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# Thyroid Hormone Drives Curiosity and Exploratory Behavior, Study Finds

Analysis by Dr. Joseph Mercola | October 12, 2024

## STORY AT-A-GLANCE

- An August 2024 study published in the journal Cell examined how active thyroid hormone T3 impacts brain circuitry and drives exploratory behavior in animals
- T3 administration increased frontal cortex gene expression, energy expenditure, body temperature and overall activity in mice. It also induced cell-specific transcriptional programs in the cerebral cortex, remodeling neural circuits and affecting synapses
- These findings could refine treatments for thyroid-related mood disorders in humans and improve our understanding of how thyroid hormones influence mental health and behavioral regulation
- Various factors disrupt thyroid function, including stress, inadequate light exposure, elevated cortisol levels, exposure to endotoxins, high intake of polyunsaturated fats (PUFAs) and exposure to endocrine-disrupting chemicals (EDCs)
- Excessive estrogen load is a major concern for thyroid health as it inhibits the conversion of T4 to T3. Transmucosal progesterone mixed with vitamin E can be used to counteract this

**Survival in the animal kingdom depends on the ability to adapt to changing environments, whether it's a bear hibernating to conserve energy or a snake rearranging its organs before fasting through the winter. These strategies involve more than just physical adaptations; they require a seamless coordination between the body's internal functions and outward behaviors.**[1]

At the heart of these changes are hormones, with the thyroid hormone standing out as a key regulator, influencing both your metabolism and brain function. A study published in August 2024 in the journal Cell[2] has revealed new insights into how the thyroid hormone impacts our brain, shaping behaviors essential for navigating the world around us.

## How Thyroid Hormone Modulates Metabolism and Exploratory Behavior

The featured study,[3] led by researchers from Harvard Medical School, specifically examined the effects of the active form of thyroid hormone, triiodothyronine (T3), on brain circuitry and exploratory behavior, which is important in animals seeking food, mates or new territories.

They suggested that this complex interplay between physiology and behavior is not unique to animals — it also extends to humans. In fact, prior studies[4,5,6] have demonstrated a link between thyroid dysfunction and psychiatric symptoms such as depression and mania, which could be seen as extremes of normal exploratory behavior.

"We hypothesized that T3 directly affects cortical brain areas, such as M2 (secondary motor cortex), that express THRs (thyroid hormone receptors)," the authors explained.[7] To test this theory, the researchers conducted a series of experiments using mice as their model organism.

They administered T3 to adult mice and compared their responses with those of mice that received a placebo. Upon examining gene activity in the brain, they observed that T3 affected gene expression in the mice's frontal cortex within one hour of treatment. It also increased their energy expenditure, body temperature and overall activity.

To see if higher levels of thyroid hormone boost exploratory behaviors, they placed mice in a box with both light and dark sections. Mice naturally prefer dark, sheltered areas and avoid light, but after being given T3 for three and a half days, male mice spent more time exploring the light area compared to those that did not receive T3.

The researchers also observed that the effect of T3 on light exploration increased with higher doses and was noticeable even at the lowest dose tested. This suggests that even small changes in thyroid hormone levels can influence behavior, which could be relevant for understanding how variations in thyroid function influence curiosity and exploratory behavior in humans.

Moreover, the study highlighted that T3's effects are specific to its action in the brain rather than peripheral effects, emphasizing the importance of direct brain involvement in regulating exploratory behaviors. According to the authors, these insights could refine treatments for thyroid-related mood disorders and improve our understanding of how thyroid hormones influence mental health and behavioral regulation.

## Thyroid Hormone Rewires Your Brain Circuits

The researchers also examined how T3 affects cortical circuits and synapses.[8] Using a combination of genetic tools and advanced imaging techniques, they manipulated T3 levels in specific cell types within the mice's brains and monitored the resulting changes in neural connections and gene expression patterns.

> *"We find that thyroid hormone … induces cell-type-specific transcriptional programs in adult cerebral cortex in a manner that, at least in glutamatergic projection neurons, is largely cell-autonomous and driven by local T3 levels. These programs are tailored to the function of each cell type.*
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> *For instance, glutamatergic projection neurons engage programs highly enriched for molecules involved in axonal remodeling, whereas transcriptional programs in both astrocytes and neurons are enriched for molecules involved in assembling and regulating synapses. In oligodendrocytes, T3 induced pathways related to their differentiation, maturation and myelination."*[9]

The authors noted that these transcriptional changes drive the remodeling of neural circuits, with T3 influencing the strength and formation of synapses, particularly in

glutamatergic neurons. Their findings also highlight the broader implications of T3-induced changes in cortical circuits, particularly in mood disorders.

The researchers found that fluctuations in T3 levels influence the brain's cortical circuits involved in behaviors like exploratory drive. This means that T3 can alter how these circuits function, which in turn impacts how individuals seek out new experiences or information. Understanding this relationship could provide insights into brain circuit functions that are disrupted in psychiatric conditions where exploratory behavior is affected. The researchers concluded:[10]

> *"Our studies reveal how the action of a single hormone can coordinate two seemingly disparate biological phenomena: exploratory drive and whole-body metabolic state.*
>
> *We anticipate that the systematic characterization of the vast array of hormonally driven molecular programs in cerebral cortex will reveal a range of novel circuit plasticity mechanisms to tune complex behaviors to match the needs of the body and the demands of the environment."*

## Is Your Thyroid Functioning Properly? Here's How to Tell

Considering the significant role thyroid hormone plays in regulating metabolism and brain function, it's important to make sure your thyroid is functioning properly. A simple way to evaluate your thyroid function is by measuring your body temperature in the morning. This method works because T3 levels are typically higher in the morning and decrease throughout the day.

High levels of T3 in the tissues are associated with a faster metabolism and, consequently, a higher body temperature and pulse rate. A morning temperature of around 98 degrees Fahrenheit indicates a healthy thyroid function. By midday, a temperature of around 98.6 degrees Fahrenheit and a pulse rate between 60 to 100 beats per minute indicate a healthy metabolic response.

If you're having your doctor assess your thyroid function, a common test they might order is the TSH test, which measures the level of TSH in your blood. It's important to note that while a low TSH level is generally desirable, it can sometimes be suppressed by cortisol and adrenaline. Even with normal lab results, abnormal body temperature and pulse readings can indicate subclinical hypothyroidism.

Checking your temperature and pulse after eating breakfast provides further insights into your thyroid function. Having a consistently low body temperature and pulse rate could mean that you have a sluggish metabolism. A drop in temperature after breakfast could also signal dependence on stress hormones, which are harmful to your health.

Your cholesterol levels also offer valuable information about your thyroid function. Elevated cholesterol (mid to high 200s) suggests an impaired thyroid-mediated conversion of cholesterol into steroid hormones. Conversely, unusually low cholesterol levels could indicate an underlying infection.

## What Causes Poor Thyroid Function?

Various lifestyle and environmental factors contribute to low thyroid function, including stress, inadequate light exposure, elevated **cortisol** levels and exposure to endotoxins. In terms of diet, high-PUFA intake is a major culprit, as PUFAs like **linoleic acid** can interfere with your cell's ability to use active thyroid hormone.

Excessive estrogen is also of particular concern, as estrogen inhibits the conversion of T4 to T3, and is one of the major contributors to cancer in my view. Unfortunately, EDCs have become ubiquitous in the environment.

One type of EDC is per- and polyfluoroalkyl chemicals (PFAS), also known as "forever chemicals."[11] These synthetic chemicals are widely used in various consumer products due to their water- and stain-resistant properties. This includes nonstick cookware, water-resistant clothing, food packaging materials and personal care products.

For practical tips on minimizing exposure to PFAS and other EDCs, I recommend you read "**Exposure to PFAS and Your Risk for Thyroid Disease**." You can also find a detailed

list of nutrients for optimal thyroid health, along with additional strategies to protect your endocrine function, in my article, "**Key Nutrients to Support Optimal Thyroid Health**."

## Progesterone and Carbs Support Thyroid Health

In my **previous interview with Keith Littlewood**, a U.K. clinician specializing in endocrine health, he highlighted that low-carb diets can disrupt thyroid function. To promote the conversion of T4 to T3, it's important to eat a diet rich in whole, unprocessed or minimally processed foods and make sure you include enough protein and healthy, easily digested carbs that won't cause intestinal irritation or endotoxin production.

**Fixing your gut health** is also important. According to Littlewood, "Digestion goes hand in hand with thyroid. It goes hand in hand with regulating thyroid, absorbing thyroid from the gut as well, and also how to regulate insulin as well. And if you can't digest your nutrients, you are always going to have a problem with supporting the thyroid."

Poor gut health is rooted in an energy deficiency in your gut that prevents proper function of the tight junctions. As the oxygen gradient in your gut increases, pathogenic bacteria thrive while beneficial bacteria die off. As a result, high-carb foods can worsen your gut health, causing gas and bloating, as the carbs feed both good and bad bacteria alike.

To fix this, you need to raise your energy production by slowly upping your carb intake. Start by incorporating fruit juice with pulp into your diet, as it offers easily digestible carbohydrates while the fiber slows sugar absorption and reduces blood sugar spikes. As your gut health improves, you can gradually add whole fruits. Once you've optimized your gut, you can start to incorporate more complex carbs and starches.

Additionally, to counteract the effects of EDCs, affect thyroid function by activating estrogen receptors, I recommend using transmucosal progesterone combined with vitamin E, as detailed below.

## How to Use Progesterone

Before you consider using progesterone, it is important to understand that it is not a magic bullet, and that you get the most benefit by implementing a Bioenergetic diet approach that allows you to effectively burn glucose as your primary fuel without backing up electrons in your mitochondria that reduces your energy production. My new book, “Your Guide to Cellular Health: Unlocking the Science of Longevity and Joy” comes out very soon and covers this process in great detail.

Once you have dialed in your diet, an effective strategy that can help counteract estrogen excess is to take transmucosal progesterone (i.e., applied to your gums, not oral or transdermal), which is a natural estrogen antagonist. Progesterone is one of only four hormones I believe many adults can benefit from. (The other three are thyroid hormone T3, DHEA and pregnenolone.)

I do not recommend transdermal progesterone, as your skin expresses high levels of 5-alpha reductase enzyme, which causes a significant portion of the progesterone you're taking to be irreversibly converted primarily into allopregnanolone and cannot be converted back into progesterone.

## Ideal Way to Administer Progesterone

Please note that when progesterone is used transmucosally on your gums as I advise, the FDA believes that somehow converts it into a drug and prohibits any company from advising that on its label. This is why companies like Health Natura promotes their progesterone products as "topical."

However, please understand that it is perfectly legal for any physician to recommend an off-label indication for a drug to their patient. In this case, progesterone is a natural hormone and not a drug and is very safe even in high doses. This is unlike synthetic progesterone called progestins that are used by drug companies, but frequently, and incorrectly, referred.

Dr. Ray Peat has done the seminal work in progesterone and probably was the world's greatest expert on progesterone. He wrote his Ph.D. on estrogen in 1982 and spent most of his professional career documenting the need to counteract the dangers of excess estrogen with low LA diets and transmucosal progesterone supplementation.

He determined that most solvents do not dissolve progesterone well and discovered that vitamin E is the best solvent to optimally provide progesterone in your tissue. Vitamin E also protects you against damage from LA. You just need to be very careful about which vitamin E you use as most supplemental vitamin E on the market is worse than worthless and will cause you harm not benefit.

It is imperative to avoid using any synthetic vitamin E (alpha tocopherol acetate — the acetate indicates that it's synthetic). Natural vitamin E will be labeled "d alpha tocopherol." This is the pure D isomer, which is what your body can use.

There are also other vitamin E isomers, and you want the complete spectrum of tocopherols and tocotrienols, specifically the beta, gamma, and delta types, in the effective D isomer. As an example of an ideal vitamin E, you can look at the label on our vitamin E in our store. You can use any brand that has a similar label.

You can purchase pharmaceutical grade bioidentical progesterone as Progesterone Powder, Bioidentical Micronized Powder, 10 grams for about $40 on many online stores like Amazon. That is nearly a year's supply, depending on the dose you choose.

However, you will need to purchase some small stainless steel measuring spoons as you will need a 1/64 tsp, which is 25 mg and a 1/32 tsp, which is 50 mg. A normal dose is typically 25-50 mg and is taken 30 minutes before bed, as it has an anti-cortisol function and will increase GABA levels for a good night's sleep.

Unfortunately, this vendor frequently runs out of product, and if that’s the case, then you can use **Simply Progesterone by Health Natura**. It’s premixed with vitamin E and MCT oil. Again, while Health Natura states that its product is for “topical use only,” I recommend applying it transmucosally, by rubbing it on your gums.

If you are a menstruating woman, you should take the progesterone during the luteal phase or the last half of your cycle, which can be determined by starting 10 days after the first day of your period and stopping the progesterone when your period starts.

If you are a male or non-menstruating woman, you can take the progesterone every day for four to six months and then cycle off for one week. The best time of day to take progesterone is 30 minutes before bed as it has an anti-cortisol function and will increase GABA levels for a good night's sleep.

This is what I have been personally doing for over a year with very good results. I am a physician so do not have any problems doing this. If you aren't a physician, you should consult one before using this therapy, as transmucosal progesterone therapy requires a doctor's prescription.

## Sources and References


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