Behavioral Modification of Cleanliness-Related Behaviors Using Operant Conditioning on an Individual Diagnosed with ADHD: A Mock Experimental Approach

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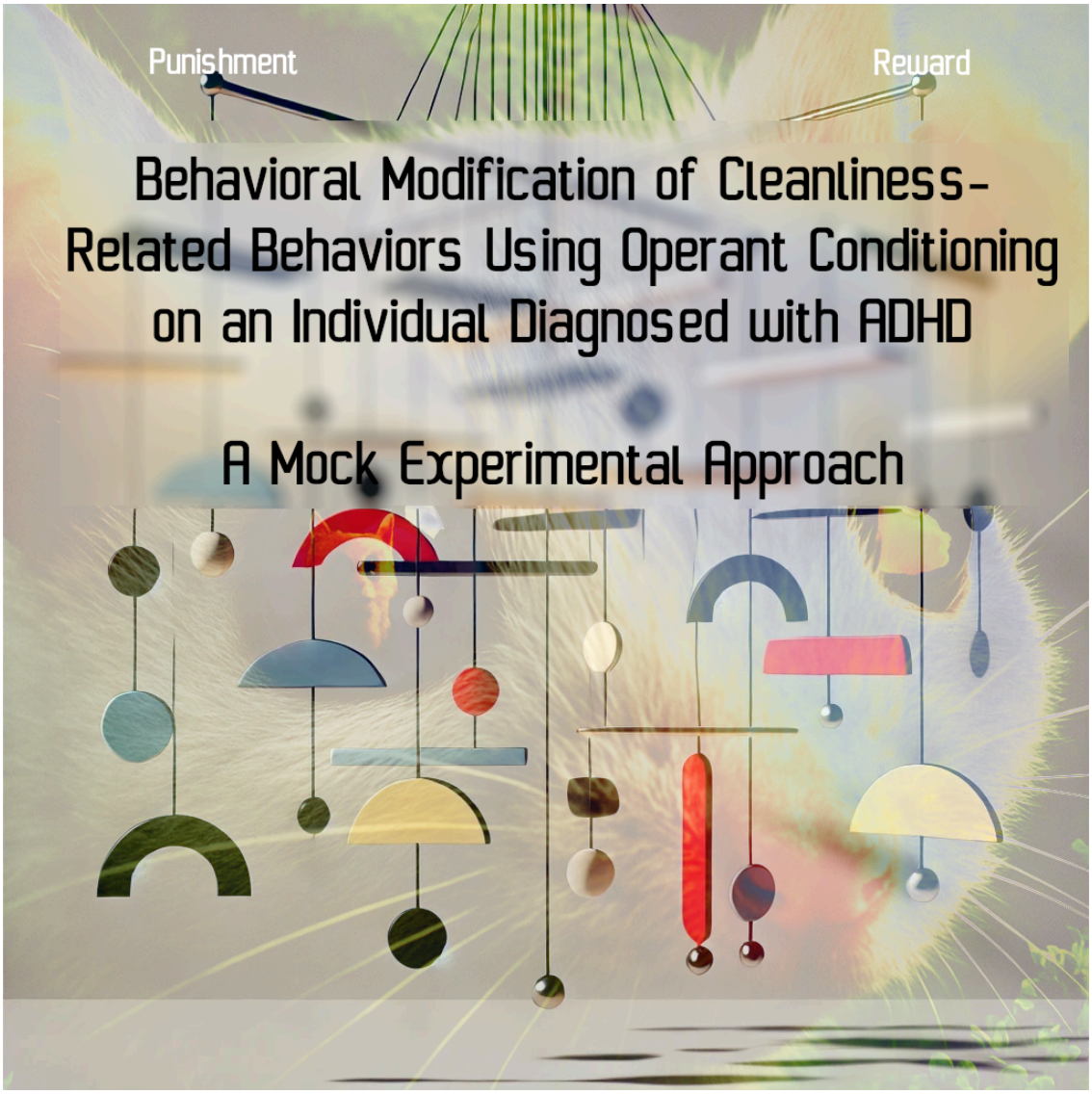


The cluttered mobile depicted in the image not only creates the visualization of the operant tension between punishment and reward as reflected in the eyes of the mouse, the cat on one side the cheese the other, it also mirrors the perceptual disarray experienced by individuals with ADHD. For those suffering with impaired executive functioning, the world often presents itself not as a mobile in equilibrium reflecting a balanced hierarchy of incentives and consequences, but rather as a disorganized field of dangling contingencies. The field is constantly shifting, overlapping, and difficult to parse. The exaggerated representation of the Calderesque mobile is a metaphor of the chaotic reinforcement environment: unpredictable, overstimulating, and difficult to regulate. As a cat might swipe at a mobile in fascination and confusion, the ADHD brain is drawn toward stimuli without clear direction or ability to readily discriminate consequences. In this mock study/paper, I attempt to use instrumental conditioning not just to shape behavior, but to impose structure onto disorder, clarity onto chaos in an effort to restore the contingencies that are drowned out by the distraction.

I. Introduction

This paper explores applying the principles of operant conditioning to modify a class of "cleanliness" related behaviors in an adult female diagnosed with attention deficit hyperactivity disorder (ADHD). Ronda M is the target subject of this project and is also my partner of fifteen years, whereby I have experienced first-hand how disruptive executive function difficulties can be, greatly affecting activities of daily living (Chronis-Tuscano et al., 2004). Ronda M's inconsistent engagement in cleanliness behaviors such as picking up after oneself, dusting, making the bed, leaving food or dirty dishes out, putting things back where they belong have resulted in a disorganized living environment. The chaotic environment has contributed to an increase in the complication of completing basic tasks such as finding car keys, a purse, reading glasses and may have even contributed to an infestation of rodents and insects–although she blames it on me. The cleanliness behavior(s), in some instances have led to household tension.

To address these issues, this project uses a novel approach developing proprietary software in Python using an internal server hosted Streamlit questionnaire to administer psychometric assessments to discover Ronda M's sensitivity to reinforcers versus punishers as well as gauge her responsiveness to specific reinforcing or aversive stimuli with a goal of optimizing a conditioning schedule to modify the targeted cleanliness behavior(s).

II. Theoretical Framework

A. Operant Conditioning

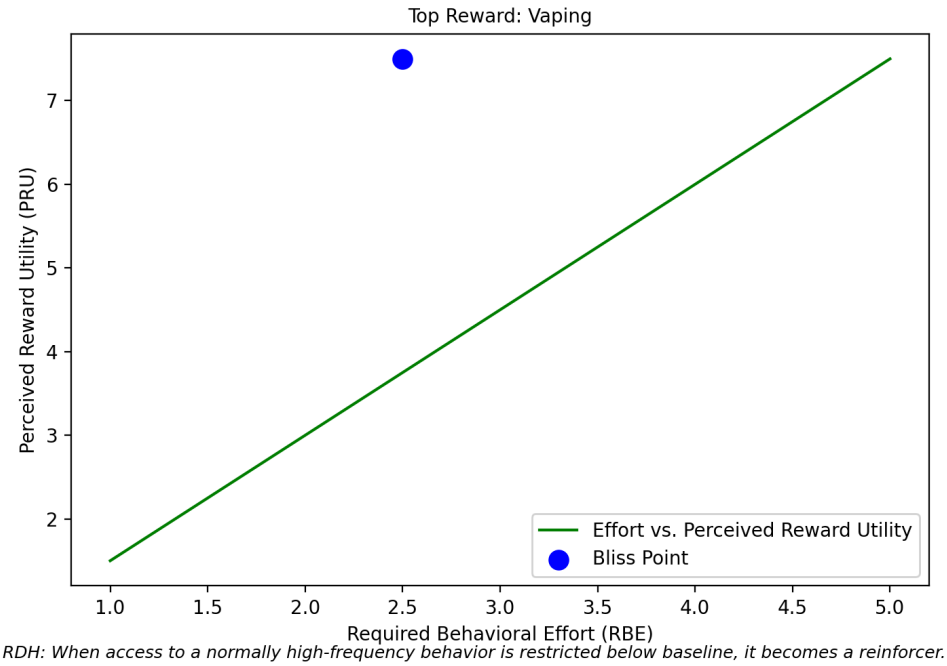
The intervention is designed based on the original tenets promulgated by Thorndike's *Law of Effect,* derived from his work in the early 1900s studying how cats, like the one pictured

on the previous page, learned to escape from puzzle boxes when rewarded with food (Thorndike, 1911). He observed that, through trial and error, the cats learned to escape the box by gradually repeating behaviors that resulted in the consequence of being able to obtain their reward, food. Over thirty years later, B.F. Skinner built upon the *Law of Effect,* creating an entire systematic experimental science of behavior, elegantly formalized in his equation: Sd: R → [Sr+,Sr-,Sp+,Sp-], which connected discriminative stimuli and consequences to the probabilistic recurrence of behavior (Skinner, 1938). This paper uses these core concepts, along with reinforcement scheduling, and applied technology, in an attempt to modify Ronda M's target cleanliness behaviors (De Houwer & Hughes, 2020).

B. Reinforcer Deprivation Hypothesis (RDH)

Building upon Premack's work analyzing the frequency of behaviors as it relates to reinforcement potential (Premack, 1959), Timberlake & Allison (1974) posit that a pleasurable behavior that is typically engaged in (the "deprived" behavior) becomes a reinforcer when exposure is restricted relative to its baseline. This deprivation increases the value of the behavior, resulting in heightened motivation and a greater likelihood of compliance to obtain the reinforcer. The RDH was adapted for reinforcer strength calibration using the RSS survey and frequency (time allocation) of rewards administered (vaping, watching Youtube). The *Bliss Point* is the level of engagement with a pleasurable behavior that yields the maximum reward per unit of effort. It represents the natural equilibrium in a subject's behavioral allocation where the hedonic return is optimized and no external manipulation is needed to sustain the behavior. The following chart generated by the behavioral_assessment.py (software) illustrates the Bliss Point

relative to Ronda M's top reinforcer and demonstrates the upward sloping reinforcement utility relative to effort required to obtain the reward:



RDH: When access to a normally high-frequency behavior is restricted below baseline, it becomes a reinforcer.

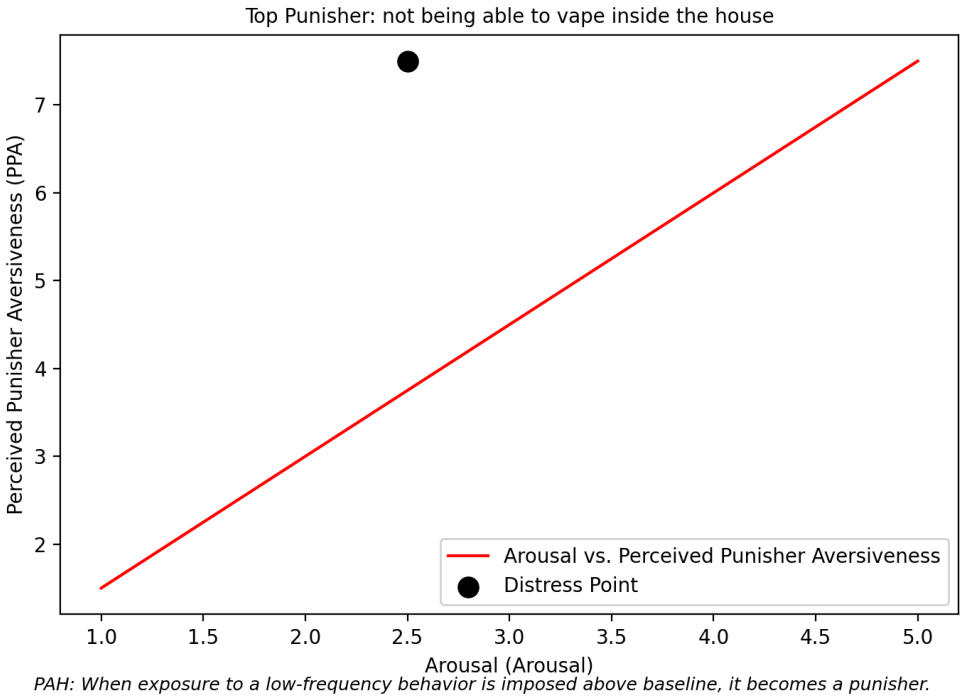
C. Punishment Augmentation Hypothesis (PAH) [Proposed]

The author proposes a natural corollary to RDH, the PAH. An aversive behavior that is rarely engaged in (the"augmented" behavior) becomes a punisher when exposure is mandated relative to its baseline. Forcing this uncommon and unpleasant behavior amplifies its punishing effect, creating a strong motivational shift away from resistance and toward compliance. If the SPSRQ had resulted in a higher sensitivity to punishment, it would have been adapted here for punisher strength calibration using the ASQ survey and frequency (time allocation) of the administered punishment. The Distress Point is the level of imposed engagement with an aversive behavior that yields the maximum punishment utility per unit of psychological resistance (arousal). It represents the threshold of cognitive-emotional instability where a subject's defenses are weakest and behavioral compliance is most susceptible to external

influence. These two points are inversely exchangeable: The Bliss Point reflects the optimal state for positive reinforcement; the Distress Point marks the optimal moment for collapse as a function of calibrated punishment. Together, they define the poles of behavioral modulation, which may be modeled as a two state quantum system in accordance with the principles of Quantum Cognition (QC) (Busemeyer et al., 2006). At the Bliss Point, the probability amplitude is weighted toward high states of approach, receptivity, or compliance via positive reinforcement. At the Distress Point, the amplitude is weighted toward low states of avoidance, surrender, or collapse as a result of negative reinforcement or punishment.

- $|0\rangle$ = low affective state (Distress Point)
- $|1\rangle$ = high affective state (Bliss Point)
- The system evolves over time under the Hamitonian (time dependent Schrodinger equation)
- α and β are complex probability amplitudes satisfying the normalization condition: $|\alpha|2+|\beta|2=1$
- $|\psi\rangle=\alpha|0\rangle+\beta|1\rangle$

The following chart generated by the behavioral_assessment.py (software) illustrates the Distress Point relative to Ronda M's top punisher and demonstrates the upward sloping aversiveness relative to arousal inflicted by exposure to the punishment:



PAH: When exposure to a low-frequency behavior is imposed above baseline, it becomes a punisher.

The final graph illustrates the marginal behavioral utility relative to increasing effort and arousal, illustrating saturation where marginal utility declines past the Bliss/Distress points.

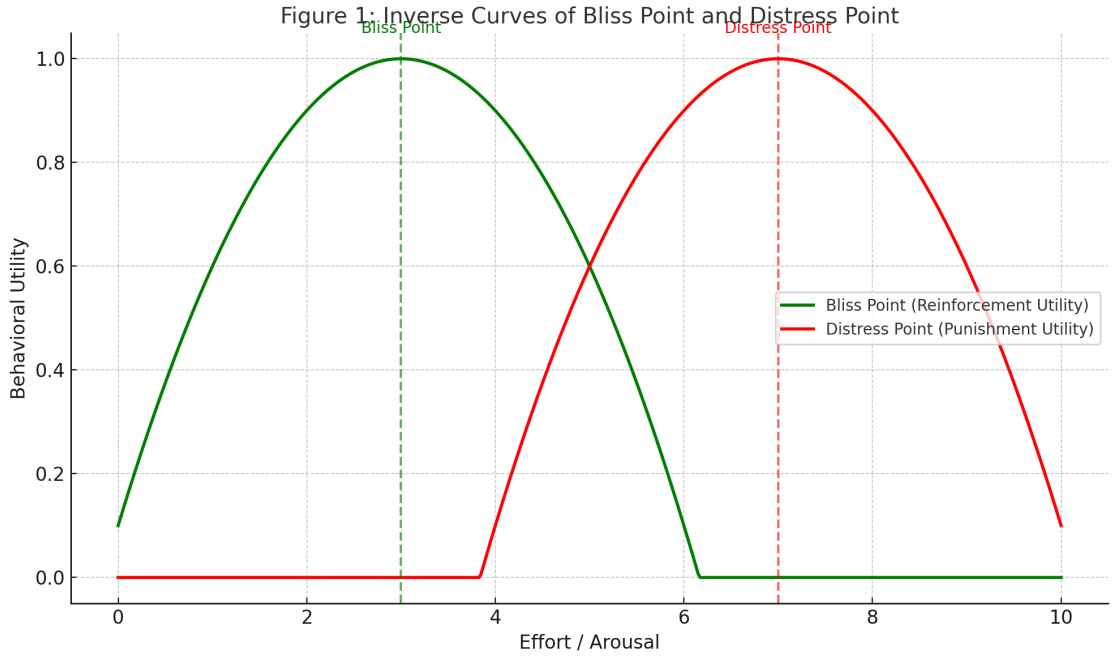


Figure 1: Inverse Curves of Bliss Point and Distress Point

III. Methodology

The program will use the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) as well as the Reinforcement Survey Schedule (RSS) and create an Aversive Stimuli Questionnaire (ASQ). Based on SPSRQ results, the dominant behavior modifier schema depending on Ronda M's sensitivity to reward vs punishment will be implemented with personalized stimuli selected based on either the RSS or ASQ results.

A. **Software Design (Python/Streamlit)**

- behavior_assessment.py (Punishment and Sensitivity to Reward Questionnaire (SPSRQ), Reinforcement Survey Schedule (RSS) and create an Aversive Stimuli

Questionnaire (ASQ)

- Sticker_chart.py (Digital Sticker Chart/scheduling calendar) Supporting PhaseI, II, Continuous, Fixed Ratio and Variable Ratio schedules.

- Data Files: spsrq_questions.csv (24/24 reward/punishment general sensitivity questions), rss_questions.csv (21 potential reinforcers) , asq_questions.csv (21 potential punishers), target_behaviors.csv (11 target cleanliness behaviors and corresponding desired modifications) based on Ronda M's observed behavior(s), weekly_behavior_log_week[#].csv (weekly performance data: [Phase: I,II]. [Schedule: Continuous, Fixed Ratio, Variable Ratio], [Weekly_Threshold_Goal: #],[Total_Stickers_Earned: #], [Log_Timestamp])

- Github Repository: https://github.com/marcuscrodriguez/operant

- Streamlit Cloud Server: https://behavior.streamlit.app/ & https://sticker.streamlit.app/ *Streamlit Cloud for demo purposes to exhibit functionality, the applications were deployed on a home server http://localhost:8501 during the implementation phase.

B. **Assessment Phase**

During the first portion of the assessment phase, the SPSRQ was administered to Ronda M, where she indicated by moving a slider, on a Likert scale of Strongly Disagree ←|→ Strongly Agree (range 1-7) her predisposition to 24 reward and 24 punishment weighted questions. The screenshot of the following table illustrates that after answering the 48 questions, she is more responsive to reward than punishment:

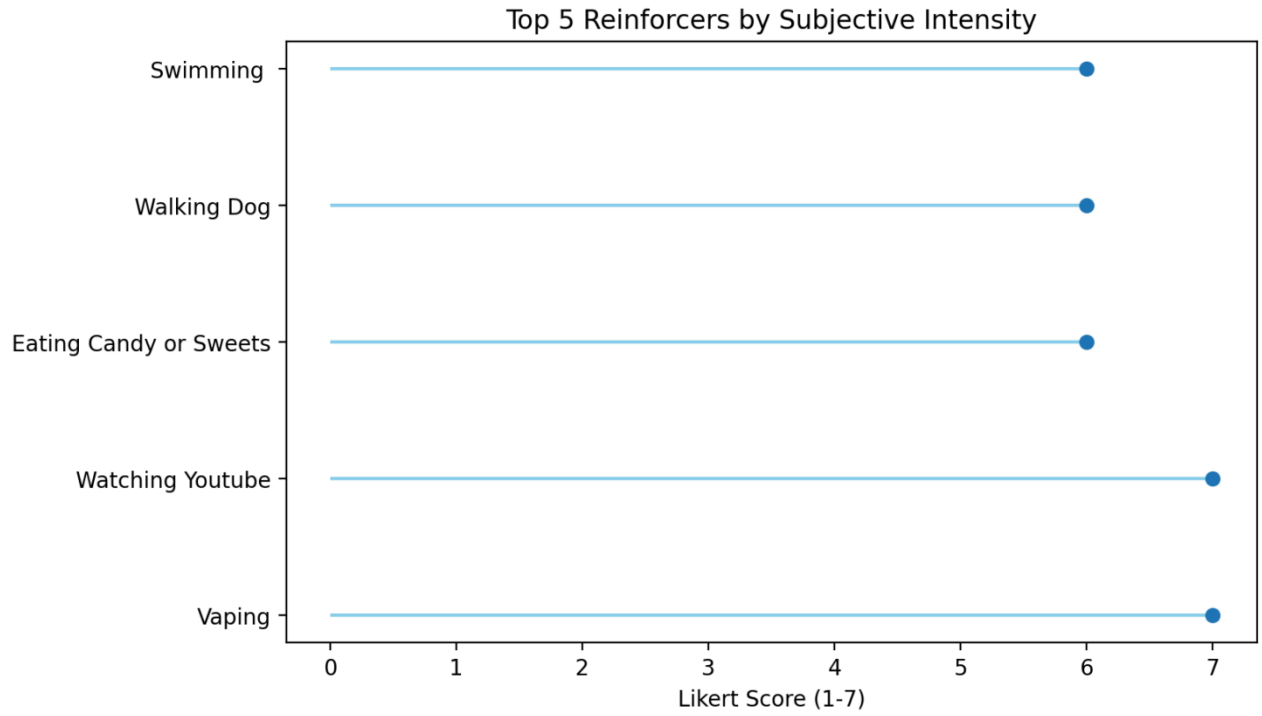
Summary of Behavioral Assessment

1. SPSRQ Scores Summary

Summary Table

Total Sensitivity to Reward	Mean Reward Score	Reward Score SD	Total Sensitivity to Punishment	Mean Punishment Score	Punishment Score SD	Dominant Sensitivity
137	5.71	1.23	123	5.12	1.42	Reward

Based on the SPSRQ results, the behavioral assessment software program then administers either the RSS: (_____ is important to me.) or ASQ (How unpleasant is _____?) Likert Scale Strongly Disagree ←|→ Strongly Agree (range 1-7) in order to rank top reinforcers/aversives and later the administrator gathers baseline usage/tolerance (frequency data). Ronda M's results illustrate her top five reinforcers and are depicted in the following screenshot of her chart:



Upon interviewing Ronda M, after completing the RSS, it was determined that her baseline usage of her vape is on average about twenty minutes and she spends one hour watching Youtube (per diem).

C. Behavior Tracking & Intervention Design

The Digital Sticker Chart imports the results from the behavior_assessment.py questionnaires and resides on the internal server in the household to facilitate behavior tracking and consequence delivery. The daily and weekly performance thresholds relative to the logged

events on the sticker chart will result in the administration of rewards based on the completed SPSRQ and RSS by Ronda M with a (weekly reset). In order to preserve the reinforcing effectiveness of vaping and watching YouTube, the administrator will implement a mild response deprivation schedule by reducing access to each activity below the individual's baseline as determined in the post RSS interview (in accordance with RDH). The following table defines the targeted behavior modification:

Behavior Class: Cleanliness Defined for Ronda M.

id_rank	target_behavior	modified_behavior
1	throwing dirty clothes on floor	putting dirty clothes in hamper
2	leaving dirty dishes out	put dirty dishes in sink/wash
3	leaving food on counter	put food back in refrigerator/cupboard
4	not dusting	dust
5	not vacuuming	vacuum
6	leaving bed unmade	make the bed in morning
7	collecting clutter and old clothes	throw out/donate old clothes
8	leaving lights on after leaving a room/closet	turn lights off when leaving
9	leaving mess	pick up after self
10	leaving caps off (toothpaste, bottles, etc)	put caps back on
11	leaving pantry doors open	close pantry doors

The modified behaviors are integrated into the Digital Sticker Chart with daily and weekly thresholds based on the Phase and schedule. During Phase I (first 2 weeks), reinforcement was continuous with a threshold of completing one modified behavior, reinforced daily and weekly in order to firmly establish contingency. During Phase II (weeks 3-5), initially a fixed ratio schedule with a threshold of completing 15 modified behaviors, reinforced weekly by allocating additional vaping and Youtube time and in the last week, a variable ratio program was employed whereby the software randomly assigned the weekly threshold of completing 23

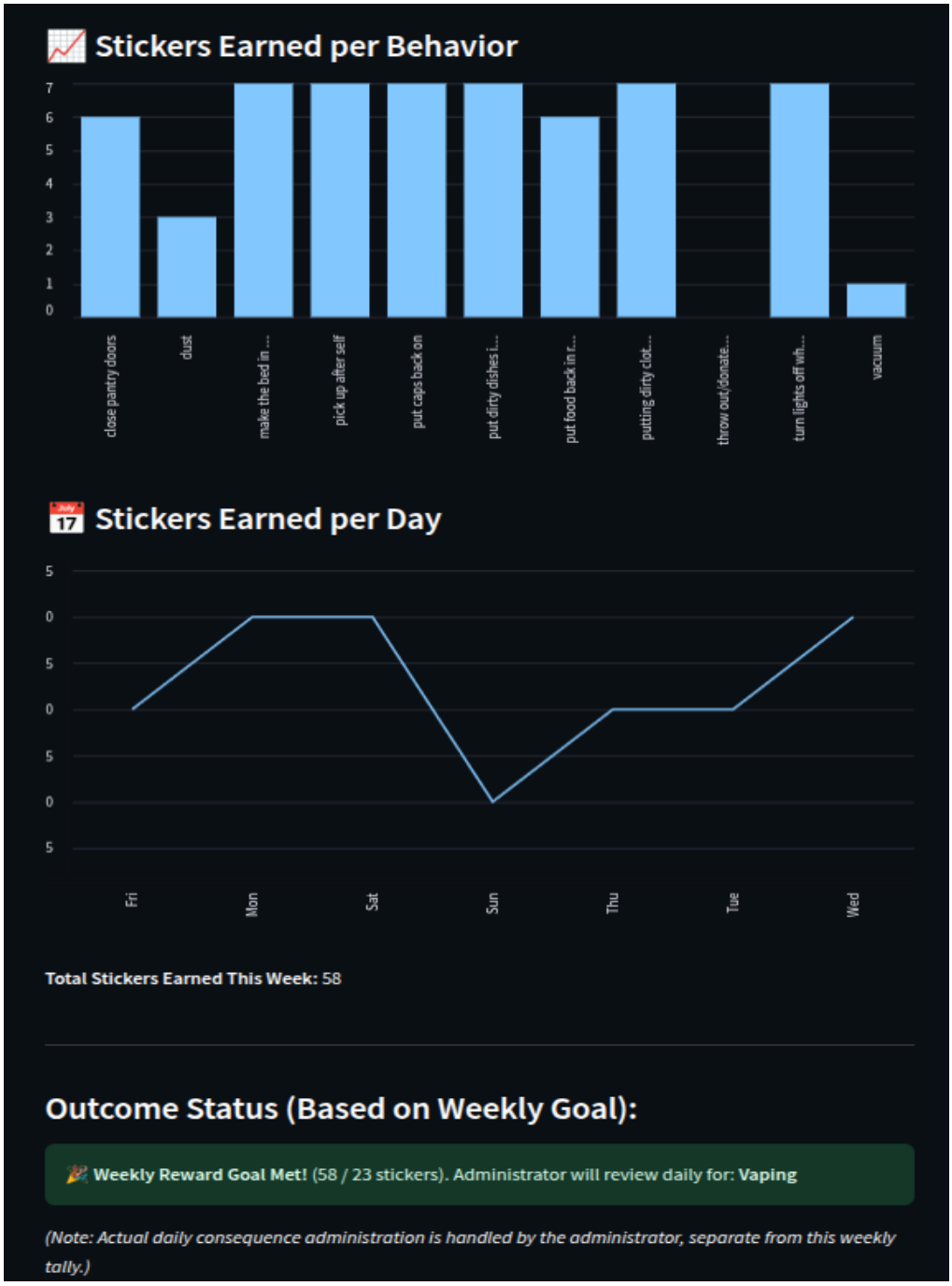
modified behaviors. The intent of using a variable ratio (VR) schedule on the final week is to make the modified behavior more resistant to extinction, when the intervention ends.

D. Implementation Phases

The structured schedule consists of Phase I (first 2 weeks) the program administrator will log behaviors and provide continuous daily reinforcement, thereafter Phase II (4 weeks) Ronda M will self-report daily cleanliness behaviors. *Outcomes are simulated due to timeline constraints The following is a sample screenshot of the weekly Digital Sticker Chart (Week 6):

IV. Data | Visualizations

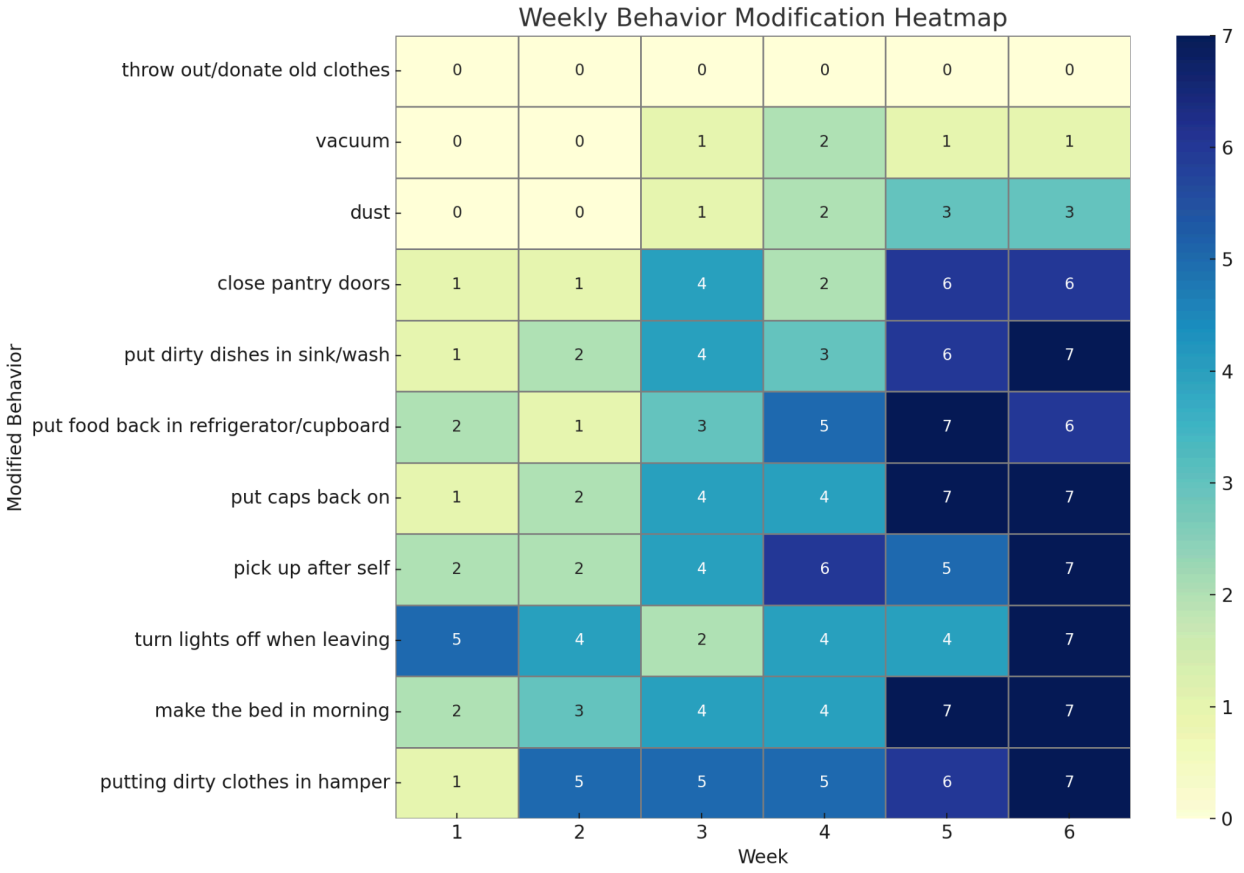
Screenshot Daily Sticker Chart Sample (Week 6)



Summary Pivot Table (Weeks 1-6)

SUM of Weekly_Total	*Week*						
Modified Behavior	1	2	3	4	5	6	Grand Total
throw out/donate old clothes	0	0	0	0	0	0	0
vacuum	0	0	1	2	1	1	5
dust	0	0	1	2	3	3	9
close pantry doors	1	1	4	2	6	6	20
put dirty dishes in sink/wash	1	2	4	3	6	7	23
put food back in refrigerator/cupboard	2	1	3	5	7	6	24
put caps back on	1	2	4	4	7	7	25
pick up after self	2	2	4	6	5	7	26
turn lights off when leaving	5	4	2	4	4	7	26
make the bed in morning	2	3	4	4	7	7	27
putting dirty clothes in hamper	1	5	5	5	6	7	29
Grand Total	**15**	**20**	**32**	**37**	**52**	**58**	**214**
Phase:	I	I	II	II	II	II	
Schedule Type:	Continuous	Continuous	Fixed Ratio	Fixed Ratio	Fixed Ratio	Variable Ratio	
Threshold:	1	1	15	15	15	23	
Above Threshold Weekly Reinforcement	Y	Y	Y	Y	Y	Y	
% Overall Performance:	**19.48%**	**25.97%**	**41.56%**	**48.05%**	**67.53%**	**75.32%**	
Least Changed:	throw out/donate old clothes						
Most Changed:	putting dirty clothes in hamper						

*****The CSV data files capturing weekly log data, was aggregated into an Excel spreadsheet merged_log_files_sticker_chart.xlxs used to create the above pivot table, and submitted with the paper.



V. Extinction

Extinction is inherently addressed in the program as rewards and/or attention are withheld for undesirable behaviors, which may have been previously unintentionally reinforced. Contingency is also embedded in the plan as clearly defined behaviors are specified per the Digital Sticker Chart, producing clearly defined consequences with daily and weekly accountability as reinforcement is scaled down over time. The administrator will monitor Ronda M with respect to cleanliness behavioral decline during thinning or the cessation of reinforcement looking for signs of extinction, especially after transitioning from the variable ratio schedule to no reinforcement at all. The administrator will add natural reinforcers to support maintenance beyond the reinforcement schedule such as verbal praise and encouragement. If it appears the targeted cleanliness behaviors are reverting back to premodification levels without

reinforcers, and natural reinforcement is not effective, the administrator will use high-ranked reinforcers from the RSS to periodically reinforce the behavior, in an effort to prevent full extinction of the modified behavior(s).

VI. Ethical Considerations

Ronda M has provided informed electronic consent throughout the scheduled plan which excludes physically or emotionally aversive punishment and emphasises working in a collaborative framework to optimize cleanliness behavior leading to a healthier, happier home. The electronic consent is logged, timestamped:

> **Purpose:** To understand individual sensitivity to punishment and reward and explore how different stimuli function as reinforcers or punishers within the context of the Response-Deprivation Hypothesis (RDH) and the proposed corollary Punishment Augmentation Hypothesis (PAH). **Procedures:** You will complete the SPSRQ, followed by an RSS or ASQ survey depending on your results. **Risks:** Minimal, limited to potential mild discomfort while answering introspective questions. **Benefits:** You may learn about your own behavioral tendencies and preferences. **Confidentiality:** Your name and responses will be kept private and used only for this session.**Voluntary Participation:** You may withdraw at any time without consequence. By typing your name below and clicking "I Consent", you agree to participate and give electronic consent. This is a mock project for educational purposes and will involve participation in self-reporting behavior, answering psychological questionnaires, and simulating data relative to receiving behaviorally contingent rewards or punishments.

VII. Conclusion

Putting together this mock experimental paper, including software development and data analytics, provided an invaluable learning experience integrating theory, operant conditioning principles, contemporary computational framework design (Python, Streamlit), and even exploring the fringes of quantum cognition to design a truly unique intervention. I had no

previous exposure to SPSRQ, RSS and ASQ (psychometric questionnaires) which facilitate personalized reinforcement and punishment calibration, offering a scalable approach to developing behavioral modification programs, which I found fascinating. The application of various reinforcement schedules, response deprivation, and digital tracking technologies to modify targeted cleanliness behaviors provided the opportunity to experience first hand material presented in the class. The other aspect that the project made me focus on in light of the Punishment Augmentation Hypothesis is the ethical considerations particularly regarding autonomy, informed consent, and avoiding undue psychological distress. Overall, this project proved to be a fantastic way to integrate what we learned from the course, apply the concepts bringing the material to life.

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