Environmental rearing effects on decision making

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Introduction

- Environmental enrichment during rearing produces a variety of neurobiological and behavioral changes
- Environmental enrichment appears to provide a “protective effect” against addictive behaviors
  - This may be due to improved decision making as risky and impulsive choice have been linked with drug abuse

Introduction

- Impulsive choice
  - A smaller magnitude available after a shorter delay (the SS) versus a larger magnitude available after a longer delay (the LL)
- Risky choice
  - A smaller magnitude that is certain (the C-S) versus a larger magnitude that is uncertain (the U-L)

Introduction

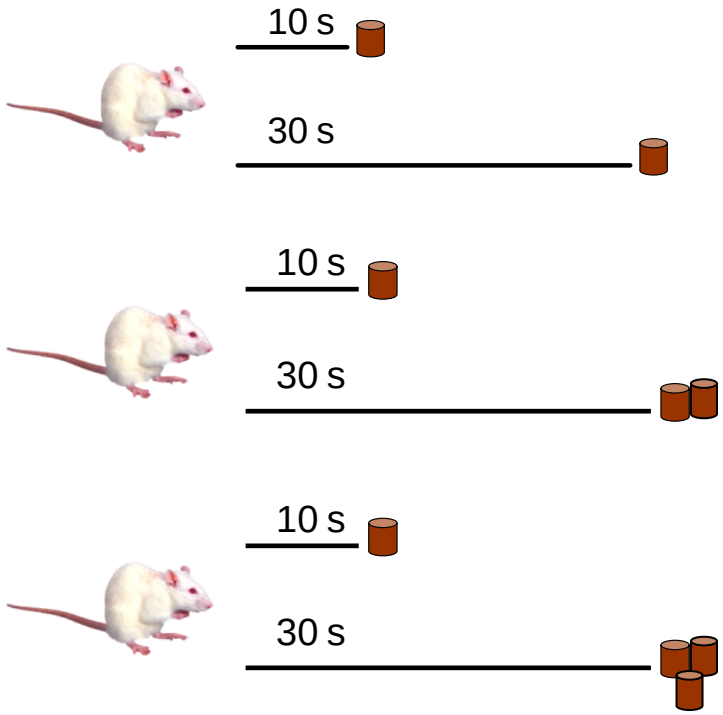
- Enrichment and impulsive choice
  - Perry et al. (2008) – Enriched condition (EC) rats displayed decreased impulsive choice
  - Hellmans et al. (2005) – Isolated condition (IC) rats displayed decreased impulsive choice
- Enrichment and risky choice
  - Zeeb et al. (2012) – IC rats made more disadvantageous choices in an Iowa Gambling Task

Method: Rearing

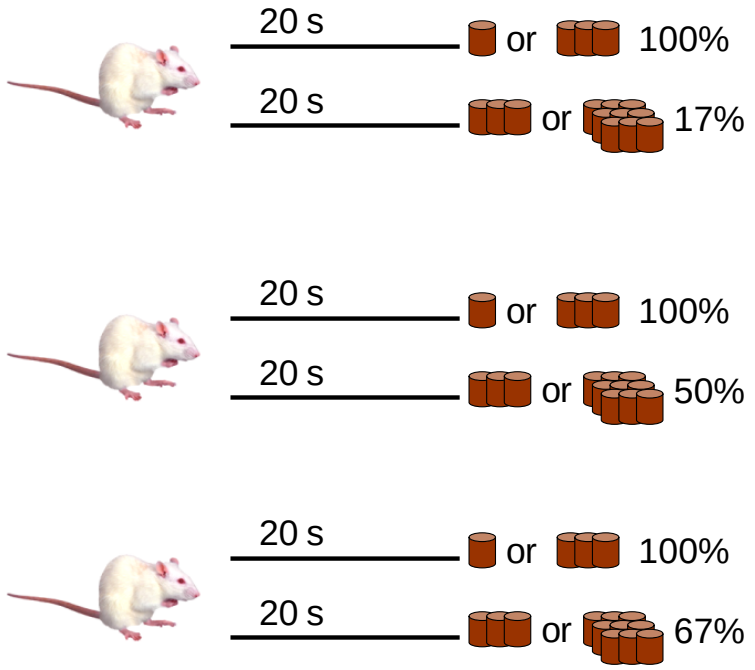
- Rats reared for 30 days
  - Enriched Condition (EC, n=11)
  - Isolated condition (IC, n=12)
- Rearing environment maintained during behavioral testing

Method: Choice tasks

Impulsive Choice

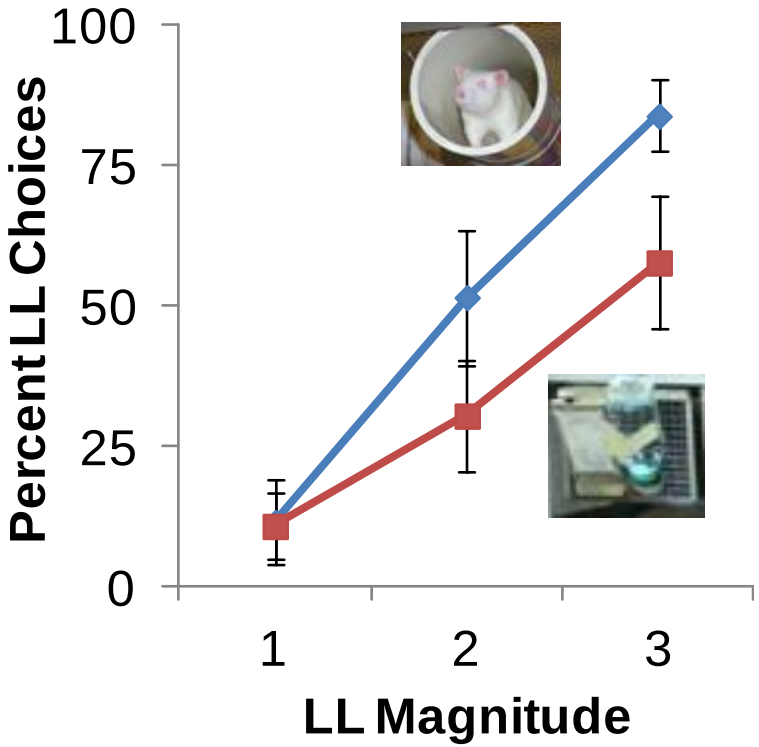


Risky Choice



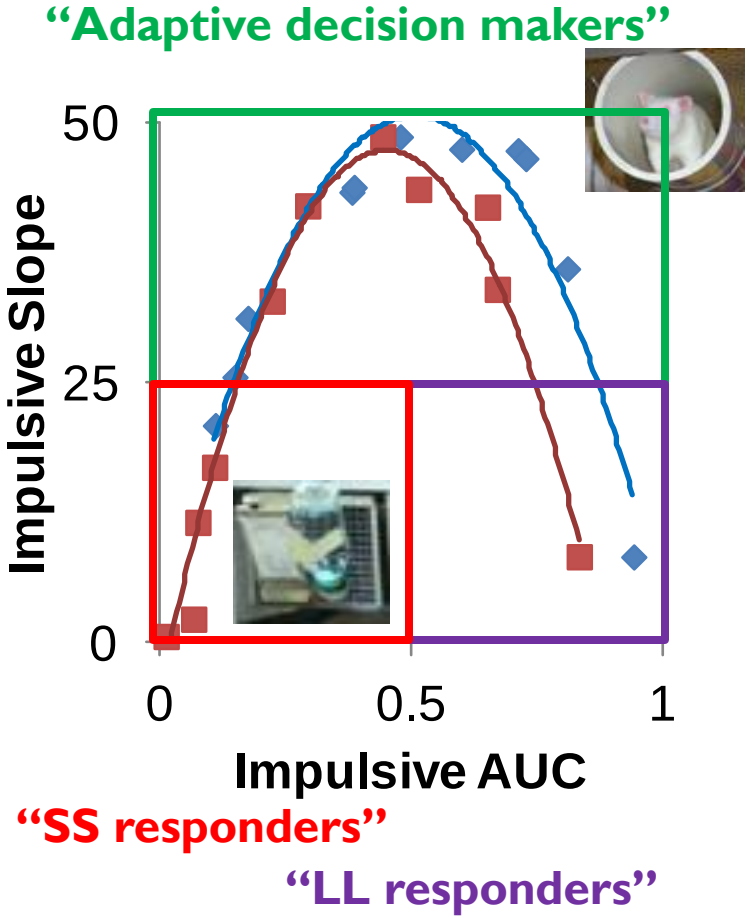
Results: Impulsive choice

- EC rats were more likely to choose the LL as the magnitude increased



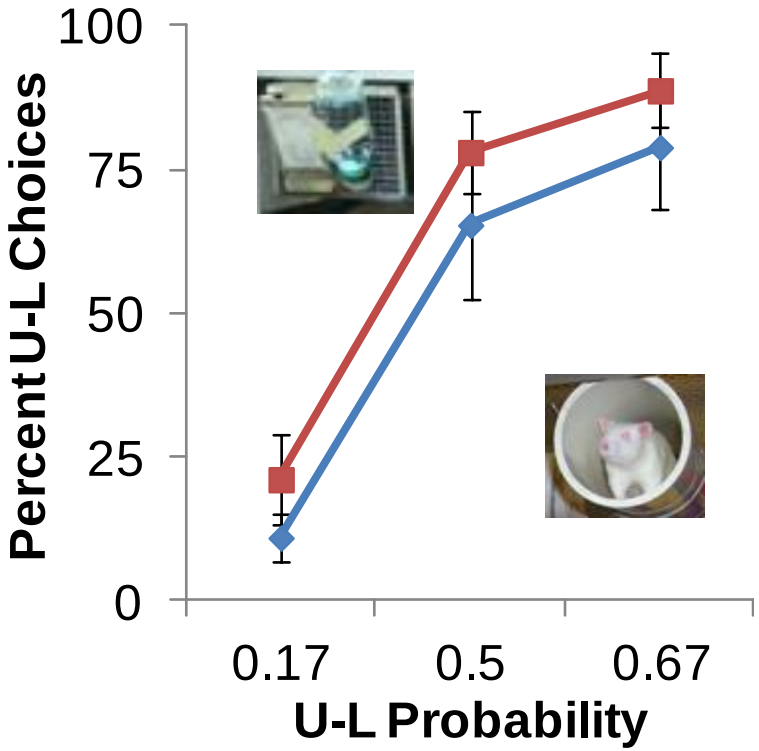
Results: Impulsive slope vs. AUC

- IC rats were more likely to be "SS responders"
- EC rats were more likely to be "Adaptive decision makers"
- Distributional shift with environmental rearing



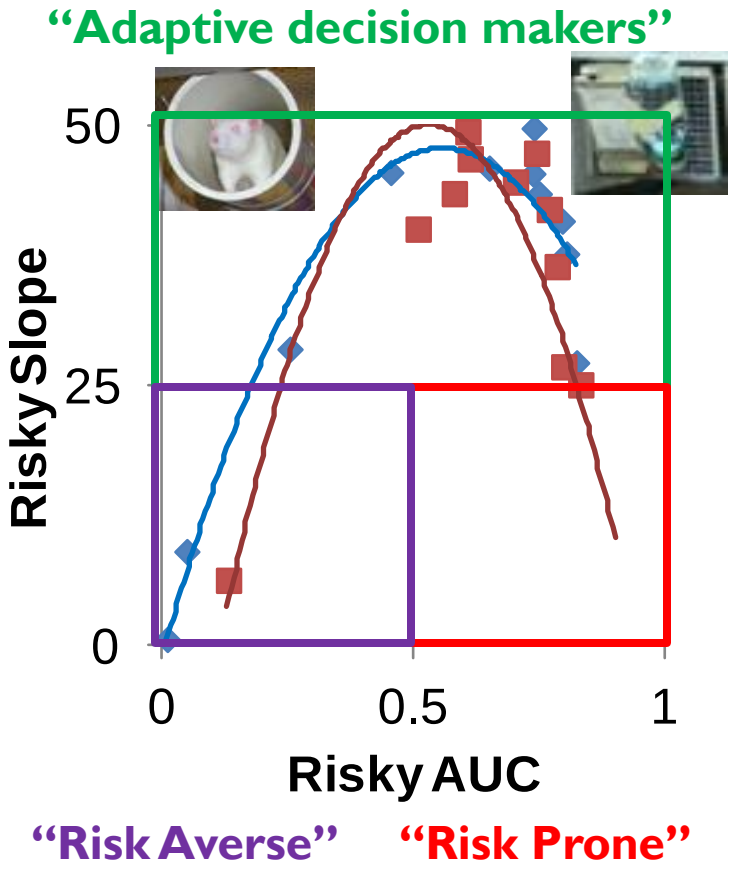
Results: Risky choice

- IC rats were more likely to choose the risky U-L option
- But, group effect not significant

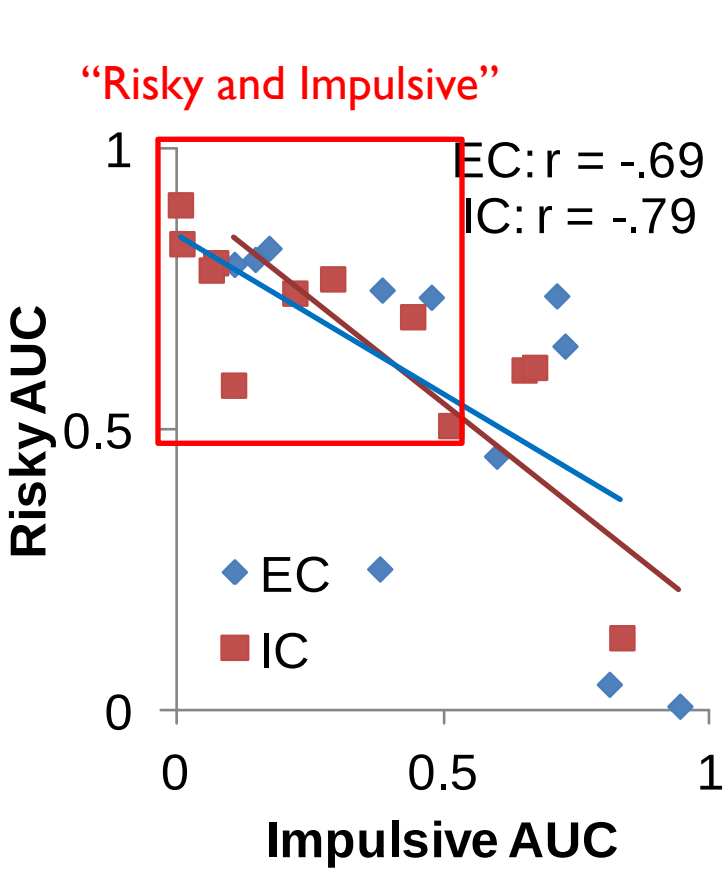


Results: Risky slope vs. AUC

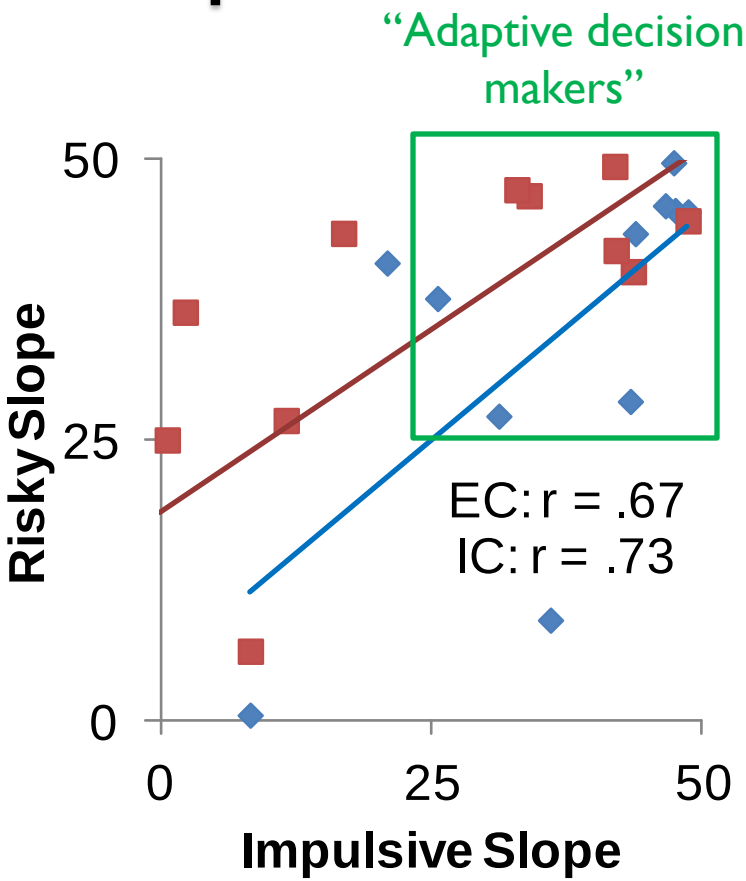
- IC rats were slightly shifted towards having higher risk-taking
- Not much of a difference in adaptive decision making



Results: Cross-task comparisons



The rats that took the most risks were also the most impulsive

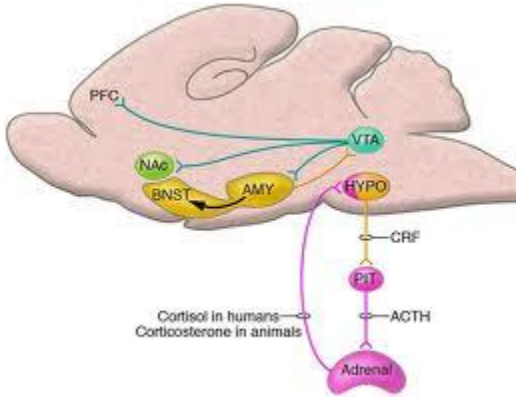


Adaptability in choice behavior was consistent across tasks

Neural mechanisms

- Nucleus accumbens (NAC) and prefrontal (PFC) are primary targets for rearing environment effects
- These areas are also implicated in choice behavior and drug addiction

The mesolimbic dopamine system

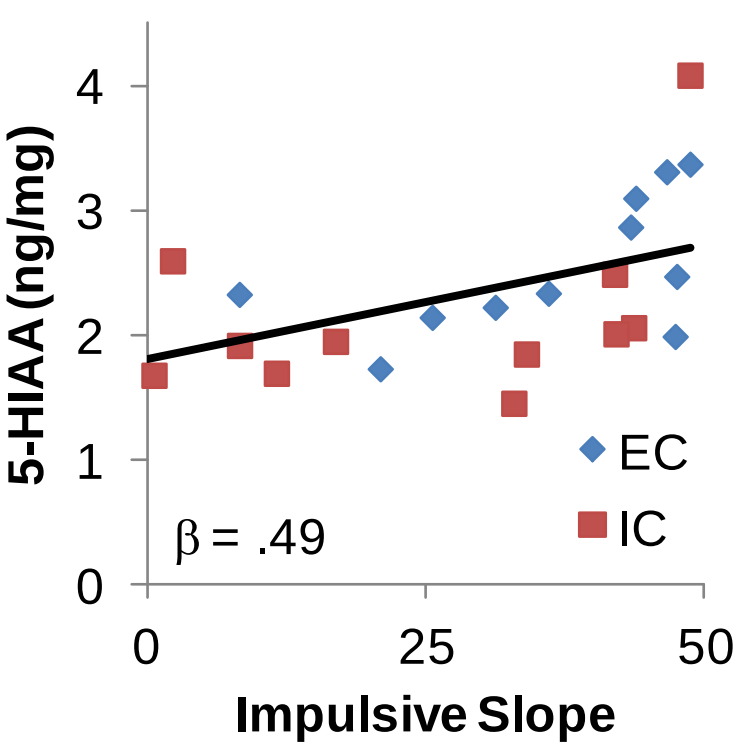


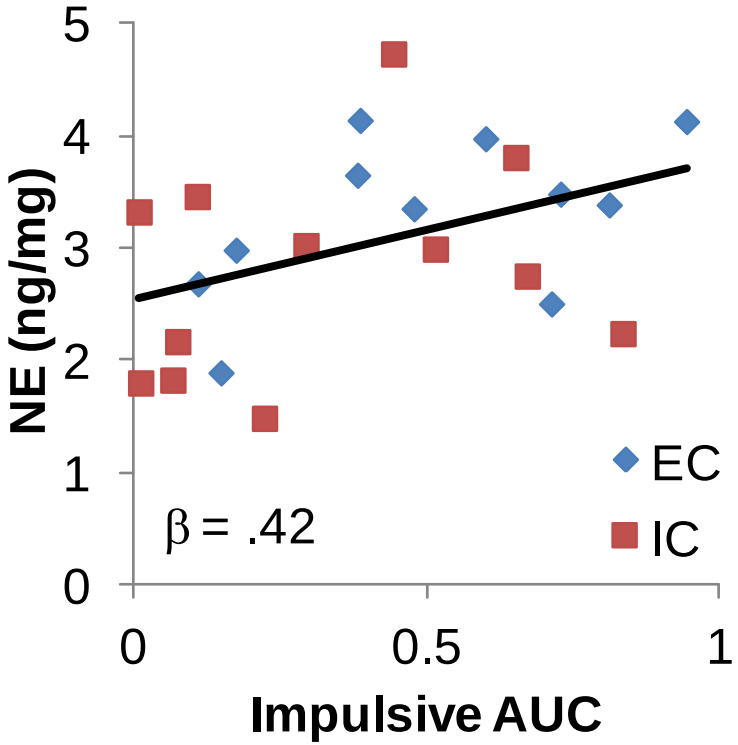
High Performance Liquid Chromatography (HPLC)

- Extracted nucleus accumbens (NAC) and pre-frontal cortex (PFC)
- Determined concentration of catecholamines using HPLC
  - Normalized for sample volume

NAC and impulsive choice

5-HIAA concentration associated with impulsive slope
NE concentration associated with impulsive AUC





NAC 5-HIAA Interpretation

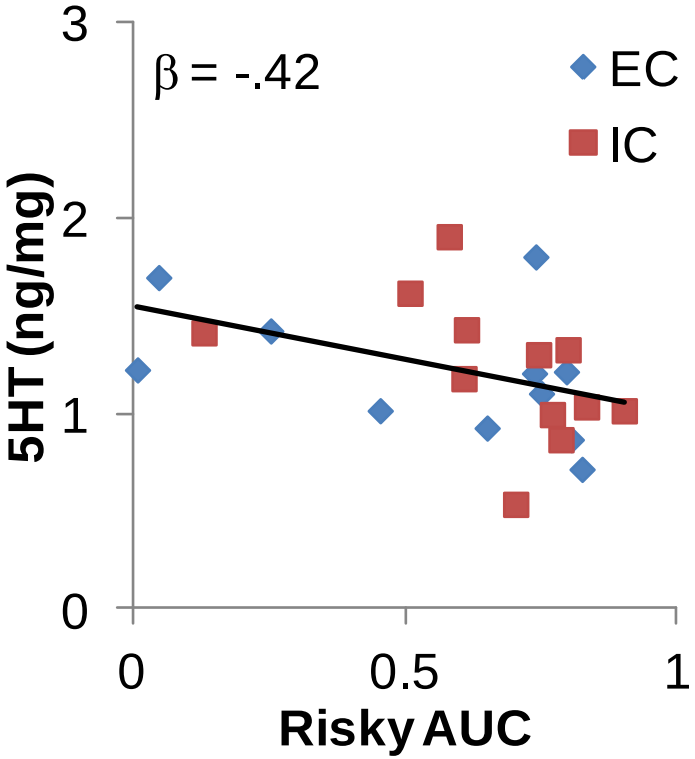
- 5-HIAA is a 5-HT metabolite that may reflect functional serotonin activity
- Rats reared in different environments have been repeatedly shown to exhibit differences in the 5-HT system (Bickerdike, Wright, & Marsden, 1993; Brenes, Rodríguez, & Fornaguera, 2008; Crespi, Wright, & Möbius, 1992; Fulford & Marsden, 1998; Jones, Hernandez, Kendall, Marsden, & Robbins, 1992; Miura, Qiao, & Ohta, 2002; Rasmuson et al., 1998)
- 5-HT has been proposed to promote delay tolerance with lower 5-HT associated with impulsive choice (e.g., Ho et al. 1998)

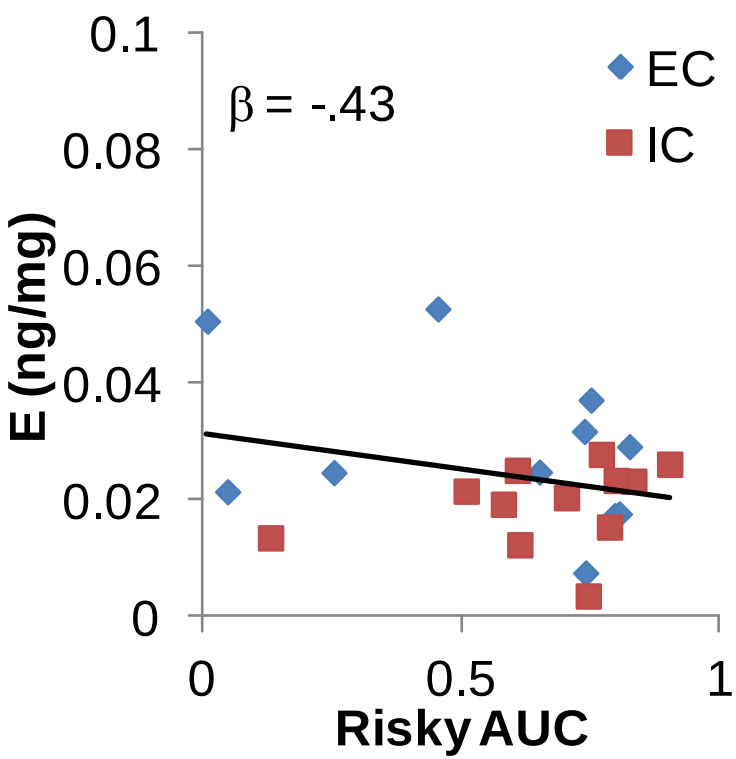
NAC NE Interpretation

- NAC NE has previously been reported to be altered by rearing environment, with EC rats displaying higher NE (Brenes et al. 2008)
- May be reflecting arousal effects or incentive motivational effects on overall impulsive bias

NAC and risky choice

5-HT and E associated with risky AUC
No correlations with risky slope





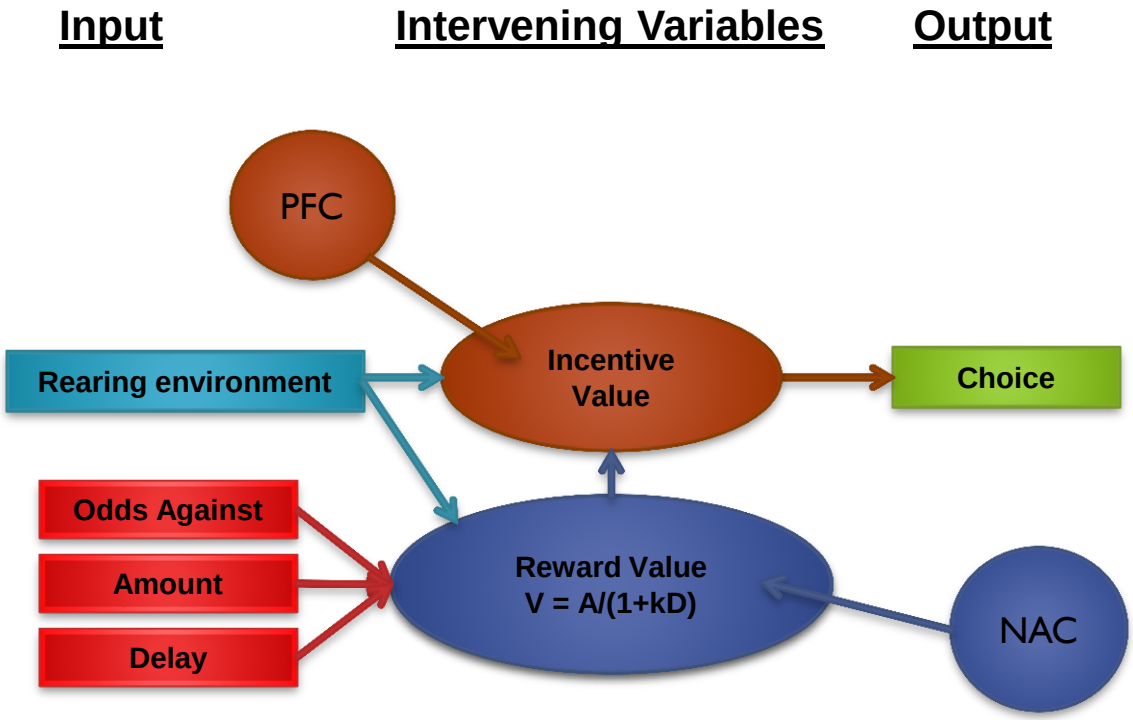
NAC 5-HT Interpretation

- Much less evidence on neurotransmitters and risky choice
- But, given the correlation of impulsive and risky AUC, not surprising that both are affected by serotonin system
  - 5-HIAA → impulsive choice
  - 5-HT → risky choice

PFC

- Both DA (r=.48) and DOPAC (r=.45) correlated with the impulsive slope
- But, when controlling for NAC neurotransmitters, these were not significant
- Therefore, DA and DOPAC are not contributing any unique prediction of choice behavior
- However, if control for PFC DA and DOPAC, NAC neurotransmitters are still significantly correlated with choice behavior
  - Therefore, NAC appear to be the primary contributor to choice behavior

Overall conclusions



Acknowledgements

- Paul Brungardt
- Andrew Marshall
- Aaron Smith
- Jon Smith
- Dr. Tiffany Galtress
- Dr. Juraj Koci
- Dr. Mary Cain
- Dr. Yoonseong Park

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