved blood circulation, and the second is a sign that your parasympathetic nervous system has been activated, which is important for stress reduction.

Sources and References

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- ⁴ PLOS One, 2018; doi: 10.1371/journal.pone.0204021
- ⁵ Cerebral Cortex Communications, 2022;3(4)
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