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# Effects of Sudden Removal of High Social Enrichment upon Monoamine Levels in Cortical and Subcortical Structures of Rat Brain

Spencer Feehan, Rachel Lichtenstein, Hailey Robson, Dr. Deborah S. Kreiss

## Background

- **Objective:** investigate the effects of removal of high social enrichment upon monoamine neurotransmitter levels in cortico-basal ganglia-thalamic circuitry
- **Intention:** model the sudden loss of social enrichment experienced during the COVID-19 pandemic
- **High enrichment:** larger cages with multiple toys, human handling, and playdates with 12 same sex non-cagemates
- **Neurochemical evaluation:** norepinephrine (NE), dopamine (DA), and serotonin (5-HT) were targeted because abnormalities of these neurotransmitters within cortical and subcortical structures underlie psychological disorders

## Methods

### Subjects and Enrichment

- 28 male, 28 female Sprague-Dawley rats
- Day 34 to 76: all rats experienced high enrichment 4 times a week
- Day 77 to 106: experimental rats experienced reduction to standard enrichment, whereas control rats experienced continued high social enrichment

### Tissue Extraction

- Post-mortem bilateral punches obtained on Day 107 from PFC, MC, ACC, OFC, AMY, HYPO, HIPPO, LT, MT, DS, & VS<sup>1</sup>
- Punches homogenized<sup>2</sup> and centrifuged
- Supernatants extracted and plated

### High Performance Liquid Chromatography (HPLC) Analysis

- Supernatants analyzed for NE, DA, 5-HT levels<sup>2,3,4</sup>

### Data Analysis

- SPSS used for 2-Factor ANOVA analysis of data
- Two-tailed Student's t-tests used for pairwise comparisons ( $p < 0.05$ )
- Data is expressed as mean  $\pm$  1 standard error of the mean (SEM)
- Outliers ( $\pm 2.0$  standard deviations) eliminated

## Neurotransmitter Levels



## Summary of Results

Change in Neurotransmitter Levels						
Monoamines	NE		DA		5-HT	
Sex	M	F	M	F	M	F
PFC	↓	↓	↓	↓	↓	↓
MC	↓	↓	↓	↓	↓	↓
OFC	↓	↓	↓	↓	↓	↓
ACC	↓	↓	↓	↓	↓	↑
LT	↓	↓	↓	↓	↓	↓
MT	↓	↓	↓	↓	↓	↓
HYPO	↑	↓	↓	↓	↓	↓
DS	↑	↓	↑	↓	↓	↑
VS	↓	↓	↓	↓	↓	↓
HIPPO	↓	↓	↓	↓	↓	↓
AMY	↓	↓	↓	↓	↓	↓

Table 1: change in neurotransmitter levels of experimental rats (underwent removal of enrichment) compared to control rats (underwent continued enrichment).

## Conclusions

Removal of enrichment **decreased** monoamine levels in cortico-basal ganglia-thalamic circuits in both males and females:

- Cortical structures: PFC, MC, & OFC
- Subcortical structures: LT, MT, & VS

**Sex** influenced the effects of removal of enrichment:

- In ACC, 5-HT in males decreased, but increased in females
- In HYPO, NE in males increased, but decreased in females
- In DS, NE in males increased, but decreased in females
- In DS, 5-HT in males decreased, but increased in females

**Increased understanding of neurochemical changes induced by removal of enrichment will facilitate development of better therapeutic strategies for those experiencing a loss of social enrichment.**

## References

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2. Bishop C, George JA, Buchta W, Goldenberg AA, Mohamed M, Dickinson SO, Eissa S, and Eskow Jaunarajs KL (2012) Serotonin transporter inhibition attenuates L-DOPA-induced dyskinesia without compromising L-DOPA efficacy in hemi-parkinsonian rats. *European Journal of Neuroscience*. 36:2839-2848
3. HTEC-500, Amuzainc.com
4. EPC-700 Envision software, Amuzainc.com

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