A Cross-Validation Study of Model-Free Learning Tasks

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INTRODUCTION

- Substance use disorder (SUD) is characterized by the inability to abstain and control behavior such as alcohol craving toward the drug of abuse despite the negative consequences presented by the drug or the innate desire to change
- The process of decision-making is impaired in those struggling with addiction
- Decision-making is informed by both goal-directed and habit-based mindsets, which is specifically reflected in model-based and model-free learning models
- Those with model-based learning behaviors tend to utilize a cognitive model centered on possible actions and their consequences to better inform their decisions.
- Model-free learning models are based on habitual behavior developed through one's lifetime.
- The Spaceship Task vs the HABIT Task comparison
- We hypothesize that individuals who utilize model-free strategies in the spaceship task will also execute model-free behaviors measured in the HABIT task. Additionally, we hypothesize that individuals who utilize more model-based strategies in the spaceship task will exhibit less model-free behavior in the HABIT task.

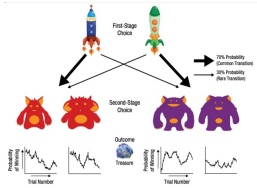
METHODS

	Mean
Demographics	
Age (years)	18.91 ± 1
SILS (calculated) IQ	107.47 ± 5.7
Education (years)	12.89 ± 1
Ethnicity (% white)	64
BSMSS (SES)	17.86 ± 4.2
Connors ADHD Scale	
DSM Inattention	6.91 ± 4.8
DSM Hyperactivity	7.46 ± 3.6
DSM ADHD	14.37 ± 7.3
Working Memory	
OSPAN Score	43.74 14.1
OSPAN Total	58.46 ± 9.6
Accuracy Errors	4.67 ± 2.3
Math Errors	6.13 ± 2.8

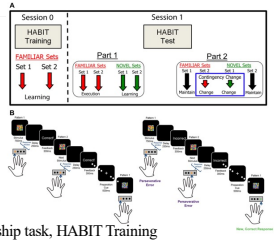
Substance Use-Related	
AUDIT Total	3.2 ± 3.5
Consumption	2.37 ± 2.4
Dependence	0.26 ± 0.6
Harm	0.57 ± 0.9
DUSI-I (%)	1.39 ± 1.9
FTQ density (%)	0.12 ± 0.1
Psychometric	
Perceived Stress	17.73 ± 5.8
BIS Total	59.1 ± 9.1
Attention	16.67 ± 3.4
Motor	20.24 ± 2.8
Non-planning	22.2 ± 5.5
Internal-External Control (LOC)	11.22 ± 3.6
STAI-State Anxiety	38 ± 9.6
STAI-Trait Anxiety	43.74 ± 10
Thought Action Fusion (TAF) Total	19.63 ± 13.8
Moral	15.96 ± 11.7
Self	1.48 ± 2.2
Others	2.24 ± 2.7
Obsessive-Compulsive Inventory (OCI-R)	13.72 ± 10.4

- 68 subjects: 36 F and 32 M
- Subjects were given Psychology 101 credit for their participation.

Spaceship Task:

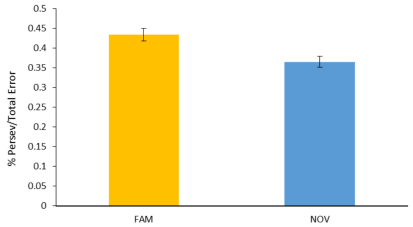


HABIT Task:

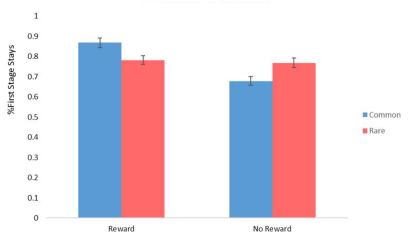


- 1st Session: questionnaires, spaceship task, HABIT Training
- 2nd Session: HABIT Test session
- Number of perseverative errors measured in the HABIT task was compared to the number of first-stage stays measured in the spaceship task through a Pearson correlation analysis.

RESULTS

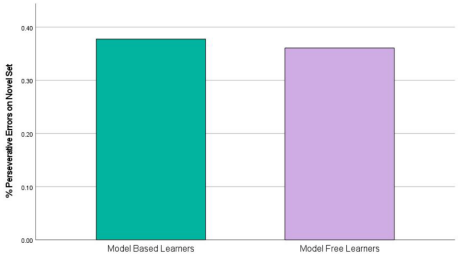


There were more perseverative errors in the familiar set rather than the novel set as expected on the HABIT task.



The highest probability of first stage stays was in the reward condition after a common transition.

There was no difference in probability of first stage stay for the rare transition (reward vs no reward).



There were no differences between the novel nor familiar perseverative errors on the HABIT Task between model-based and model-free learners on the spaceship task..

	Spaceship Task				HABIT Task	
	Common Transition, Reward Received	Rare Transition, Reward Received	Common Transition, No Reward Received	Rare Transition, No Reward Received	Familiar Perseverative Errors	Novel Perseverative Errors
Common Transition, Reward Received	1	.725**	.585**	.524**	.002	.132
Rare Transition, Reward Received		1	.595**	.325*	-.078	.215
Common Transition, No Reward Received			1	.637**	-.211	.157
Rare Transition, No Reward Received				1	.129	.225
Familiar Perseverative Errors					1	.976**
Novel Perseverative Errors						1

** = p < 0.01
* = p < 0.05

Overall, we did not find a correlation between the perseverative errors of the HABIT Task and the probability of first stage stays of the Spaceship Task.

DISCUSSION

- The results found do not support our hypothesis as we did not observe a positive relationship between the number of perseverative errors committed in the HABIT Task and the first-stage stays in the Spaceship Task.
- HABIT Task has a very long training session, so running an additional spaceship task to conduct a within-subject confirmation of the participant's performance would be more effective.
- HABIT Task is very complex to learn, which could have influenced the learning methods participants use.
- The type of learning strategy that participants used in the HABIT task is likely not the learning strategy they used in the spaceship task.
- The small sample size is a limitation of the study.
- In the future, we would like to look at task performance and AUDIT score as well as other psychometric variables, such as current perceived stress, impulsivity, and anxiety.

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