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Assessing the Effects of Experimentally Contrived Negative Emotional Contexts on Affect, Willingness, and Impulsivity

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ASSESSING THE EFFECTS OF EXPERIMENTALLY CONTRIVED NEGATIVE EMOTIONAL CONTEXTS ON AFFECT, WILLINGNESS, AND IMPULSIVITY

A Master's Thesis

Presented to

The Graduate College of

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In Partial Fulfillment

Of the Requirements for the Degree

Master of Science, Behavior Analysis and Therapy

By

Amanda Nicole Middleton

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ASSESSING THE EFFECTS OF EXPERIMENTALLY CONTRIVED NEGATIVE EMOTIONAL CONTEXTS ON AFFECT, WILLINGNESS, AND IMPULSIVITY

Psychology

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Master of Science

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ABSTRACT

Emotions are a naturally occurring and unavoidable part of life. To investigate the role that negative emotional experiencing plays in transfer of stimulus function, relational behavior, and intervention effectiveness, this thesis combines and explores the implications of two manuscripts that examine the effects of negative emotional contexts. Specifically, the first chapter presents research demonstrating the ability of operant schedules of reinforcement and respondent relational training to result in acquired affective and willingness stimulus functions. A between groups design demonstrated that when paired with a frustration-inducing task, negatively valenced functions can be established for arbitrary stimuli, and when observational pairing was used to relate those stimuli with other stimuli, the stimulus functions not only transferred to those stimuli but the function appeared to diffuse across the stimuli, lessening the stimulus functions for the originally trained stimuli. Taking into consideration how behavior changes while experiencing a negative emotional context, the second chapter presents an experiment assessing the effects of brief mindful practice on impulsive responding while experiencing a stressful noise context. In this study, a Go/No-Go task is utilized as a measure of impulsivity to explore the generality of existing findings from research conducted through a delay discounting account of impulsivity (Dixon et al., 2019). Participants were assigned to either a mindfulness+ or mindfulness- intervention group, and participants from both groups completed a Go/No-Go task before and after their respective intervention. During one of the Go/No-Go task completions, a stressful noise context was introduced for the duration of the task. Findings suggest that impulsive responding did not change dependent upon intervention group or stress condition. Taken together, these results suggest a need for emphasis on understanding an individual's emotional context and the extent to which it affects their behavior in order to better determine whether intervention is necessary and what type of intervention may be most meaningful for improving their context.

KEYWORDS: affect, willingness, impulsivity, stress, mindfulness, AWS, Go/No-Go, emotional experiencing, SPOP, valence

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OVERVIEW

Before being able to intentionally and effectively intervene on negative emotional experiencing, understanding how negative emotional experiencing operates and functions in relation to other stimuli in an individual's environment is necessary (Assaz et al., 2023; Hayes & Hofmann, 2021). While third wave behavioral therapies have made steps toward this, a gap between the effectiveness of these interventions and a true understanding of how they work still appears to exist (Assaz et al., 2023). However, analyzing dynamic patterns of relating through a Relational Frame Theory (RFT) lens may be able to begin to bridge this gap (Belisle & Dixon, 2021). Recently, a model for beginning to conceptualize emotions through the blended perspectives of RFT, Relational Density Theory (RDT), and the Hyperdimensional Multilevel Model (HDML) framework has been proposed that may allow for an avenue to deepen the field's understanding of these patterns of relating that include emotions (Belisle et al., 2024). Further efforts to understand the role emotional experiencing plays in relational behavior and the functions emotions carry are needed, especially experimentally.

One way to progress the research on emotional experiencing is to conduct experimental research with explicit measures that are indicative of emotional experiencing. While the literature includes much research that utilizes implicit measures such as the Implicit Relational Assessment Procedure (IRAP; Barnes-Holmes et al., 2006), fewer behavior analytic studies explore relational behavior with explicit measures of emotion. RDT research has also incorporated some aspects of emotional experiencing, with stimuli organizing according to valence in a geospaces resulting from multidimensional scaling procedures (MDS; Sickman et al., 2023). However, as much as RDT appears to present potential for assessing relational framing that includes an affective dimension, the typically used MDS procedure has captured this implicitly rather than explicitly. Informed by RFT, RDT, and the HDML, and attempting to fill this gap for an explicit affective measurement instrument, an Affect and Willingness Scale (AWS) was developed by Paliliunas and Belisle (in prep) and utilized in the first manuscript in this thesis (Middleton & Belisle, under review). This measurement tool was used by the authors of the study to capture the explicit affective and willingness functions of stimuli that were experimentally contrived to study the effects of a negative emotional context, particularly a frustrating one.

Stress is another commonly experienced negative emotional context. Research by Banis and Lorist (2012) has shown that stress can lead to increased impulsive responding in the short-term. Dixon and colleagues (2019) demonstrated the effectiveness of a brief mindfulness practice to decrease impulsive responding and to mitigate and reduce the stimulus control exerted by stress. The study utilized a delay discounting framework of impulsivity to demonstrate this change in negative emotional context. The second manuscript in this thesis on which I am an author aimed to examine how a negative emotional context, specifically a stressful noise context, affects impulsivity (Belisle et al., under review). The experiment also included examination of the effects of a brief mindfulness intervention on impulsive responding in the context of stress. The researchers created the negative emotional context through presentation of a stressful noise context while participants completed an attentional- and inhibition-based task known as a Go/No-Go task to measure their impulsive responding. Prior research has been conducted utilizing Go/No-Go tasks with a stressful noise context, suggesting a relationship between trait impulsivity, stress, and emotion (Robinson et al., 2020). The study describes the noise context present during the experiment as not only stressful, but also irritating, suggesting a negative emotional context. The study of impulsivity and mindfulness intervention in the context of negative emotional experiencing allows for a better understanding of how emotions interact with an individual’s environment and contribute to an individual’s behavior.

For both manuscripts, final analyses were conducted from de-identified data collected through the Institute for Dynamic Behavior Science and Missouri State University made available by the primary investigator of those studies.

TRANSFER OF EXPLICIT NEGATIVE AND NEUTRAL AFFECTIVE AND WILLINGNESS FUNCTIONS THROUGH OPERANT SCHEDULES AND PAIRING OBSERVATION: A PRELIMINARY ANALYSIS

The current manuscript was written by the authorship of Amanda Middleton and Jordan Belisle. The contents of this manuscript and authorship may differ from the finalized version based on review and revision. Final analyses were conducted from de-identified data collected through the Institute for Dynamic Behavior Science and Missouri State University made available by the primary investigator of those studies. The studies were conducted consistent with the IRB approval process presented in the appendix. Correspondence regarding this thesis should be directed to Amanda Middleton (middleton723@live.missouristate.edu) and correspondence regarding the manuscript should be directed to Dr. Jordan Belisle at the Institute for Dynamic Behavior Science (jordanbelisle@dynamicbehaviorscience.com).

With the combination of both the prevalence and social cost of mood disorders, including medicinal treatments and need for behavior therapies, emotional experiencing is interwoven into behavior analysis (Bessonova et al., 2020; Kessler et al., 2006). Third wave behavior therapies, including Acceptance and Commitment Therapy (ACT) seem to be working well for progressing the field forward in this area (Arch et al., 2012; Hayes, 2004). A process-based functional approach utilizing these third-wave therapies potentiates advances in treatment of disordered emotional experiencing and mental health care (Hayes and Hofmann, 2021). These third wave behavior therapies represent a movement toward understanding operant learning processes that lead to negative emotional experiences (affect) and experiential avoidance (unwillingness).

McLoughlin and Roche (2023) drew attention to the differentiation between knowing that ACT works and understanding how it works, suggesting that the link between Relational Frame Theory (RFT) and ACT is unclear. This point was echoed by Assaz and colleagues (2023), urging that higher precision is necessary to increase pragmatic utility of cognitive defusion. Though cognitive defusion is commonly considered a process, the authors suggested that it is more accurately described as an outcome resulting from detachment from cognitive fusion. Nevertheless, they suggested the potential utility of cognitive defusion as a component of ACT for making advances in providing emotional experiencing-inclusive treatment. Belisle and Dixon (2021) also suggested the need to better dissect the way in which ACT works, again reiterating the utility of ACT while explaining it through extensions to RFT approaches. The authors described relational framing as dynamic behavior patterns that may be important to consider when implementing ACT. While the disconnect between researched methodologies for managing emotional experiencing and effective understanding of how they operate and how best to incorporate them into practice has been identified by many researchers, it seems that a solution has not yet emerged for bridging the gap.

To begin to better understand emotional experiencing from a behavior analytic perspective, Belisle and colleagues (2024) described a behavioral model of emotional experiencing that combines radical behaviorism, RFT, Relational Density Theory (RDT), and the Hyperdimensional Multilevel (HDML) framework. Within this model, RFT is used to model the interaction amongst antecedent behaviors, contextual events, and a response class of affective experiences. This response class is comprised of physiological reflexes, overt behaviors, and cognitive appraisal. The cognitive appraisal component in particular is then modeled, illustrating the relationship between relational networks and valence. They further emphasized that relational networks have been shown to organize across an affective dimension and connect RDT and the HDML into the model to explain the dynamic nature of affect and emotional experiencing.

Other RFT research has also incorporated experiencing relating to emotion in meaningful ways. One study notably demonstrated the transfer of emotional function across related stimuli (Dougher et al., 2007). The study utilized match-to-sample procedures to establish arbitrary relational functions for A, B, and C stimuli, and then mild shocks were paired with the B stimulus later in the experiment. Results of the study indicated that through the relational training, stimulus function was transferred.

RDT research, extending from RFT, has also begun to demonstrate organization of relational framing according to valence (Belisle et al., 2023; Hutchison et al., 2023; Sickman et al., 2023). RDT research often utilizes a multidimensional scaling procedure (MDS) to create a geospatial display of the density of relations within a network. Within this geospace, stimuli in several studies have been seen to organize by positive and negative valence. In a study about gender stereotyping, characteristics used as stimuli appeared to organize within a geospace not only organized by the perceived masculinity and femininity of the terms, but also by what appears to be a dimension of positive to negative valence (Sickman et al., 2023). Similarly, in another RDT study investigating racial stereotyping, stimuli in the geospace organized along not only a racial dimension but also by positive and negative valence (Belisle et al., 2023). Finally, a third RDT study studying climate-related consumer behavior showed a similar effect (Hutchison et al., 2023). In this study, stimuli not only organized by pro-climate and anti-climate imagery, but also in what appear to be positively and negatively valenced clusters. Each of the studies' findings suggest a natural integration of emotional experiencing and affect in the way humans relate. This, taken with the prior research outlined, suggests a need to further and more directly aim to investigate the incorporation of valence, affect, and emotions in behavior analytic research.

A framework that presents great utility for conceptualizing affect and emotion is the HDML (Barnes-Holmes et al., 2020; Harte et al., 2020). Prior to this, the multi-dimensional multi-level (MDML) framework was proposed. While the MDML can be useful for encapsulating c-rels, levels, and dimensions, it critically left out c-funcs. That is, the MDML captured structure but not function. To address this, the HDML built on this framework by including the ROE-M (Harte & Barnes-Holmes, 2021). The ROE-M incorporates relating, orienting, evoking, and motivating events into consideration for analysis. This addition, especially the evoking piece of the ROE-M within the HDML, allows for a more functional conceptualization of emotion within an RFT framework and accounts for the elicitation of emotions. Additionally, the motivating piece of the ROE-M describes events as being either appetitive or aversive, either making an individual more likely to approach or avoid them.

Notably, affect has been captured through numerous studies through technologies such as the Implicit Relational Assessment Procedure (IRAP; Barnes-Holmes et al., 2006) and MDS procedures (Hutchison et al., 2023). The former methodology has been used with emojis displaying happy and angry expressions to study implicit arbitrarily applicable relational responding (Schmidt et al., 2021). The latter methodology has been used by incorporating stereotype-related stimuli into relational density tasks, giving way for for observation of relatedness of affect likely elicited by these stimuli as shown through the sorting across a dimension of valence (Sickman et al., 2023). While both of these technologies have succeeded in capturing affective responding to a certain degree, two important factors stand in the way of utilizing either of them for measuring and assessing emotional experiencing. The first barrier for using both the IRAP and MDS procedures is that they are time-consuming for a client or participant to complete. While this is not necessarily a problem when using a measure once or twice, neither of them lend themselves well to repeated measurements or transferability to clinical applications where repeated measurements would be crucial to capture ongoing and potentially changing emotional experiencing. The second reason that neither the IRAP nor the MDS procedure appear to be most suitable for this particular use is that while they each use explicit responding, they are still ultimately measuring implicit relations.

To capture an individual's private emotional experiencing, another tool may be needed. To fill this gap, an Affect and Willingness Scale (AWS; Paliliunas & Belisle, 2024) was developed to capture an individual's emotional experiencing more clearly and explicitly at a given time. The AWS probes for explicit appraisals of an individual's emotional experiencing. In addition to more directly encapsulating emotional experiencing, this measure is also much quicker to complete than the aforementioned technologies, making it more accessible to use when repeated measurements are needed. Likewise, this measure potentiates myriad clinical applications as well since it is not time-intensive. Using repeated measurements of the AWS for a client receiving ABA services may give a practitioner valuable insight into their emotional experiencing and could be used to inform practice. One way to incorporate the AWS into practice may be to use pertinent stimuli chosen from a client's ACT matrix to generate stimuli for insertion into the AWS (Polk et al., 2016).

One example of a negatively valenced experience is frustration. Frustration has been defined as occurring when a response is nonreinforced when reinforcement is expected (Amsel, 1992) and, through the Dollard-Miller model, as an interruption of a predicted behavioral sequence (Dollard et al., 1939). Taking frustration as an exemplar for a negatively valenced experience, this emotional experiencing can occur through changes in schedules of reinforcement. An experiment working with rats investigated and demonstrated a frustrative non-reward effect through manipulation of reinforcement (Spencer, 1982). In order to induce frustration through operant schedules, an unexpected change in a previously consistent schedule of reinforcement would likely result in a negatively valenced, potentially frustrating experience. While schedule-induced behavior refers to behavior occurring in the presence of the schedule specifically, a negatively valenced function may be established for a stimulus paired with the schedule (Roper, 1981). If a function related to the emotional experiencing endured during schedule-induced frustration is established for a stimulus related to or paired with the experience, then perhaps the function would maintain outside of the context of the schedule of reinforcement and even be able to transfer to other related stimuli. In order for this c-func to transfer to other stimuli, relational training may be effective. A form of respondent relational training known as the Stimulus Pairing Observation Procedure (SPOP) may be one way to train relations across which the c-func may transfer (Belisle et al., 2020). An individual who interacts with a stimulus that elicits an emotional function and then undergoes SPOP training that relates that emotionally eliciting function to other stimuli may experience a transfer of that c-func from the original stimulus to the related stimuli.

The Wisconsin Card Sorting Test (WCST; Grant & Berg, 1948) is a psychological assessment commonly used for assessing perseveration by employing shifting stimulus conditions through changing contingencies for sorting cards. In order to experimentally generate schedule-induced frustrative and negative emotional experiencing, the WCST may be modified. The WCST lends itself well to modification for this purpose, as it already consists of elements of changing predictability and operant contingencies of reinforcement.

The present study incorporates assumptions within RDT that have been established in prior research and can be conceptualized within the theoretical framework of the HDML. Specifically, in the present study, the AWS was used as a measure of the response evoking (E) functions of symbolic stimuli that may appear in the environment. Whereas prior research has induced implicit affective responses using stimulus pairing (respondent process), the present study attempted to induce explicit affective and willingness functions using schedules of reinforcement within a modified version of the WCST (M-WCST). Additionally, relations (R) were developed through stimulus pairing, rather than the more typical match-to-sample arrangements used in tests of implicit responding (operant). Relating and evoking functions of the ROE-M were emphasized in the present study that likely participate with orienting and motivational variables in clinical or therapeutic applications of this initial translational experiment. The study was considered translational because the AWS is an instrument that can be used in more meaningful clinical applications.

Methods

Participants

A total of 62 participants were recruited through a crowdsourcing platform and were compensated for their participation in this experiment. Participant ages ranged from 18-76, with a mean age of 39 years old. Of these participants, 34 identified as men, 27 identified as women, and 1 identified as non-binary. Participant self-identification of race was as follows: 40 White/Non-Hispanic, 14 Black/Non-Hispanic, 3 Multiracial, 2 Latino/Hispanic, 1 Native American/Alaska Native, 1 Asian/Pacific Islander, and 1 preferred not to disclose their race. Of these participants, 33 were randomly assigned to Group 1 and the other 29 were randomly assigned to Group 2.

Setting and Materials

As participants were recruited digitally through a crowdsourcing website, their participation was completed virtually. Participants were instructed to complete their participation on a computer rather than a mobile device. Length of participation was approximately 45 minutes long. The study required only visual attending with no audio components. The experiment was entirely completed through Qualtrics ("Qualtrics Experience Management," 2024), an online survey platform. The link to the Qualtrics survey was provided to participants upon recruitment. The experiment was designed and built on Qualtrics for the purpose of this study. Questions presented in the administration of the experiment included sliding scale responses, multiple choice/matching responses, and visual attending to videos presented. The apparatus first provided participants with an informed consent form. Once participants read the form and provided their consent to participate, they were advanced to a brief demographics questionnaire consisting of multiple choice and write-in response options. Following completion of the demographics questionnaire, the experiment began with instructions for completing the AWS, followed by a presentation of various stimuli, each with a sliding scale below to provide their explicit affect and willingness ratings for. Other phases of the study, described in further detail later, included interaction with matrix-style card sorting trials, in which participants were able to view an array of cards with varying elements and a sample card to match to one card from the array. The apparatus was built in such a way that only one trial was presented on-screen at a time, and participants were unable to progress to the next trial until the correct response was selected. Within the Qualtrics link, two visual-only videos were embedded for participants to watch, which were the vehicle for the observational pairing procedure.

Dependent Variables/Measures & Experimental Design

The primary dependent variables of interest in this experiment were affect and willingness. These variables were measured through the AWS, which asked participants to rate both their affect toward and willingness to engage with each of the stimuli included in the experiment. Affect was defined as how each stimulus made the participant feel (either positive or negative). Similarly, willingness was defined as how willing the participant was to engage with each stimulus (either willing or unwilling). Each variable was rated in increments of 10 on a sliding scale, ranging from -100 to +100. Specifically, a rating of -100 indicated the most negative affect toward and the most unwilling to engage with a particular stimulus, while a rating of +100 indicated the most positive affect toward and the most willing to engage with a particular stimulus. The AWS was presented to all participants a total of 6 times, with each presentation displaying the stimuli in a new and randomized order. The AWS can be utilized either with stimuli predetermined by the assessor or primed based on participant responses collected using other technologies such as the ACT Matrix. For the purpose of the present study, stimuli were predetermined and included the stimuli shown in Table 1.

Table 1. Equivalence Classes

Class Number	A Stimulus	B Stimulus	C Stimulus
Class 1	※	kep	◨
Class 2	₪	jib	Ӝ
Class 3	⩿	zat	⇄
Class 4	✧	lud	✺

This experiment employed a between groups experimental design. The Qualtrics link was programmed to randomly assign participants to 1 of 2 groups. The group distribution resulting from this randomization included 33 participants in Group 1 and 29 participants in Group 2. Within this design, the only difference between groups was which stimuli were assigned to the differing operant schedules included in the study. Having two groups complete this experiment with different stimuli associated with the differing operant schedules allowed the design to demonstrate experimental control, helping ensure that any effects observed were the result of the experimental manipulation rather than some unforeseen qualities of the stimuli assigned to the various conditions. Specifically, the A2 stimulus served as the A-negative stimulus for Group 1 (along with its corresponding equivalence class members being the negative response class), whereas A4 was used as the A-negative stimulus (along with its corresponding equivalence class members being the negative response class) for Group 2. Therefore, although there were two different groups in this experiment, the participants in both groups experienced the same procedures, exclusively differentiated by this difference in stimulus classes 2 and 4 as can be seen in Figure 1. Because of this, no procedural differences for Groups 1 and 2 are described.

Procedure

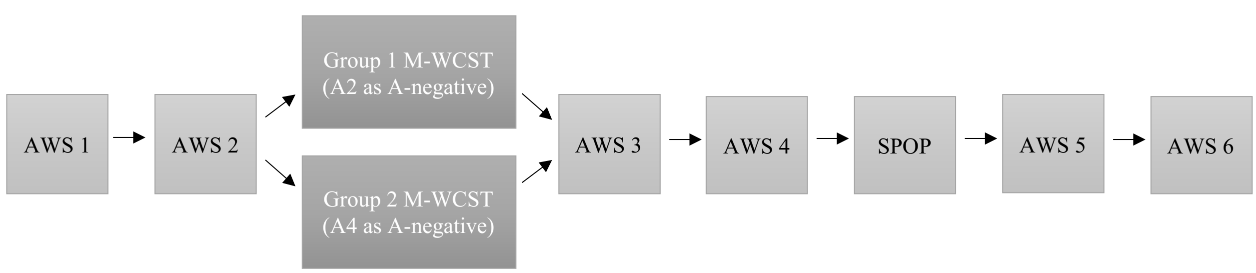

Figure 1. Procedure

Baseline

All participants began the experiment by completing 2 baseline measures of the AWS. During these 2 baseline measures, participants rated both their affect and willingness to engage with each of the 12 stimuli included in the experiment. At this point in their participation, they had no experience or engagement with the stimuli aside from viewing them during their completion of the measure. All ratings made during these 2 measurement periods were presumed to be based only on their pre-existing learning histories outside of the experiment. Due to this, these baseline ratings were particularly important due to the arbitrary nature of the stimuli. These baseline ratings are especially necessary with arbitrary stimuli to serve as a reference point for gauging the establishment and transfer of affect and willingness functions resulting from the experimental manipulations that followed the baseline period.

M-WCST

Directly following baseline, participants engaged in a schedule-induced frustration task, which was a modified version of the Wisconsin Card Sorting Test (M-WCST). The task adapted the traditional WCST to consist of 5 different phases with different reinforcement contingencies producing differing schedules of reinforcement. Each phase of the task included 10 question trials, each of which presented participants with one sample card to match to one card from an array of four total cards. All cards presented included a random combination of characteristics: a number (1, 2, 3, or 4), a color (blue, red, green, or yellow), and a shape (circle, triangle, star, cross). No two cards presented during a trial were identical; instead, participants had to guess and learn what feature of the card to sort by. The 5 phases of this task were defined by a changing sorting contingency. The first three phases had simple sorting contingencies of sorting by color, then by number, then by shape.

The fourth phase diverged from these simple sorting criteria by instead having a random card assigned as the correct answer, with no consistent sorting rule for participants to respond according to. This random sorting phase was designed with the intention of creating a frustrating experience for participants. Throughout these first four phases, participants were not instructed as to what they were supposed to sort the cards based on. Instead, participants were only instructed to match the sample card to the correct card in the array. However, 4 symbols were used as discriminative stimuli throughout each phase. Each of the four symbols were assigned to one of these phases and were therefore each associated with one of the four sorting contingencies. Aside from the discriminative stimulus and vague instructions, participants were not instructed on how to sort the cards. When a participant chose an incorrect card from the array, they received a message informing them that the response was incorrect and were forced to choose again until selecting the correct card from the array. Across the 10 trials within each of the first four phases, the discriminative stimulus and sorting contingency remained the same.

Finally, the fifth phase contained the same instructions and feedback, however it differed in format. This final phase was a mixed block, during which 12 total trials, with 3 trials of each of the four prior phase's sorting contingencies, were presented in a mixed order. The only indicator of the active sorting contingency was the symbol that was presented alongside the trials in the corresponding sorting phases. This was the only phase in which the sorting contingency changed from question to question, with the only explicit indicator of the shifts being the discriminative stimulus presented alongside the trial.

The fixed sequence of these phases was chosen to make the random sorting phase more likely to create a frustrating experience for participants. The first three phases each had a predictable schedule of reinforcement within the phase, and the inclusion of all three phases of predictable reinforcement coming before the phase with a more random and frustrating sorting contingency allowed participants to adjust to both the reliable reinforcement and the shifting contingencies prior to the random phase, which definitionally allowed for the maximum potential for the random phase to result in a frustrating emotional experience. After completing all five phases of this schedule-induced frustration task, participants completed the AWS twice more.

SPOP Training

Once participants finished the M-WCST, they underwent equivalence training. The equivalence training consisted of participants visually attending to two videos. The equivalence training included 12 total stimuli, which were the 12 stimuli included on each measurement of the AWS. Of those 12 stimuli, there were 4 3-member equivalence classes, as seen in Table 1. The A stimuli were the four symbols used as discriminative stimuli in the M-WCST, the B stimuli were CVCs, and the C stimuli were 4 different symbols. These relations were trained in the two videos shown through a SPOP training. The first SPOP video presented an A stimulus for 2 seconds followed immediately by the corresponding B stimulus for another 2 seconds to train the stimulus relations. All 4 stimulus pairings were presented a total of 10 times in a randomized order, with 2 seconds of a blank screen displayed between pairings. The second video replicated these methods exactly, with the only difference being that it trained the four B-C relations instead of the A-B relations. After completing their observation of both SPOP training videos, participants completed their final two AWS measurements.

Results

To interpret the results of the experiment, the data was analyzed through multiple methods. Because the experiment aimed to compare transfer of stimulus function for stimuli in the negative conditions against the stimuli in the neutral conditions, analyses were conducted using the average AWS ratings across the neutral stimuli. That is, the 3 neutral A stimuli ratings were averaged into one A-neutral mean for each group, the 3 neutral B stimuli were averaged into one B-neutral mean for each group, and the 3 neutral C stimuli were averaged into one C-neutral mean for each group. The A-, B-, and C-negative stimuli only represent the mean group ratings of each stimulus in the single equivalence class corresponding to the negative affective contingency. Across all analyses, the primary point of interest is the difference between negative and neutral stimulus ratings of affect and willingness.

For both AWS score analyses, the mean ratings from each repeated measurement of the AWS, with potential ratings ranging from -100 to +100 were averaged across members for each group. To identify potential differences between ratings for the stimuli associated with the neutral affective conditions and the stimuli associated with the negative affective conditions, the mean ratings for 6 categories of stimuli were graphed as seen below in Figures 2 and 3. It is important to note that the same changes were expected to be seen in both groups. This is because the data are displayed with reference to the functions carried by the stimuli rather than the specific stimuli used. While the stimuli in the negatively valenced equivalence class were comprised of different symbols for each group, the data are graphed by anticipated function rather than by the specific symbols themselves. It is also necessary to note that the emphasis in interpreting the data is not on the explicit ratings for the stimuli themselves, but rather on the changes in ratings across phases of the experiment. When viewing the mean group ratings, the change in ratings is indicative of transfer of stimulus function.

Based on the design of the experiment, when comparing the affect ratings at Times 1 and 2 to the affect ratings at Times 3 and 4, differences were expected to be seen primarily in the A-negative stimulus. This is because at Times 3 and 4, participants had engaged with the M-WCST, which only included the 4 A stimuli and induced a frustration contingency for only the A-negative stimulus. As can be seen in Figure 2, both groups did indeed respond with a largely decreased mean affect rating for the A-negative stimulus after completing the M-WCST as compared to baseline. This decrease in affect ratings for the A-negative stimulus that was observed in both groups appears to indicate that negative emotional experiencing did occur in the context of that particular stimulus and that an affective function was, indeed, established in response to the frustration contingency. At Times 5 and 6, participants had undergone equivalence training relating the A stimulus observed in the M-WCST to the B and C stimuli in each stimulus class. At these times, potential transfer of function was expected to occur for the B and C stimuli. This would be seen through a decrease in mean affect ratings for the B- and C-negative stimuli from Times 3 and 4 to Times 5 and 6 in both groups. As the data show, some decrease in affect ratings did occur for these 2 stimuli, more so for the B-negative stimulus than the C-negative stimulus. This slight gradient of transfer across class members can be potentially understood by the fact that the A-negative stimulus was directly trained to the B-negative stimulus, whereas the C-negative stimulus was only directly trained to the B-negative stimulus. No direct relation was explicitly trained between the A-negative and C-negative stimulus. Yet, some decrease in affect rating did still occur for both groups, suggesting that the function may have still transferred to a certain extent.

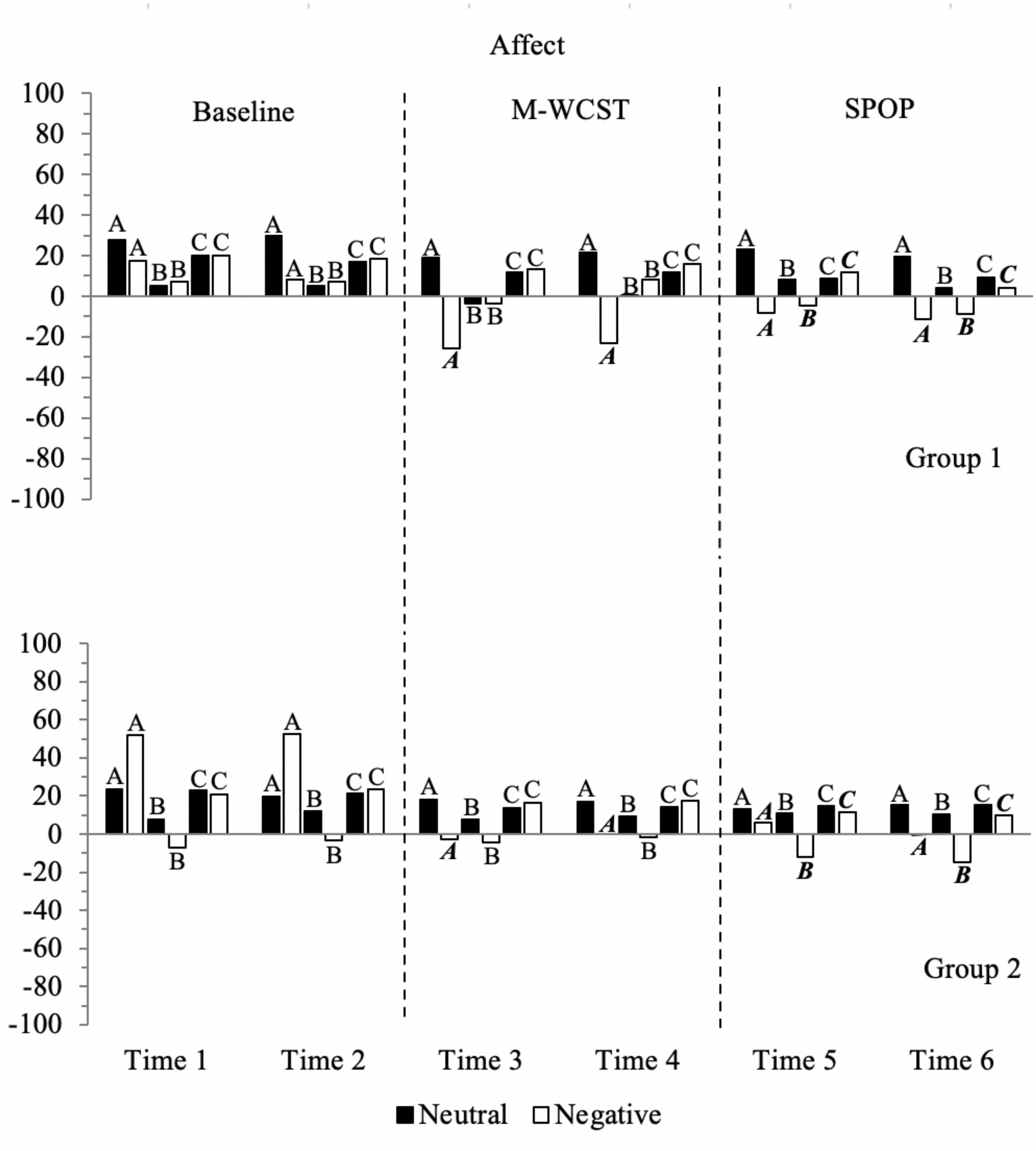

Figure 2. Affect Scores

Willingness score means for the 6 types of stimuli were compared and graphed in the exact same way as the affect scores, and the same changes were expected to be seen at the same times throughout the experiment. Figure 3 displays the willingness rating means collected from the AWS at the same times throughout the experiment as the affect ratings. Once again, the changes in rating are the focal point in assessing the establishment and transfer of function resulting from operant schedules in the M-WCST and the observation procedure. The willingness data appear to closely mirror those of the affect data. Once again, a large decrease for the ratings of the A-negative stimulus is observed in both groups when comparing ratings at Times 3 and 4 to Times 1 and 2. This stark decrease in willingness scores for the A-negative stimulus in particular after interacting with the M-WCST suggests that negative emotional experiencing occurred when interacting with the A-negative stimulus in particular. This appears to have resulted in the establishment of a negatively valenced function for the stimulus. Similarly again to the affect ratings, a decrease in willingness ratings was observed in B-negative and C-negative stimuli in both groups at Times 5 and 6, following the equivalence training. This decrease, again, is more pronounced for the B-negative stimulus than it is for the C-negative stimulus. This decrease of willingness ratings for stimuli in the equivalence class with the A-negative stimulus brings further support for the transfer of stimulus function related to emotional experiencing.

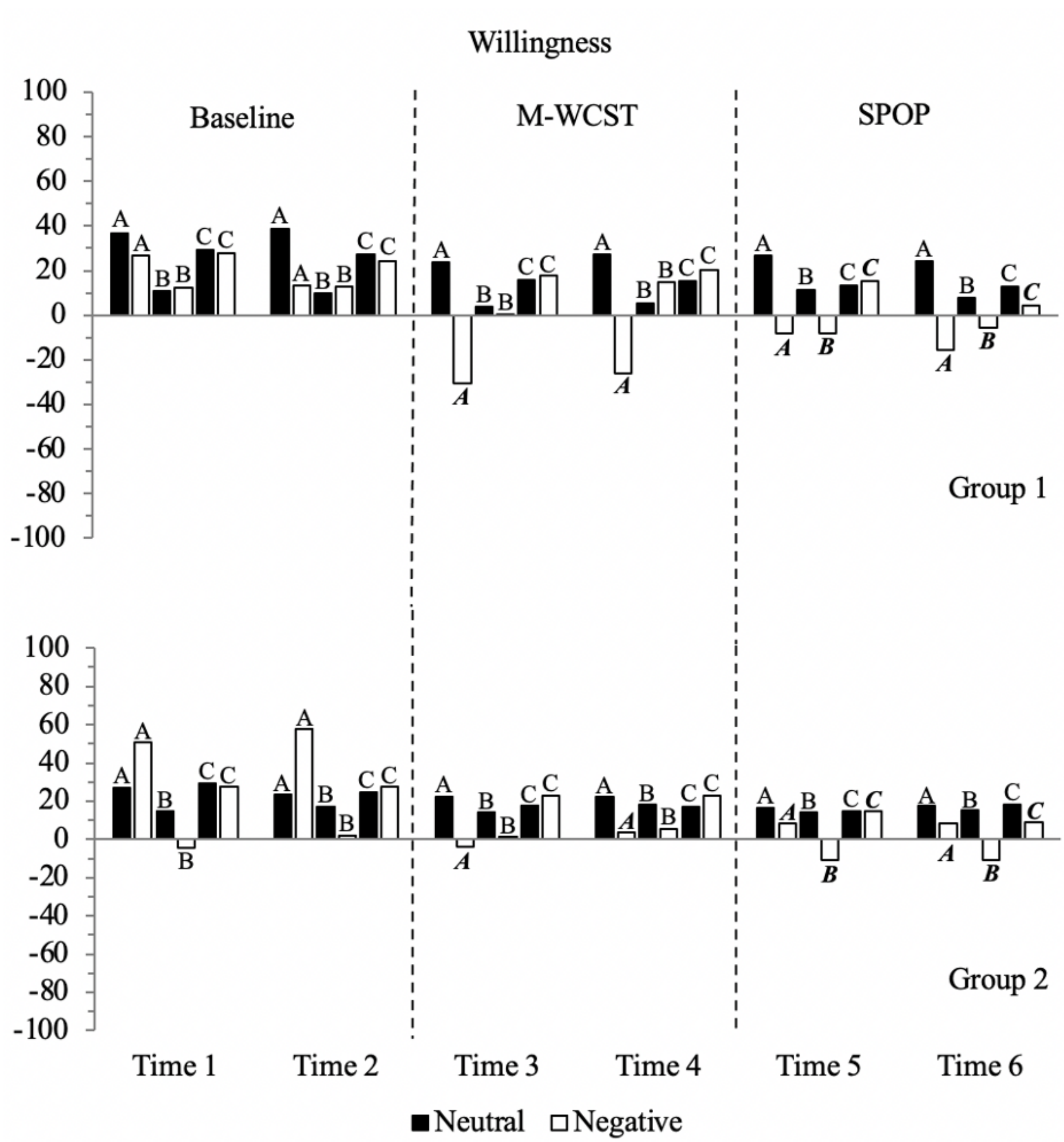

Figure 3. Willingness Scores

Further analyses comparing the stimuli from equivalence classes 2 and 4 were conducted to assess the experimental control built into the design with the interchanging of these two stimulus classes across groups, where class 2 stimuli comprised the negatively valenced class for Group 1 and class 4 stimuli comprised the negatively valenced class for Group 2. Conversely, class 2 stimuli were contained in the neutrally valenced class for Group 2 and the class 4 stimuli were contained in the neutrally valenced class for Group 1. The visual comparison of the mean affect ratings for each stimulus from these classes is compared between groups in Figure 4 to examine how much the experimental manipulation accounted for the decreases observed in the stimuli belonging to the negatively valenced contexts created in the experiment. Decreases in affect ratings do, indeed, appear to occur for the stimuli at the expected points in time throughout the experiment in the groups when the stimuli belonged to the negative equivalence class. These differences are the most exaggerated for the A-negative stimuli at Times 3 and 4. Asterisks seen above data points indicate a statistically significant difference in ratings for the stimuli as determined through ANOVAs and post-hoc analyses. A smaller differentiation also occurs in B-negative and C-negative stimuli when anticipated at Times 5 and 6.

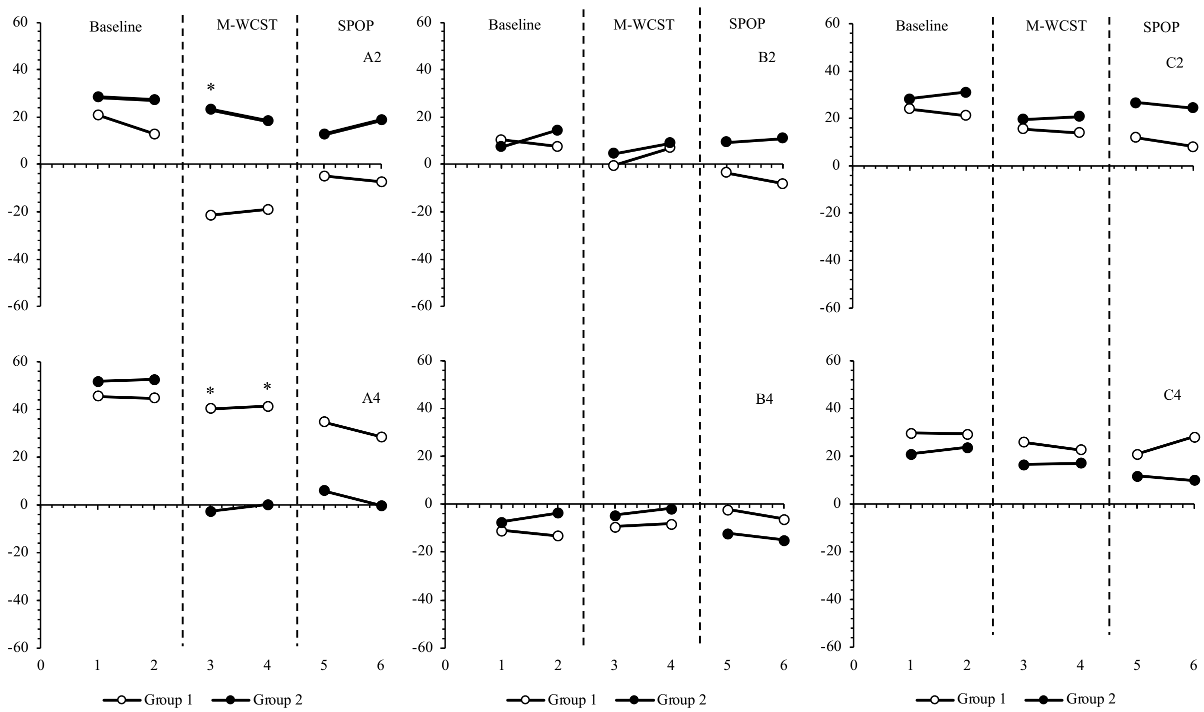

Figure 4. Equivalence Class 2 and 4 Affect Scores

Finally, Figure 5 shows the same analysis of equivalence class 2 and 4 stimuli for mean willingness ratings. The same effects were both hypothesized and observed, once again with the most differentiated ratings occurring in stimuli A2 and A4 at Times 3 and 4, directly after those stimuli were seen as discriminative stimuli for the sorting contingencies in the M-WCST. Each of these differences, where statistical significance was found in post-hoc analyses, is indicated with an asterisk in Figure 5. The same is true again where B-negative and C-negative stimuli are also visually differentiated across groups at Times 5 and 6, although the differentiation is not as large as the post M-WCST differences for the A-negative stimuli.

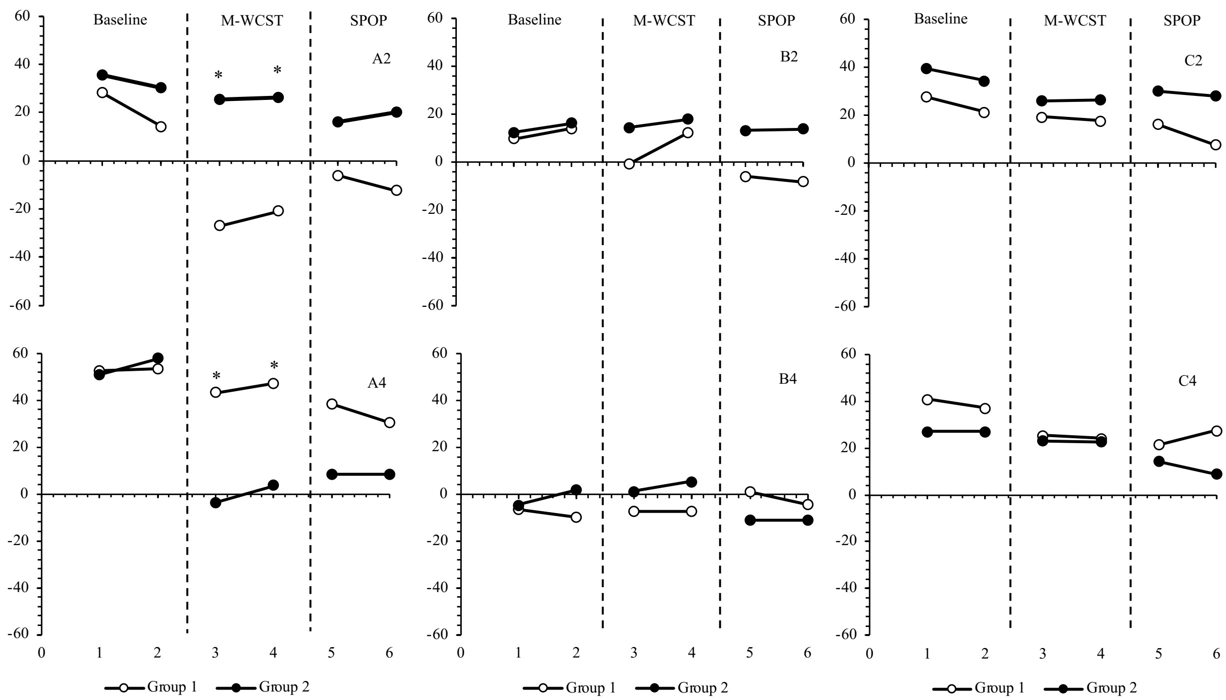

Figure 5. Equivalence Class 2 and 4 Willingness Scores

Discussion

In the pursuit of study of transfer of stimulus functions relating to emotional experiencing resulting from operant schedules and pairing observation, the present study did result in observed transfer of stimulus function. The M-WCST designed for this experiment does appear to have established functions for the symbols used as discriminative stimuli for differing schedules of reinforcement, and the SPOP training also appears to have resulted in some transfer of those established affect and willingness functions. These results not only suggest the success of these methodologies for establishing and facilitating the transfer of stimulus functions, but also the ability of the AWS to be used as an instrument for assessing affect and willingness functions. The latter presents possibilities for meaningful clinical applications for bringing the AWS into settings beyond the laboratory.

Clinical utility may be derived from the research presented by considering the use of the AWS for clients in an applied setting. This measure demonstrated the ability to be used quickly and easily to capture emotional experiencing and the related c-funcs for various stimuli. In addition to practicality and speed, an instrument also needs to be reliable to be recommended for clinical use. The results of the experiment do, indeed, support the reliability of the AWS. This is shown through the differences in ratings between Times 1 and 2, Times 3 and 4, and Times 5 and 6 not being significantly different within the same symbol. Further, the AWS also appears to be sensitive to contextual shifts. This can be concluded because a clear directional change was observed for the A-negative symbol following the negative emotional context induced by the M-WCST. All of this taken together suggests high clinical utility for the AWS.

Another implication of the research presented may be understood by bringing RDT into discussion. Interestingly, the A-negative stimulus ratings showed slight increases in both affect and willingness following equivalence training. While subtle, this increase may suggest a slight diffusion of stimulus function across class members. As stimulus function transferred to the B-negative and C-negative stimuli, the function appeared to be somewhat lessened for the A-negative stimulus itself in comparison to when the A-negative stimulus was the only stimulus carrying the function. This diffusion effect may be conceptualized through an RDT lens and may have implications for clinical applications. From a relational density standpoint, as the volume of a relational class increases, density decreases. This coheres with the effect observed, as an increase in class members (volume) resulted in a decrease in intensity of the stimulus function for a single class member (density). Considering this may be insightful for clinical applications in which a client may be having negative emotional experiencing tightly fused to a particular stimulus. The ACT process of defusion may provide a clinical approach to achieving this diffusion, lessening the negative emotional experiencing.

While there are several exciting implications of the findings, this experiment and the conclusions drawn from it are not without limitations. While the group data align with the anticipated changes and support the ability of the AWS to capture these explicit affect and willingness functions reliably, no analysis is presented at the individual level. While the data suggest potentially promising clinical utility as described, more research is needed to further examine the extent of its utility at the individual level rather than at the group level. This is especially worth noting because, although the measure is designed to be relatively sensitive given its wide range of score ratings available for participants to assign to a stimulus, if an individual responds with a rating that is close to either the bottom or top end of the scale at baseline, future responses may be difficult to interpret due to potential floor or ceiling effects. Relatedly, the experiment was conducted with arbitrary stimuli and contrived contingency-established stimulus functions. While this provides a starting point for introducing the AWS as a useful instrument, incorporation of more meaningful stimuli into the measure was not explored in this study.

Extending the research on this measure through further translational and applied research that incorporates more individually relevant stimuli would be beneficial to further understand the instrument's utility. As mentioned earlier, stimuli used in the AWS can be either predetermined or adapted based on an individual's particular responding as captured through various technologies, such as the ACT matrix. While the present study used predetermined stimuli, future research should incorporate personalized stimuli into the AWS in an applied setting. Doing so would allow for greater access and insight into a client's emotional experiencing relating to pertinent stimuli. This would allow for an increase in consideration of emotions during service delivery and could be completed in a brief amount of time, allowing for repeated measures. This would also address a limitation of the present study by examining the utility of the AWS at the individual level instead of strictly at the group level.

In summary, the findings of the present study can be interpreted translationally in terms of emotional responding in the clinic. Emotional responses that clients produce and experience may be due to the schedules of reinforcement and punishment that they are operating within and it may be the case that, through relational learning, this can transfer to environmental experiences where contingencies are not directly contacted. Through research imposing real-world stimuli into an AWS, it may be possible to detect these changes in response to intervention when contingencies are altered, when relations are changed, or when functions are targeted through ACT strategies.

References

Amsel A. (1992). Frustration theory--many years later. *Psychological Bulletin*, *112*(3), 396–399. https://doi.org/10.1037/0033-2909.112.3.396

Arch, J. J., Eifert, G. H., Davies, C., Plumb Vilardaga, J. C., Rose, R. D., & Craske, M. G. (2012). Randomized clinical trial of cognitive behavioral therapy (CBT) versus acceptance and commitment therapy (ACT) for mixed anxiety disorders. *Journal of Consulting and Clinical Psychology*, *80*(5), 750–765. https://doi.org/10.1037/a0028310

Assaz, D. A., Tyndall, I., Oshiro, C. K., & Roche, B. (2023). A process-based analysis of cognitive defusion in acceptance and commitment therapy. *Behavior Therapy*, *54*(6), 1020-1035. https://doi.org/10.1016/j.beth.2022.06.003

Barnes-Holmes, D., Barnes-Holmes, Y., Power, P., Hayden, E., Milne, R., & Stewart, I. (2006). Do you really know what you believe? Developing the implicit relational assessment procedure (IRAP) as a direct measure of implicit beliefs. *The Irish Psychologist*, *32*(7), 169-177.

Belisle, J., & Dixon, M. R. (2021). Relational behavior and ACT: A dynamic relationship. *Behavior Analysis in Practice*, *15*(1), 71–82. https://doi.org/10.1007/s40617-021-00599-z

Belisle, J., Paliliunas, D., Catrone, R., Sickman, E., & Ramakrishnan, A. (2024). A comprehensive behavioral model of emotion rooted in relational frame theory and contemporary extensions. *The Psychological Record,* 1-19. https://doi.org/10.1007/s40732-024-00603-2

Belisle, J., Paliliunas, D., Lauer, T., Giamanco, A., Lee, B., & Sickman, E. (2020). Derived relational responding and transformations of function in children: A review of applied behavior-analytic journals. *The Analysis of Verbal Behavior*, *36*(1), 115–145. https://doi.org/10.1007/s40616-019-00123-z

Belisle, J., Payne, A., Sellers, B., Sickman, E., & Hutchison, L. (2023). Modeling complex verbal relations within racial stereotyping: A translational analysis of relational density. *Behavior and Social Issues, 32*(2), 376–395. https://doi.org/10.1007/s42822-023-00134-5

Bessonova, L., Ogden, K., Doane, M. J., O'Sullivan, A. K., & Tohen, M. (2020). The economic burden of bipolar disorder in the United States: A systematic literature review. *ClinicoEconomics and Outcomes Research: CEOR*, *12*, 481–497. https://doi.org/10.2147/CEOR.S259338

Dollard, J., Miller, N. E., Doob, L. W., Mowrer, O. H., & Sears, R. R. (1939). *Frustration and aggression.* Yale University Press. https://doi.org/10.1037/10022-000

Dougher, M. J., Hamilton, D. A., Fink, B. C., & Harrington, J. (2007). Transformation of the discriminative and eliciting functions of generalized relational stimuli. *Journal of the Experimental Analysis of Behavior*, *88*(2), 179–197. https://doi.org/10.1901/jeab.2007.45-05

Grant, D. A., & Berg, E. A. (1948). *Wisconsin Card Sorting Test* [Database record]. APA PsycTests. https://psycnet.apa.org/doiLanding?doi=10.1037%2Ft31298-000

Harte, C., & Barnes-Holmes, D. (2021). A primer on relational frame theory. In *The Oxford Handbook of Acceptance and Commitment Therapy*. Oxford University Press.

Harte, C., Barnes-Holmes, D., Barnes-Holmes, Y., & Kissi, A. (2020). The study of rule-governed behavior and derived stimulus relations: Bridging the gap. *Perspectives on Behavior Science*, *43*(2), 361–385. https://doi.org/10.1007/s40614-020-00256-w

Hayes, S. C. (2004). Acceptance and commitment therapy, relational frame theory, and the third wave of behavioral and cognitive therapies. *Behavior Therapy, 35,* 639-665. https://doi.org/10.1016/S0005-7894(04)80013-3

Hayes, S. C., & Hofmann, S. G. (2021). "Third-wave" cognitive and behavioral therapies and the emergence of a process-based approach to intervention in psychiatry. *World Psychiatry: Official Journal of the World Psychiatric Association (WPA)*, *20*(3), 363–375. https://doi.org/10.1002/wps.20884

Hutchison, L., Belisle, J., Matthews, M., & Sickman, E. (2023). Applying concepts of relational density theory to climate related consumer behavior: A contextual extension study. *Journal of Contextual Behavior Science, 30,* 8-19. https://doi.org/10.1016/j.jcbs.2023.08.006

Kessler, R. C., Akiskal, H. S., Ames, M., Birnbaum, H., Greenberg, P., Hirschfeld, R. M. A., Jin, R., Merikangas, K. R., Simon, G., & Wang, P. S. (2006). Prevalence and effects of mood disorders on work performance in a nationally representative sample of US workers. *American Journal of Psychiatry*, *163*(9), 1561-1568. https://doi.org/10.1176/ajp.2006.163.9.1561

McLoughlin, S., & Roche, B. T. (2023). ACT: A process-based therapy in search of a process. *Behavior Therapy*, *54*(6), 939-955. https://doi.org/10.1016/j.beth.2022.07.010

Paliliunas, D., & Belisle, J. (in prep). *Affect and Willingness Scale* [Measurement instrument].

Polk, K. L., Schoendorff, B., Webster, M., & Olaz, F. O. (2016). *The essential guide to the ACT matrix: A step-by-step approach to using the ACT matrix model in clinical practice*. New Harbinger Publications.

Qualtrics Experience Management. (2024, July 1). Qualtrics XM. https://www.qualtrics.com/

Roper, T. J. (1981). What is meant by the term “schedule-induced,” and how general is schedule induction? *Animal Learning & Behavior*, *9*(4), 433-440. https://doi.org/10.3758/BF03209773

Sickman, E., Belisle, J., Payne, A., Hutchison, L., & Travis, E. (2023). An exploratory analysis of gender stereotyping using the theoretical framework of relational density theory. *Journal of Contextual Behavioral Science*, *28*, 256-265. https://doi.org/10.1016/j.jcbs.2023.04.007

Schmidt, M., de Rose, J. C., & Bortoloti, R. (2021). Relating, orienting and evoking functions in an IRAP study involving emotional pictographs (emojis) used in electronic messages. *Journal of Contextual Behavioral Science*, *21*, 80-87. https://doi.org/10.1016/j.jcbs.2021.06.005

Spencer, M. A. (1982). *The frustration effect in the operant setting utilizing second-order schedules of reinforcement*. Lamar University-Beaumont.

EVALUTATING THE INFLUENCE OF MINDFULNESS ON IMPULSIVITY UNDER STRESS

The current manuscript was written by the authorship of Jordan Belisle, Dana Paliliunas, Emily Hermann, Jaelyn Compton, and Amanda Middleton. The contents of this manuscript and authorship may differ from the finalized version based on review and revision. Final analyses were conducted from de-identified data collected through the Institute for Dynamic Behavior Science and Missouri State University made available by the primary investigator of those studies. The studies were conducted consistent with the IRB approval process presented in the appendix. Correspondence regarding this thesis should be directed to Amanda Middleton (middleton723@live.missouristate.edu) and correspondence regarding the manuscript should be directed to Dr. Jordan Belisle at the Institute for Dynamic Behavior Science (jordanbelisle@dynamicbehaviorscience.com).

Impulsivity appears to be a concept that is defined heavily in reference to behavior, although it is also defined highly variably (Baumann & Odum, 2012; Evenden, 1999). Given this wide variability of how the construct is defined, discussed, and studied, it is not only widely relevant but also somewhat limited. Because of this multidimensionality of meaning when using the term, it is critical to not only broadly understand what the construct entails but to also clarify how the term is being defined in the particular context in which it is being referred to. Within the behavior analytic literature examining impulsivity, there appears to be wide agreement that the construct is not clearly defined (Stahl et al., 2014). One behavior analytic definition, largely in the context of contrasting from self-control, offers that impulsivity is characterized by behaving in such a way that small immediate reinforcers are accessed despite sacrificing larger but more delayed reinforcers (Dixon et al., 2019; Jackson & Hackenberg, 1996; Vollmer et al., 1999). Alternatively, impulsivity has also been defined in the field of neurobiology as the opposition to response inhibition (Bari & Robbins, 2013). While impulsivity may lack a definite definition, the dimensions that it is often based around remain similar in domain (Meda et al., 2009).

Commonly in the behavior analytic literature, the dimension of impulsivity that is studied and measured deals with the reinforcement-based definition, emphasizing choice of a sooner and smaller reward instead of a larger but later one (Dixon et al., 2019). Operating within this domain of the construct, delay discounting has shown great utility for assessing impulsive responding (Odum, 2011). Delay discounting describes the lessening value of reinforcing consequences as they become more distant (Mazur, 1987). While delay discounting has been largely studied within behavior analysis to assess individuals with various behavioral addictions, especially including gambling disorders (Weinsztok et al., 2021), it has also been used to study impulsive responding in individuals with eating disorders (Steward et al., 2017), impulsive responding in individuals with brain injuries (Dixon et al., 2005), and even altruistic choosing (Belisle et al., 2020). Delay discounting tasks assess impulsivity by determining the switch point at which participants shift away from choosing the larger delayed reward in favor of the smaller immediate reward.

While delay discounting has been a highly used method for studying impulsivity, it is not the only way to measure impulsivity. Operating more closely under the definition that aligns impulsivity with disinhibition and attentional dimensions, the Go/No-Go task has been used for study (Evenden, 1999; Yechiam et al., 2006). This Go/No-Go task is an alternative method for measuring impulsivity, although it appears to be studied under this alternative definitional domain. A Go/No-Go task is a test of momentary discrimination, largely measuring the attentional aspect of impulsivity (Yechiam et al., 2006). The Go/No-Go task is a test of an individual's ability to accurately discriminate and then either respond or inhibit responding depending upon the stimulus presented. A recent version of this task, known as the ImGo, which has demonstrated reliability has been suggested as a tool with high potential for use in diagnostic practice as well as research (Šašinka et al., 2023). This task has also been used to study the impulsive behavior of a variety of populations, including those with internet gaming addiction (Ding et al., 2014) and children (Bezdijan et al., 2009). The Go/No-Go task provides a different behavior analytic method for assessing impulsivity, although it is unclear to what extent the impulsivity captured through this task overlaps with that captured through delay discounting.

Across the impulsivity research, both stress and mindfulness have been incorporated to identify the effects they have on impulsivity. Banis and Lorist (2012) brought attention to the effects that stress has on impulsivity, showing that this type of stress can lead to momentary increases in impulsive responding. Specifically, they studied these findings with noise as the stressor, as noise can operate as a contextual variable that increases stress-consistent responding. Delay discounting research has incorporated mindfulness into impulsivity research, demonstrating that on self-report delay discounting tasks brief mindfulness intervention has resulted in lower measures of impulsivity (Maltais et al., 2020). Another study by Dixon and colleagues (2019) demonstrated that impulsive responding on a self-report delay discounting survey could have momentary sensitivity to mindfulness interventions, which also relates back to stress since mindfulness practice can reduce internal stimulus control that is exerted by the physiological experiencing that results from stress and might make an individual more sensitive to external stimulus events. However, this study, along with others, does not contain a measure of stimulus control, such as could be measured through a Go/No-Go analysis of mindfulness, stress, and impulsivity.

The present experiment sought to extend the current behavior analytic impulsivity literature by examining the effects of both a stressful context and brief mindfulness practice on impulsivity as measured through a Go/No-Go task instead of through a delay discounting framework. Specifically, the study assessed whether impulsive responding as measured through accuracy of responding and speed of responding within a Go/No-Go task changed when a stressful context was introduced and after a brief mindfulness exercise was completed.

Methods

Participants

Undergraduate psychology students from a Midwestern university were recruited for participation in this study. Out of 87 students who were recruited in total, 81 were retained in the final analysis while the other 6 were left out based on exclusion criteria. Participants were excluded if they failed to complete all the tasks included in the experiment as instructed or they did not attend to all presented stimuli. Of the 81 participants retained in the analysis, 41 were randomly assigned to the experimental/mindfulness+ group and 40 were randomly assigned to the control/mindfulness- group.

Setting and Materials

All sessions were completed in a dedicated research laboratory space, in which a participant sat in one room with a computer and the researcher sat in a connected room. The rooms were joined with one-way glass, allowing the researcher to monitor a participant's completion of the experiment without being visibly nearby. The researcher entered the room the participant was in during transitions in the experiment to instruct the participant about the next portion of their participation and to switch windows on the computer in correspondence to the phase of the experiment. Only one participant occupied the room and completed the experiment at a time. Participants used a desktop computer to complete the experiment in the room. As the study involved several audio components, headphones were also provided, and participants were instructed to wear them.

Dependent Variables/Measures

The primary dependent variable of interest during this study was impulsivity as measured through a Go/No-Go task. The Go/No-Go task utilized for this experiment is available through PsyToolkit (“Go/No-go task,” 2021). Impulsivity was measured through accuracy of participant responses during the Go/No-Go task. In addition to accuracy, speed of responding was also recorded as a supplemental assessment of impulsive responding. Both measures of impulsivity were included in the data analysis.

Experimental Design

This study employed a between groups design. Participants were randomly assigned to one of two groups. The experimental group, or the mindfulness+ group, underwent an intervention that consisted of a brief guided meditation. The control group, or the mindfulness- group, completed a brief control activity of similar length to the mindfulness+ group. All participants, both in the mindfulness+ and mindfulness- groups, were exposed to 2 conditions during their participation. These conditions were a stress+ and a stress- condition, which intended to assess the impulsivity of participant responses under different noise contexts.

Procedure

Regardless of group assignment, participation began with a pretest of the Go/No-Go task. The task presented one digit on-screen at a given point in time. Participants were instructed that all digits except for the number 3 were Go stimuli, during which they needed to press the spacebar on the keyboard within 2 seconds of the digit appearing on-screen. Participants were also instructed that the number 3 was a No-Go stimulus, during which they needed to refrain from pressing the spacebar on the keyboard for 2 seconds after the digit appeared on-screen. A spacebar press in response to the number 3 would be an inaccurate No-Go response, whereas refraining from pressing the spacebar in this case would be an accurate No-Go response. Conversely, a spacebar press in response to any digit other than 3 would be an accurate Go response, whereas refraining from pressing the spacebar in this scenario would be an inaccurate Go response. Incorrect Go and No-Go responses both indicate impulsive responding in the task. During completion of the task, participants wore headphones and were exposed to either a stress+ or stress- condition to introduce a noise context and assess whether a stressful noise context affects a participant's impulsive responding. Each of these conditions consisted of a sound playing for the entirety of their engagement in the Go/No-Go task. Participants were randomly assigned to either experience the stress+ or stress- condition during this first Go/No-Go task completion. The sound listened to by participants while experiencing the stress+ condition was created with generally aversive sounds layered together in one sound clip, intended to simulate a stressful context. Sounds included in this clip included sirens, crying babies, yelling, animal noises, and more. Alternatively, the stress- condition consisted of participants listening to calm and peaceful piano music.

Following pretest, participants experienced a brief intervention dependent upon their group assignment. Members of the mindfulness+ group watched a short, guided meditation video on YouTube (Great Meditation, 2020), intended to expose participants to a brief period of mindful engagement. During this same time, members of the mindfulness- group instead watched a similar length of video that was expected to be a more neutral activity. The video that this control group watched was a short TEDx Talk about business and entrepreneurship (TEDx Talks, 2020).

Finally, after participants concluded their group-assigned video, they completed a posttest Go/No-Go task. The task was the same one used at pretest, although the numbers presented during the task were randomized so there was no threat of participants memorizing the sequence of the digits presented. During this posttest Go/No-Go task completion, participants once again listened to either the stress+ or stress- sound clip that lasted for the entire duration of the task. Participants completed posttest with the opposite stress condition from pretest.

Results and Discussion

The data analysis for the study focused on both the accuracy of participant responding and the speed of participant responding as facets of impulsivity. Accuracy of participant responding is demonstrated through count of both accurate and inaccurate responses during the Go/No-Go task. Response speed for both accurate and inaccurate responses is shown in milliseconds (ms). Each of these variables are graphed to compare the data for the mindfulness+ and mindfulness- groups. In addition to these group comparisons, a total of 8 ANOVA tests were conducted to further analyze the data and investigate relationships between stress conditions and accuracy/inaccuracy as well as the relationships between stress conditions and response speed for both accurate and inaccurate responses.

First considering accuracy data, as seen in Figure 6, the count for both accurate and inaccurate responses are broken down by time of the Go/No-Go task completion (Time 1 indicates pretest and Time 2 indicates posttest), stress condition, and are compared across groups. As can be seen in the top graph of the figure, the accurate response count showed little to no differences between the mindfulness+ and mindfulness- groups. Not only were there negligible differences between group performance in terms of accurate response count, but there were also negligible differences between stress conditions and pretest and posttest. The data strongly indicate that accurate response count did not vary based on mindfulness intervention, stress condition, or time of Go/No-Go task completion. Likewise, these same findings are true for inaccurate response count as shown in the bottom graph in the figure.

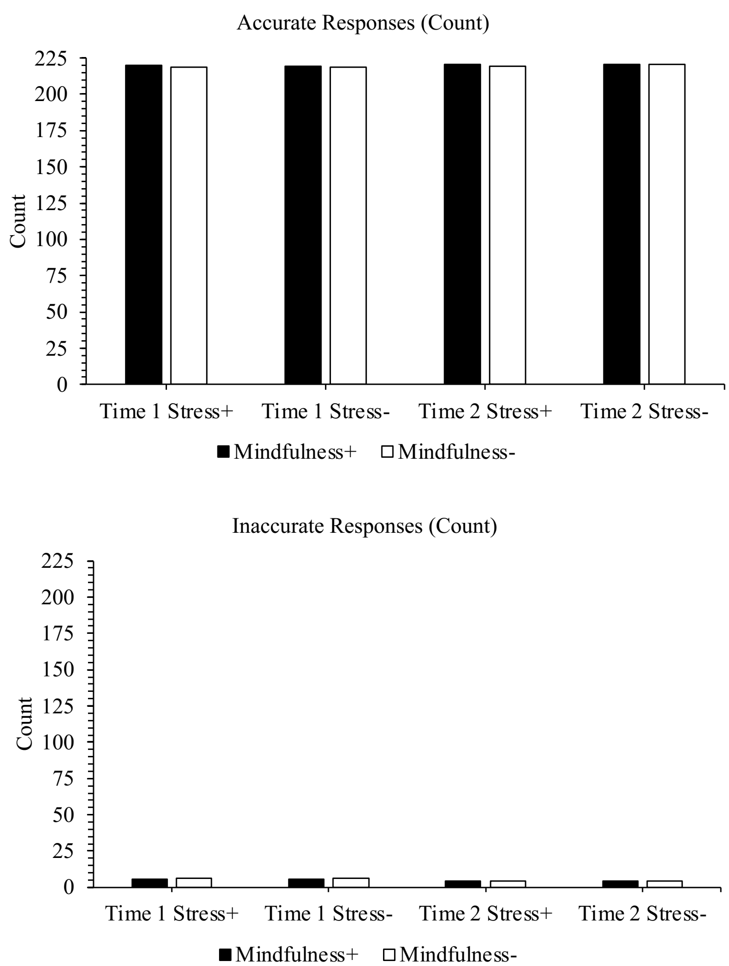

Figure 6. Count Data for Accurate and Inaccurate Responses

Moving onto the other measure of impulsivity, Figure 7 displays the response speed in milliseconds (ms) for both accurate and inaccurate response. A slight bit more differentiation between groups is observed in these data for response speed in accurate responding. The mindfulness- group appeared to perform slightly more quickly in their accurate responding. This appears to indicate that, if any difference worth noting exists, the mindfulness- group performed slightly better in terms of speed when responding correctly. When examining the response speed data for inaccurate responses, there is the most pronounced difference out of all of the comparisons. While still a small difference between groups, the group difference in speed of inaccurate responding appears to be the least trivial. The difference seen between groups for this measure indicates that the mindfulness- group committed errors quicker than the mindfulness+ group did.

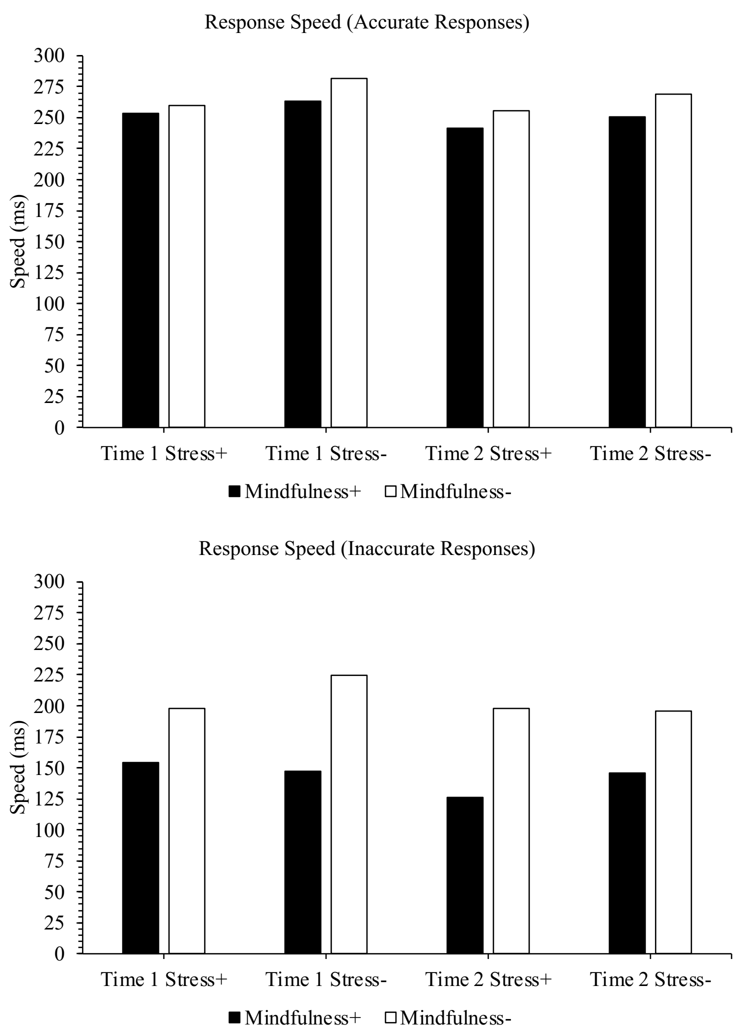

Figure 7. Response Speeds for Accurate and Inaccurate Responses

Examining the statistical analyses conducted, 8 2x2 ANOVAs, which were run to assess the relationships between the stress conditions and the accuracy and inaccuracy of responding as well as the response speed for accurate and inaccurate responding, the negligibility of the differences visually observed in Figures 6 and 7 were reiterated with all analyses resulting in statistically insignificant effects. For the interaction between stress+ and accurate responding, findings indicate no significant effects ($F(1) = 0.00$, $p = 0.93$). For the interaction between stress- and accurate responding, significant effects were also not found ($F(1) = 0.1$, $p = 0.71$). Similarly, no significant difference was determined to exist between stress+ and inaccurate responding ($F(1) = 0.14$, $p = 0.71$) or between stress- and inaccurate responding ($F(1) = 0.14$, $p = 0.71$). Insignificant findings were also reported between stress+ and response speed for accurate responding ($F(1) = 0.10$, $p = 0.75$), stress- and accurate responding ($F(1) = 0.00$, $p = 0.99$), stress+ and inaccurate responding ($F(1) = 0.35$, $p = 0.56$), and stress- and inaccurate responding ($F(1) = 0.36$, $p = 0.55$).

While the present study sought to examine the effects of mindfulness on impulsivity under stress, the results do not inherently appear to show any notable effects at all. However, based on prior research, it is known that mindfulness clearly does influence impulsivity as measured through delay discounting (Dixon et al., 2019). Similarly, the literature also informs that stress, even specifically noise-based stress, can negatively affect responding and contribute to behavior often described as impulsive (Banis & Lorist, 2012). Crucially, the difference in this experiment appears to be the conceptualization of impulsivity measured. In this attempt to assess whether these previously established relationships maintain the type of impulsivity measured through a Go/No-Go task, the data suggest that the same effects do not necessarily apply. This may highlight the nuance that exists when discussing and measuring impulsivity.

How a delay discounting framework of impulsivity and a Go/No-Go framework of impulsivity operate in relation to mindfulness and stress appear to differ heavily. The findings of the present study seem to indicate that, while statistically insignificantly, the mindfulness group showed a slower generation of correct responses as well as a quicker committal of errors. This may point to a larger insight, that impulsivity in a simple stimulus control and attending-based context such as the Go/No-Go task is fundamentally different than impulsivity in a rule-governed context such as a delay discounting task. A key differentiating factor between these seems to be the effects that mindfulness has on these two variations of impulsivity. Whereas long-term hypothetical decision-making in the rule-governed, delay discounting variation of impulsivity appears to be susceptible to change with brief mindful intervention (Dixon et al., 2019), the in-the-moment impulsive responding observed in the Go/No-Go variation of impulsivity appears to be much less susceptible to change with similar intervention, with performance even being ever so slightly worsened. Perhaps mindfulness overall primes an individual to respond more slowly and relaxed, resulting in a reduction of impulsivity in a less time-sensitive task such as delay discounting but worsened performance in a speed-intensive one.

Another suggestion from the data presented in this study may be that stress, while often framed as negative, serves an important role in momentary decision-making. If this is the case, then stress may not inherently be bad or negative. Considering the potential benefits of stress in certain capacities and contexts, an avenue for future study may be to research whether stress may serve a mediating function for impulsivity in the context of momentary decision-making.

Despite the suggested takeaways, it is also necessary to consider limitations of the experiment that could also contribute to the results observed. A critical limitation to point out is that, while brief mindful intervention has been sufficient for observing effects in a delay discounting framework of impulsivity, it is altogether possible that the brief mindfulness intervention chosen for the mindfulness+ group in this study was simply too brief. It is also possible that the particular mindfulness intervention chosen for the mindfulness+ group was not well-suited for affecting this type of impulsivity, but that a different brief mindful intervention that was not used would produce different results. Future research assessing a broader range of interventions, including other types of mindful activities or longer lengths of mindful practice may serve a purpose in further investigating how best to mitigate impulsivity in a Go/No-Go task or similar context. It also appears to be worth searching for what other types of interventions that are not mindfulness-based may affect this particular type of impulsivity.

Another potential weakness and limitation of this study is that only one Go/No-Go task was utilized as a measure of impulsivity. It is not known whether a different Go/No-Go task would produce similar findings. Especially considering the high rate of accurate responding across all groups and conditions, a more difficult Go/No-Go task may be more sensitive and produce findings that differ from those produced in this experiment.

A final limitation for consideration is that while the research investigating the relationship between mindfulness and impulsivity assessed through delay discounting relies on self-report of hypothetical responding, this investigation of the relationship between mindfulness and impulsivity observed explicit behavioral responding. This difference of reported versus observed behavior complicates the ability to directly compare results.

This experiment prompts several avenues for future research. One avenue is to further delve into the interplay between stress and impulsivity by studying impulsivity under several different types of stressful contexts. Another direction for future research building off of the present study is to further manipulate the types of mindful activities used as intervention to gain a greater understanding of the relationship between mindfulness and this Go/No-Go conceptualization of impulsivity. Finally, it also appears to be worth studying how interventions besides those involving mindfulness may interact with this Go/No-Go variety of impulsivity.

It appears that a more nuanced view of mindfulness, stress, and impulsivity may need to be adopted. Additionally, these findings emphasize the importance of clearly understanding and defining the behavioral outcome desired. With the amount of nuance that exists within impulsivity, a more specific understanding of the desired outcome may be necessary to choose an intervention that is most contextually appropriate and beneficial.

References

Baumann, A. A., & Odum, A. L. (2012). Impulsivity, risk taking, and timing. *Behavioural Processes*, *90*(3), 408–414. https://doi.org/10.1016/j.beproc.2012.04.005

Banis, S., & Lorist, M. M. (2012). Acute noise stress impairs feedback processing. *Biological Psychology*, *91*(2), 163–171. https://doi.org/10.1016/j.biopsycho.2012.06.009

Bari, A., Robbins, T.W. (2013). Inhibition and impulsivity: Behavioral and neural basis of response control. *Progress in Neurobiology*, *108,* 44–79. https://doi.org/10.1016/j.pneurobio.2013.06.005

Belisle, J., Paliliunas, D., Vangsness, L., Dixon, M. R., & Stanley, C. R. (2020). Social distance and delay exert multiple control over altruistic choices. *The Psychological Record, 70*, 445-457. https://doi.org/10.1007/s40732-020-00399-x

Bezdjian, S., Baker, L. A., Lozano, D. I., & Raine, A. (2009). Assessing inattention and impulsivity in children during the Go/NoGo task. *The British Journal of Developmental Psychology*, *27*(2), 365–383. https://doi.org/10.1348/026151008X314919

Ding, W., Sun, J., Sun, Y., Chen, X., Zhou, Y., Zhuang, Z., Li, L., Zhang, Y., Xu, J., Du, Y. (2014). Trait impulsivity and impaired prefrontal impulse inhibition function in adolescents with internet gaming addiction revealed by a Go/No-Go fMRI study. *Behavioral and Brain Functions, 10*(20). https://doi.org/10.1186/1744-9081-10-20

Dixon, M. R., Paliliunas, D., Belisle, J., Speelman, R. C., Gunnarsson, K. F., & Shaffer, J. L. (2019). The effect of brief mindfulness training on momentary impulsivity. *Journal of Contextual Behavioral Science*, *11*, 15-20. https://doi.org/10.1016/j.jcbs.2018.11.003

Dixon, M. R., Jacobs, E. A., Sanders, S., Guercio, J. M., Soldner, J., Parker-Singler, S., Robinson, A., Small, S., & Dillen, J. E. (2005). Impulsivity, self-control, and delay discounting in persons with acquired brain injury. *Behavioral Interventions, 20*(1), 101-120. https://doi.org/10.1002/bin/173

Evenden, J. L., (1999). Varieties of impulsivity. *Psychopharmacology, 146*(4), 348-361. https://doi.org/10.1007/p100005481

Great Meditation. [Username]. (2020, August 5). *A ten minute guided meditation to clear your mind* [Video]. YouTube. https://www.youtube.com/watch?v=ez3GgRqhNvA

Go/No-go task. (2021, December 2021). PsyToolkit. https://www.psytoolkit.org/experiment-library/go-no-go.html

Jackson, K., & Hackenberg, T. D. (1996). Token reinforcement, choice, and self-control in pigeons. *Journal of the Experimental Analysis of Behavior*, *66*(1), 29–49. https://doi.org/10.1901/jeab.1996.66-29

Maltais, M., Bouchard, G., & Saint-Aubin, J. (2020). Predicting mindfulness facets: An examination of executive control, neuroticism, and impulsivity. *Canadian Journal of Behavioural Science, 52*(1), 1–7. https://doi.org/10.1037/cbs0000152

Mazur, J. E. (1987). An adjusting procedure for studying delayed reinforcement. In M. L. Commons, J. E. Mazur, J. A. Nevin, & H. Rachlin (Eds.), *The effect of delay and of intervening events on reinforcement value* (pp. 55–73). Lawrence Erlbaum Associates, Inc.

Meda, S. A., Stevens, M. C., Potenza, M. N., Pittman, B., Gueorguieva, R., Andrews, M. M., Thomas, A. D., Muska, C., Hylton, J. L., & Pearlson, G. D. (2009). Investigating the behavioral and self-report constructs of impulsivity domains using principal component analysis. *Behavioural Pharmacology*, *20*(5-6), 390–399. https://doi.org/10.1097/FBP.0b013e32833113a3

Odum A. L. (2011). Delay discounting: I'm a k, you're a k. *Journal of the Experimental Analysis of Behavior*, *96*(3), 427–439. https://doi.org/10.1901/jeab.2011.96-423

Šašinka, Č., Lacko, D., Čeněk, J., Popelka, S., Ugwitz, P., Řádová, H., Fabianová, M., Šašinková, A., Brančík, J., & Jankovská, M. (2023). ImGo: A novel tool for behavioral impulsivity assessment based on Go/NoGo tasks. *Psychological Reports*, *126*(1), 434–476. https://doi.org/10.1177/00332941211040431

Stahl, C., Voss, A., Schmitz, F., Nuszbaum, M., Tüscher, O., Lieb, K., & Klauer, K. C. (2014). Behavioral components of impulsivity. *Journal of Experimental Psychology. General*, *143*(2), 850–886. https://doi.org/10.1037/a0033981

Steward, T., Mestre-Bach, G., Vintró-Alcaraz, C., Agüera, Z., Jiménez-Murcia, S., Granero, R., & Fernández-Aranda, F. (2017). Delay discounting of reward and impulsivity in eating disorders: From anorexia nervosa to binge eating disorder. *European Eating Disorders Review: The Journal of the Eating Disorders Association*, *25*(6), 601–606. https://doi.org/10.1002/erv.2543

Tedx Talks. (2020, May 28). *How to start your own business without investors | Nicholas Hänny | TEDxHochschuleLuzern* [Video]. YouTube. https://www.youtube.com/watch?v=owS4NQmzv2w&t=107s

Vollmer, T. R., Borrero, J. C., Lalli, J. S., & Daniel, D. (1999). Evaluating self-control and impulsivity in children with severe behavior disorders. *Journal of Applied Behavior Analysis*, *32*(4), 451–466. https://doi.org/10.1901/jaba.1999.32-451

Weinsztok, S., Brassard, S., Balodis, I., Martin, L. E., & Amlung, M. (2021). Delay discounting in established and proposed behavioral addictions: A systematic review and metaanalysis. *Frontiers in Behavioral Neuroscience*, *15*, 1-13. https://doi.org/10.3389/fnbeh.2021.786358

Yechiam, E., Goodnight, J., Bates, J. E., Busemeyer, J. R., Dodge, K. A., Pettit, G. S., & Newman, J. P. (2006). A formal cognitive model of the go/no-go discrimination task: evaluation and implications. *Psychological Assessment*, *18*(3), 239–249. https://doi.org/10.1037/1040-3590.18.3.239

SUMMARY

Before being able to intentionally and effectively intervene on negative emotional experiencing, it is necessary to better research and understand how emotions operate in an individual's context and how an instrument or intervention accounts for and interacts with emotional experiencing. Gaining access to information about which stimuli in an individual's environment are carrying salient functions related to negative emotions as well as what function those negative emotions may carry in relation to other events may be essential for choosing an appropriate course of action for managing those emotions to manage the environment. The first manuscript submitted in this thesis by Middleton and Belisle (under review) informs further on how negative affective and willingness functions may be contrived experimentally, and their findings also suggest a potential added understanding of how these functions may diffuse across other stimuli when introduced as related and in the absence of the conditions generating or maintaining those functions. This may also provide a translational understanding of how defusion as an ACT process may be contextually useful in a less contrived setting (Assaz et al., 2018). Further, incorporating repeated measurements of an instrument such as the AWS may fill a bit of a gap between understanding how affective functions operate in research and theory and actually being able to easily gauge how they operate in practice and in natural settings.

This functional understanding of emotions matters enormously not only for managing and defusing from negative affective functions, but also for determining what type of intervention will be useful as well as for assessing whether the negative affective functions are serving an adaptive function in relation to other events in the environment, as informed by the second manuscript submitted in this thesis in which I was an author (Belisle et al., under review).

The findings of this experiment brought attention to the idea that some negative affective experiences, such as stress, may actually allow individuals to more successfully navigate their environment. Dependent upon saliency and context of negative emotional experiencing, the goal need not always be to detach from negative experiences. This finding aligns and connects back in closely with underlying teachings of ACT – it is important to approach emotional experiencing from a nuanced perspective, leaving room for acceptance and present moment awareness of emotions. In the particular case of stress, there is even a body of evolutionary behavior research indicating that humans evolved to experience stress for a reason, and that certain levels of stress do, in fact, appear to serve practical functions (Badyaev, 2005). Further research describes eustress as a healthy outcome that can result from stress, in contrast to distress (Hargrove et al., 2016). Studying functional assessment of stress to determine whether eustress or distress will occur as well as how to intervene to potentially convert distressing contexts and emotional experiencing into eustress may be an avenue for future research.

Finally, with regards to responding under stressful conditions, momentary responding that may align with certain dimensions of impulsivity, and responding occurring in the presence of other negative affective contexts such as frustration, further research and careful consideration of intervention selection are urged to gain a greater understanding of how best to manage emotions without suppressing them. In cases of disordered emotional experiencing and maladaptive behaviors, intervention consisting of a more defusion-oriented approach may be appropriate. In other cases of contextually adaptive emotions, even if somewhat negative in valence, interventions geared toward embracing, accepting, and being willing to work through those emotions appear to be desirable. In order to be sensitive to and aware of these nuances, functional assessment of emotions, through both research and practice, appears to be vital.

Incorporation of functional assessment methods such as the ACT matrix (Polk et al., 2016) may be bolstered by use in conjunction with explicit repeated measurements acquired through an instrument such as the AWS to access ongoing information about the affective and willingness functions and to incorporate them into behavior analytic practice.

ADDITIONAL REFERENCES

Assaz, D. A., Roche, B., Kanter, J. W., & Oshiro, C. K. (2018). Cognitive defusion in acceptance and commitment therapy: What are the basic processes of change? *The Psychological Record*, *68*, 405-418. https://doi.org/10.1007/s40732-017-0254-z

Assaz, D. A., Tyndall, I., Oshiro, C. K., & Roche, B. (2023). A process-based analysis of cognitive defusion in acceptance and commitment therapy. *Behavior Therapy*, *54*(6), 1020-1035. https://doi.org/10.1016/j.beth.2022.06.003

Badyaev, A. V. (2005). Role of stress in evolution: from individual adaptability to evolutionary adaptation. In *Variation* (pp. 277-302). Academic Press. https://doi.org/10.1016/B978-012088777-4/50015-6

Barnes-Holmes, D., Barnes-Holmes, Y., Power, P., Hayden, E., Milne, R., & Stewart, I. (2006). Do you really know what you believe? Developing the implicit relational assessment procedure (IRAP) as a direct measure of implicit beliefs. *The Irish Psychologist*, *32*(7), 169-177.

Belisle, J., & Dixon, M. R. (2021). Relational behavior and ACT: A dynamic relationship. *Behavior Analysis in Practice*, *15*(1), 71–82. https://doi.org/10.1007/s40617-021-00599-z

Belisle, J., Paliliunas, D., Catrone, R., Sickman, E., & Ramakrishnan, A. (2024). A comprehensive behavioral model of emotion rooted in relational frame theory and contemporary extensions. *The Psychological Record.* 1-19. https://doi.org/10.1007/s40732-024-00603-2

Belisle, J., Paliliunas, D., Hermann, E., Compton, J., & Middleton, A. (under review). Evaluating the influence of mindfulness on impulsivity under stress.

Dixon, M. R., Paliliunas, D., Belisle, J., Speelman, R. C., Gunnarsson, K. F., & Shaffer, J. L. (2019). The effect of brief mindfulness training on momentary impulsivity. *Journal of Contextual Behavioral Science*, *11*, 15-20. https://doi.org/10.1016/j.jcbs.2018.11.003

Hargrove, M. B., Hargrove, D., & Becker, W. S. (2016). Managing stress: Human resource management interventions for stress and eustress. *Journal of Human Resources Education*, *10*(2), 25-38.

Hayes, S. C., & Hofmann, S. G. (2021). "Third-wave" cognitive and behavioral therapies and the emergence of a process-based approach to intervention in psychiatry. *World Psychiatry: Official Journal of the World Psychiatric Association (WPA)*, *20*(3), 363–375. https://doi.org/10.1002/wps.20884

Middleton, A., & Belisle, J. (under review). Transfer of explicit negative and neutral affective and willingness functions through operant schedules and pairing observation: A preliminary analysis.

Polk, K. L., Schoendorff, B., Webster, M., & Olaz, F. O. (2016). *The essential guide to the ACT matrix: A step-by-step approach to using the ACT matrix model in clinical practice*. New Harbinger Publications.

Robinson, M. D., Klein, R. J., & Irvin, R. L. (2020). Provoked into action: Noise, irritation, and impulsivity as predictors of go/no go commission errors. *Motivation Science*, *6*(4), 456. https://doi.org/10.1037/mot0000181

Sickman, E., Belisle, J., Payne, A., Hutchison, L., & Travis, E. (2023). An exploratory analysis of gender stereotyping using the theoretical framework of relational density theory. *Journal of Contextual Behavioral Science*, *28*, 256-265. https://doi.org/10.1016/j.jcbs.2023.04.007

APPENDIX: HUMAN SUBJECTS IRB APPROVAL

For both manuscripts, final analyses were conducted from de-identified data collected through the Institute for Dynamic Behavior Science and Missouri State University made available by the primary investigator of those studies.

The studies were conducted consistent with the below IRB approval:

Missouri State
UNIVERSITY

To:
Dana Paliliunas
Psychology
Jordan Belisle

Date: Feb 9, 2022 8:32:49 AM CST

RE: Notice of IRB Exemption
Study #: IRB-FY2022-335
Study Title: Measuring the Effects of Meditation on Impulsivity Through Various Noise Contexts

This submission has been reviewed by the Missouri State University Institutional Review Board (IRB) and was determined to be exempt from further review. However, any changes to any aspect of this study must be submitted, as a modification to the study, for IRB review as the changes may change this Exempt determination. Should any adverse event or unanticipated problem involving risks to subjects or others occur it must be reported immediately to the IRB.

This study was reviewed in accordance with federal regulations governing human subjects research, including those found at 45 CFR 46 (Common Rule), 45 CFR 164 (HIPAA), 21 CFR 50 & 56 (FDA), and 40 CFR 26 (EPA), where applicable.

To:
Jordan Belisle
Psychology

Date: Jul 23, 2020 7:52 PM PDT

RE: Notice of IRB Exemption
Study #: IRB-FY2021-30
Study Title: Exploring Verbal Distraction in Behavior Performance Tasks

This submission has been reviewed by the Missouri State University Institutional Review Board (IRB) and was determined to be exempt from further review. However, any changes to any aspect of this study must be submitted, as a modification to the study, for IRB review as the changes may change this Exempt determination. Should any adverse event or unanticipated problem involving risks to subjects or others occur it must be reported immediately to the IRB.

This study was reviewed in accordance with federal regulations governing human subjects research, including those found at 45 CFR 46 (Common Rule), 45 CFR 164 (HIPAA), 21 CFR 50 & 56 (FDA), and 40 CFR 26 (EPA), where applicable.