



12-7-2023

Pick Your Poison: How Aspartame Causes Anxiety

Abby J. Kersey
abby.kersey@und.edu

Baylee R. Kram

Blessing O. Okosun

Diane C. Darland
University of North Dakota, diane.darland@UND.edu

[How does access to this work benefit you? Let us know!](#)

Follow this and additional works at: <https://commons.und.edu/as-showcase>



Part of the [Biology Commons](#)

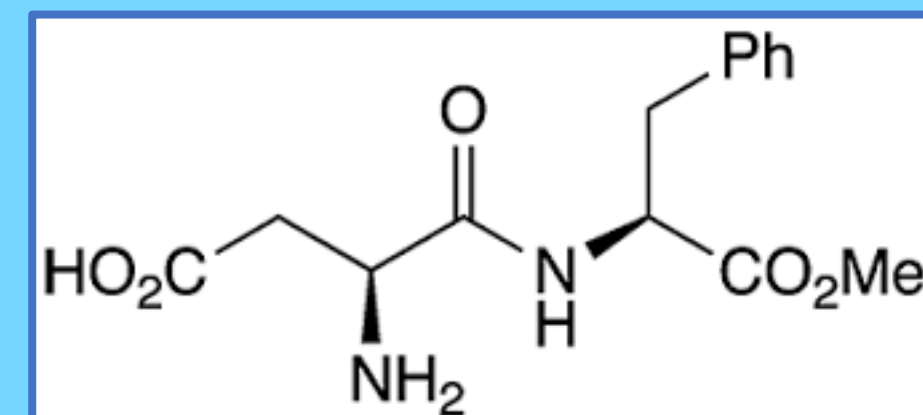
Recommended Citation

Kersey, Abby J.; Kram, Baylee R.; Okosun, Blessing O.; and Darland, Diane C., "Pick Your Poison: How Aspartame Causes Anxiety" (2023). *Arts & Sciences Undergraduate Showcase*. 15.
<https://commons.und.edu/as-showcase/15>

This Poster is brought to you for free and open access by the College of Arts & Sciences at UND Scholarly Commons. It has been accepted for inclusion in Arts & Sciences Undergraduate Showcase by an authorized administrator of UND Scholarly Commons. For more information, please contact und.common@library.und.edu.



Pick Your Poison: How Aspartame Causes Anxiety



Abby J. Kersey, Baylee R. Kram, Blessing O. Okosun, and Diane C. Darland
Primary Research Project: BIOL491/503 Nutrition and Neuroscience
Department of Biology, College of Arts and Sciences

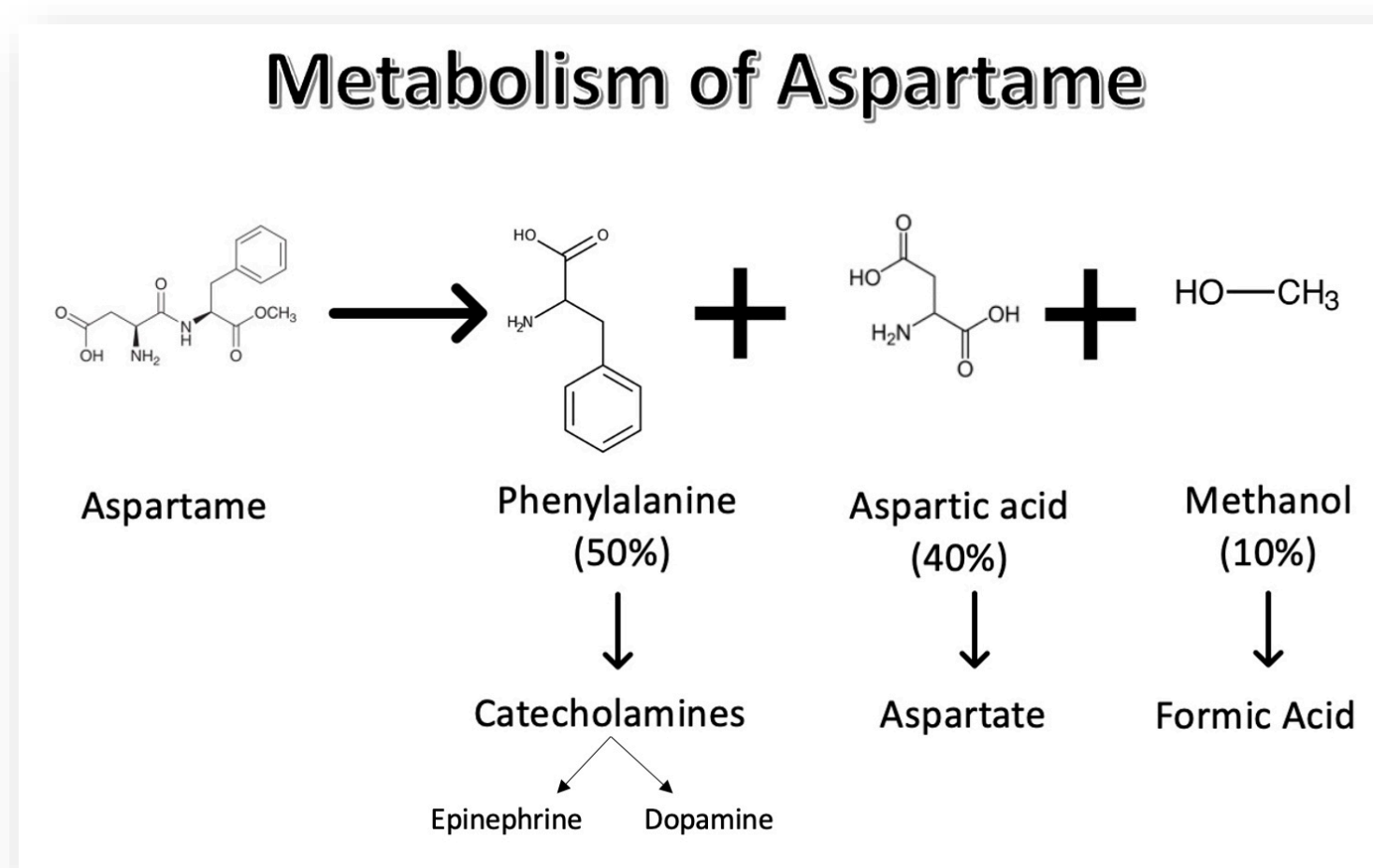
UNIVERSITY OF
ND NORTH DAKOTA
College of Arts & Sciences

Primary Research Article

Transgenerational transmission of aspartame-induced anxiety and changes in glutamate-GABA signaling and gene expression in the amygdala. Jones, S.K., McCarthy, D.M., Vied, C., Stanwood, G.D., Schatschneider, C., and Bhide, P.G. *PNAS* 2022 119 (49):e2213120119

What is Aspartame?

- ❖ Artificial sweetener found in ~5,000 diet foods and drinks
- ❖ A methyl ester dipeptide consisting of aspartic acid and phenylalanine

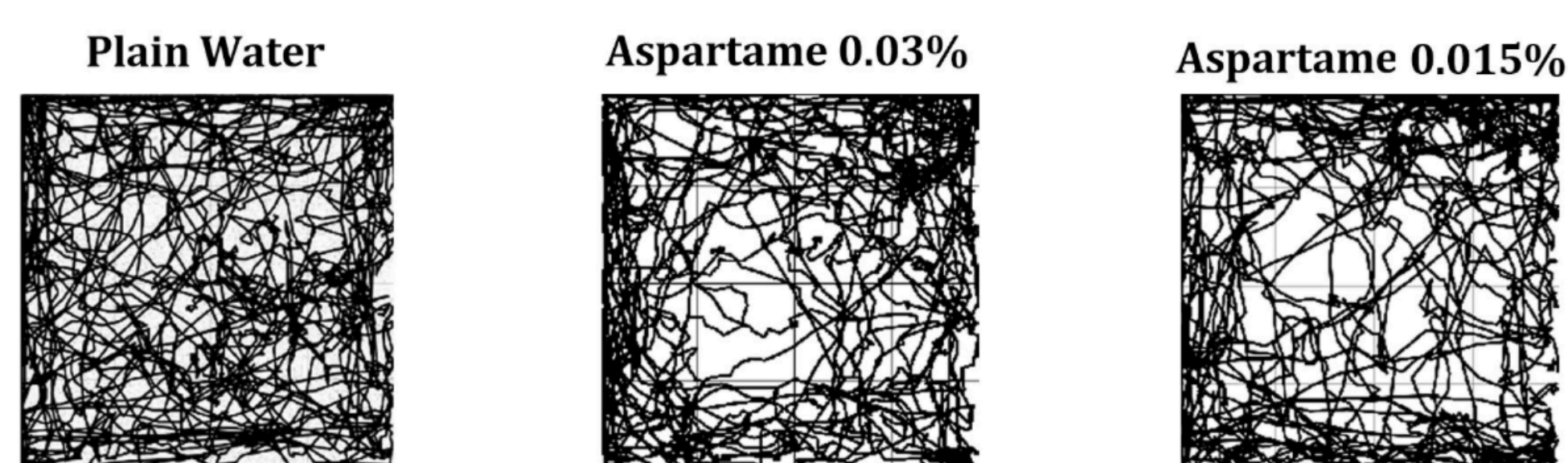


- ❖ Breaks down into phenylalanine, aspartic acid, and methanol in the digestive system
- ❖ Phenylalanine is a precursor and is converted to tyrosine which is a precursor of catecholamines
- ❖ Aspartic acid is an excitatory neurotransmitter

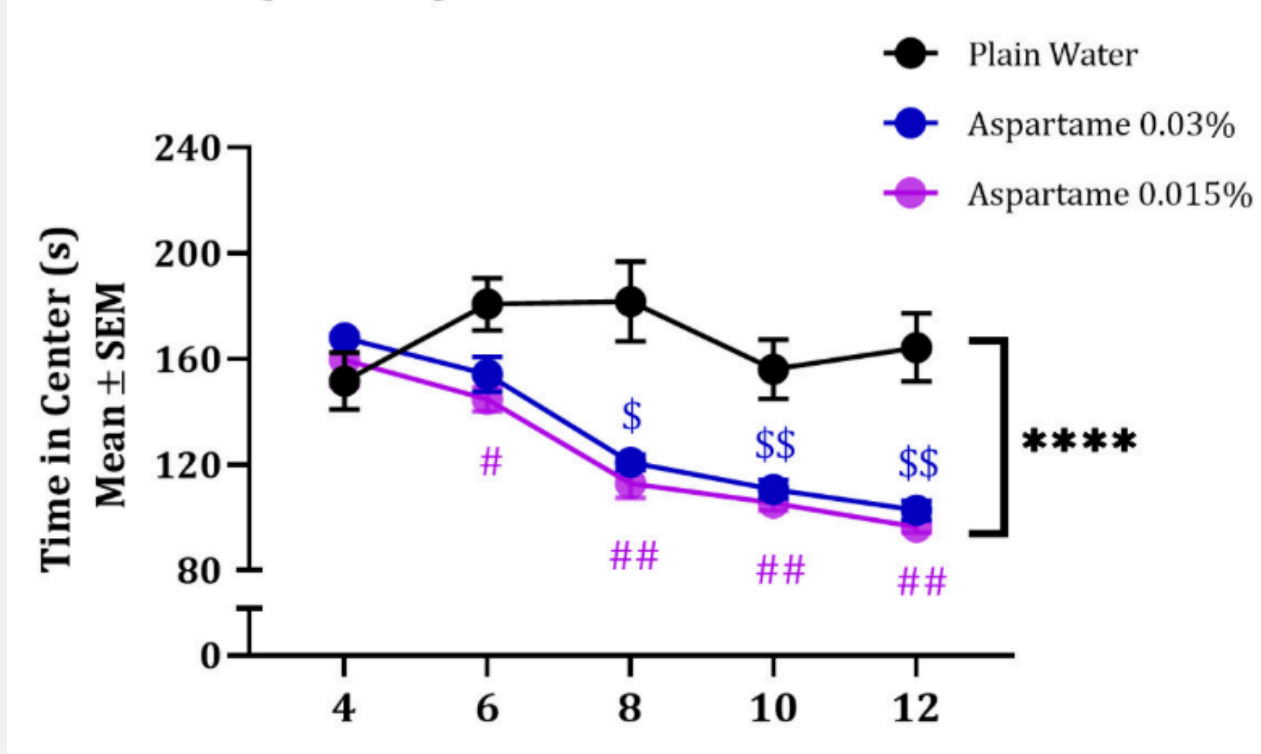
How can anxiety be measured in mice?

- ❖ **What is the open field test?** Mice with anxiety spend relatively shorter time in the center areas than mice without anxiety.

OFT (Representative Tracks; Male)



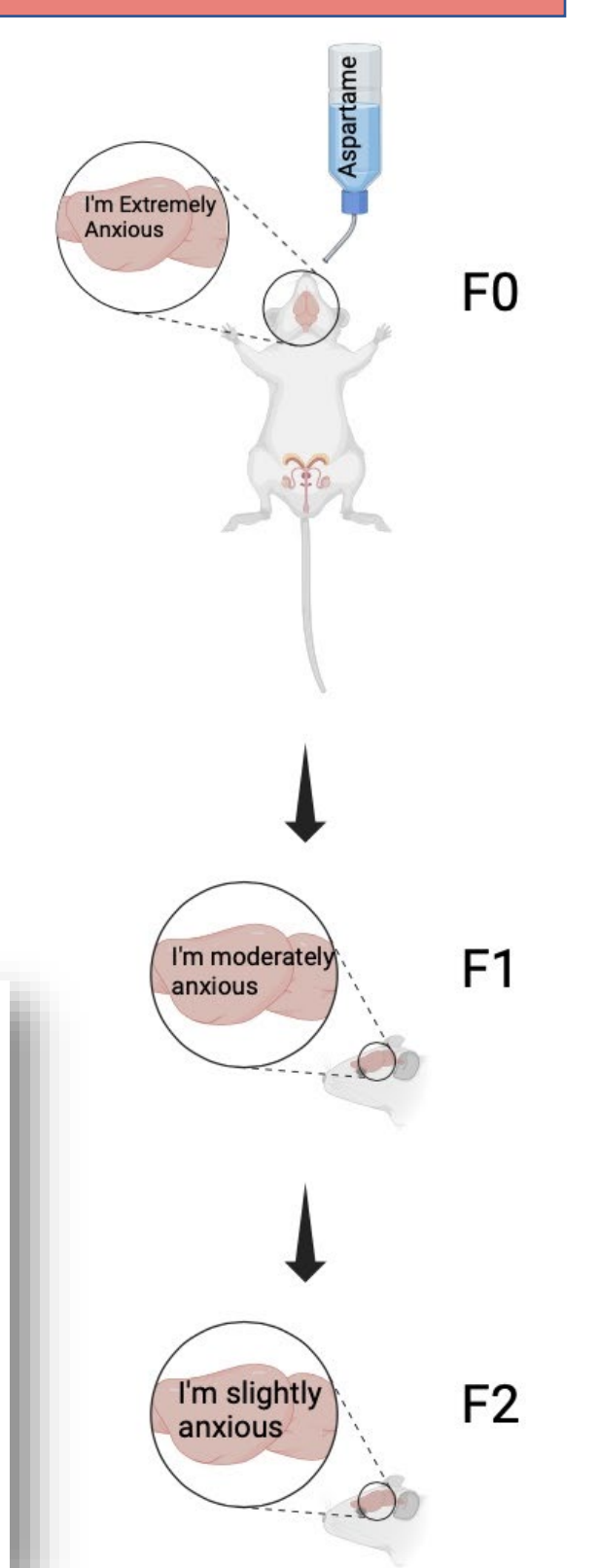
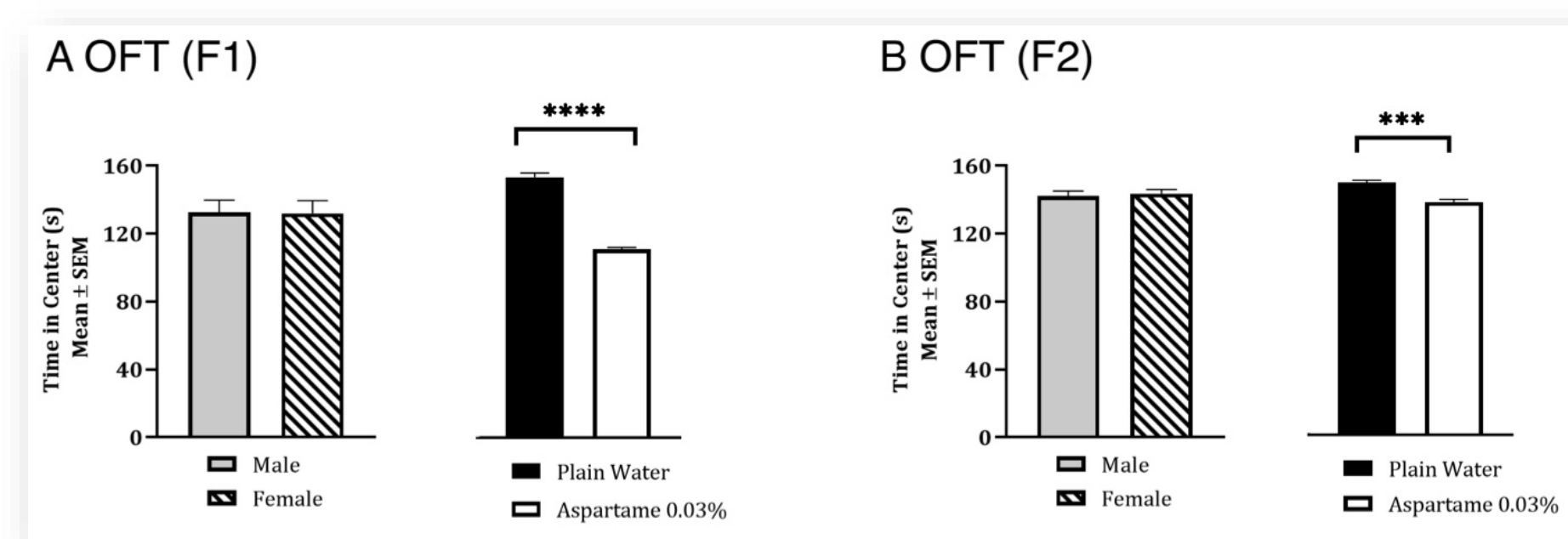
A OFT (Male)



- ❖ Anxiety phenotypes began at 6 weeks of aspartame exposure and persisted until 12 weeks

Is aspartame-induced anxiety “inherited” in mice?

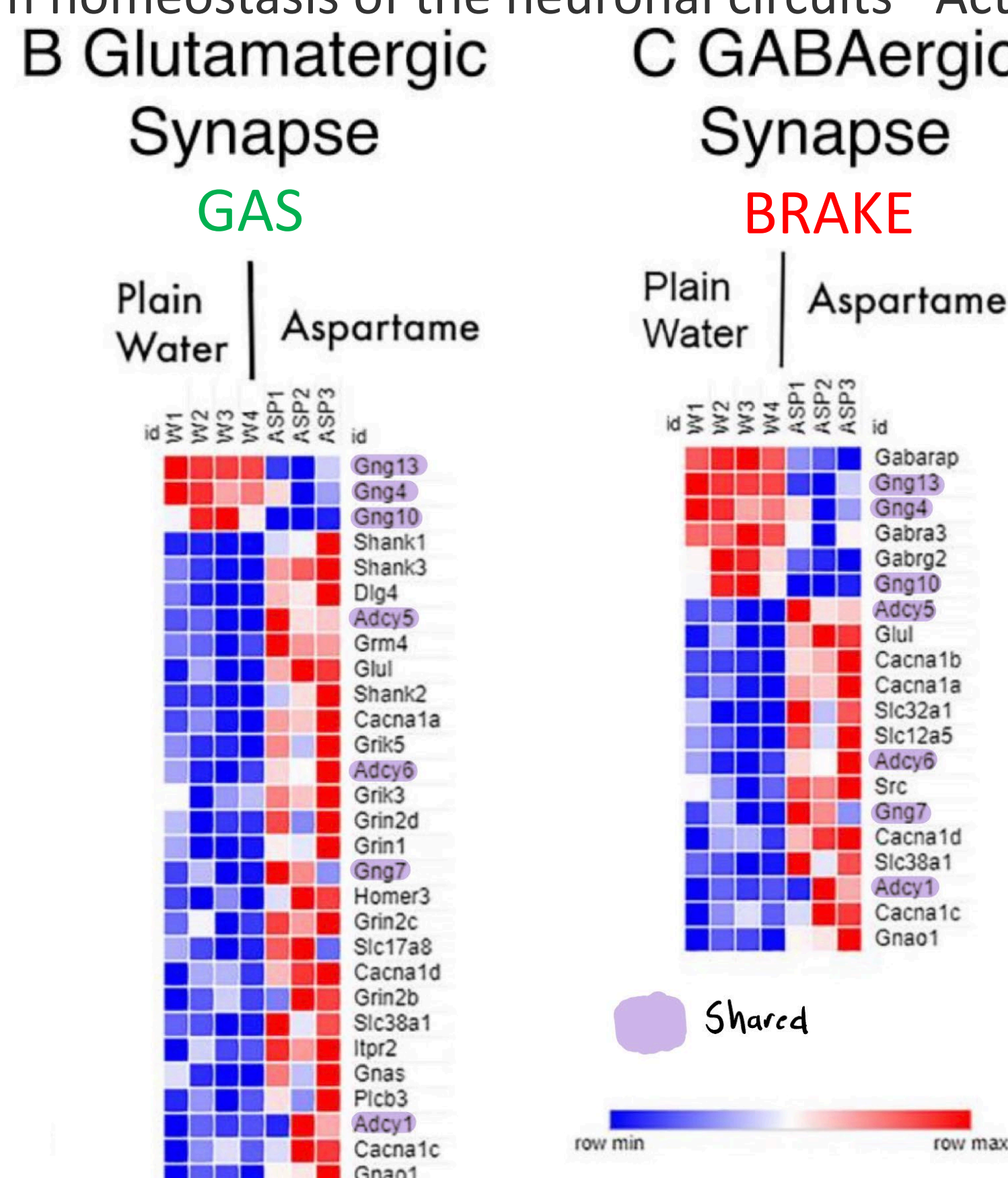
- ❖ **Transgenerational Transmission**-phenotypes that are inherited by multiple generations descending from the directly exposed individuals
- ❖ F1 mice were produced from three F0 male mice lineages following 12 wk: 0.03% & 0.015% aspartame exposure, and plain water
- ❖ F2 mice were produced from F1 0.03% aspartame lineage and F1 plain drinking water lineage



How does aspartame treatment change gene expression in mice brains?

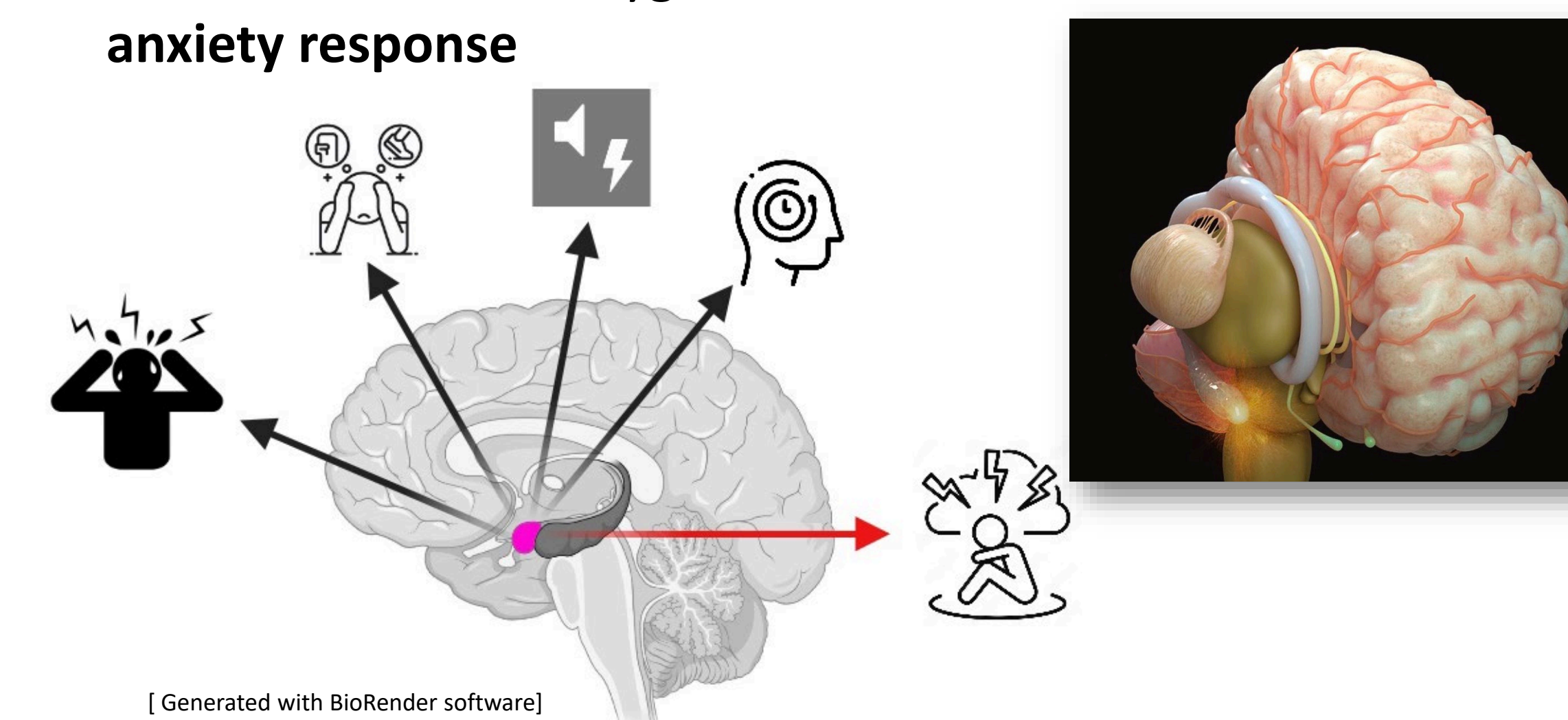
- ❖ **Glutamatergic Synapse**- Glutamate is the major excitatory neurotransmitter at almost all synapses in the vertebrate central nervous system (CNS) *Acts as the **gas** pedal*
- ❖ **GABAergic Synapse**- maintains the balance between excitatory and inhibitory synaptic transmission, and plays a crucial role in normal function and long-term homeostasis of the neuronal circuits *Acts as the **brake** pedal*

- ❖ Aspartame consumption shifts the excitation-inhibition equilibrium in the amygdala toward excitation
- ❖ Outcome: the amygdala now has double **gas** pedals, and no **brake** pedal.



What does the Amygdala do?

- ❖ Part of the Limbic Loop which acts as the center of **emotions, behavior, and memory**
- ❖ Neural Excitation-inhibition equilibrium in the amygdala plays a central role in the regulation of anxiety
- ❖ Stimulation of the amygdala causes an **increased stress and anxiety response**



How does aspartame affect humans?

- ❖ **Neurobehavioral effects of aspartame consumption.** Lindseth, G.N., Coolahan, S.E., Petros, T.V., and Lindseth, P.D. *Res Nurs Health* 2014 37(3):185-193.
- ❖ FDA “safe” recommended *daily* value is 50 mg per 1 kg (RDA)
- ❖ Aspartame exposure in students was 50% of RDA for 8 days
- ❖ Students reported impaired working memory and spatial orientation

Table 1
Typical Food and Beverage Servings for a High-Aspartame (25 mg/kg/day) Diet for a 54 kg Female

Food and Beverage Containing Aspartame	Portion Size	Aspartame (mg)
Breakfast		
Sugar-free fruit juice	10 oz.	116
Sugar-free yogurt	8 oz.	160
Lunch		
Sugar-free gelatin	4 oz.	100
Sugar-free lemonade	12 oz.	120
Snack/beverage		
Diet soda	20 oz. bottle	325
Dinner		
2 scoops (4 oz.) sugar-free ice cream	8 oz.	100
1 glass sugar-free fruit punch	12 oz.	120
Evening snack beverage		
Diet soda	20 oz. bottle	325
Total:		1,364

Table 2
Within-Subject Differences in Neurobehavior Scores After High and Low Aspartame Intake (N = 28)

Variable	M	SD	Paired t-test	p
Spatial orientation				
High-aspartame	14.1	4.2	2.4	.03*
Low-aspartame	16.6	4.3		
Working memory				
High-aspartame	730.0	152.7	1.5	N.S.
Low-aspartame	761.1	201.6		
Mood (irritability)				
High-aspartame	33.4	9.0	3.4	.002**
Low-aspartame	30.5	7.3		
Depression				
High-aspartame	36.8	7.0	3.8	.001**
Low-aspartame	34.4	6.2		

- ❖ Vulnerable populations are at greater risk with consecutive aspartame consumption
- ❖ 13/40 participants dropped from study after only 7 days
- ❖ Aspartame group reported more symptoms than placebo group

Take Home Message: Limit Your Aspartame Consumption!