AN EVALUATION OF THE EFFECTS OF TRAUMA-RELATED STIMULI ON BEHAVIOR DURING PREFERENCE ASSESSMENTS AND FUNCTIONAL ANALYSES WITH PEOPLE WITH INTELLECTUAL DISABILITIES

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People with intellectual disabilities (ID) face a high risk of experiencing adverse events including abuse, neglect, and serious medical issues. Access to effective interventions for people with moderate to severe ID is limited because of communication deficits that are characteristic of this population. Some of the negative effects of exposure to trauma for people with ID can include increases in problem behaviors. Behavior analysts have developed robust assessments and treatments to address these problem behaviors for people with ID; however, when these behaviors arise after a traumatic event, specialized assessments may be necessary to ensure effective treatment and decreased risk of re-traumatization. Specifically, if trauma-related stimuli (TRS) differentially affect preferences and functions of behavior, assessments of the effects of these stimuli may be critical to mitigate those effects. In my first experiment I found that TRS differentially affected behavior (including heartrate) during preferences assessments. In my second experiment I found that TRS differentially affected heartrate and the function of problem behavior for two of three participants. I discuss implications of these findings, including 1) that measuring some of the physiological effects of TRS using commercially available heart rate monitors could improve behavior analytic assessments for people with potential trauma histories; and 2) the presence of TRS can differentially affect the function of problem behavior in such a way that treatment plans developed and evaluated in either the presence or absence of TRS may be ineffective in the alternate setting.

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CHAPTER 1

AN EVALUATION OF THE EFFECTS OF TRAUMA-RELATED STIMULI ON BEHAVIOR DURING PREFERENCE ASSESSMENTS AND FUNCTIONAL ANALYSES

People with intellectual disabilities (ID) comprise 1.5% of the general population. ID impacts adaptive functioning and impairs communication (Boat & Wu, 2015; McKenzie et al., 2016). People with ID have more caregivers across their lifetime than people in the general population (Mpofu et al., 2020), and the greater the severity of ID, the more likely people are to require substantial care from others (Boat & Wu). Further, dependency on others to meet their basic needs increases the likelihood of people with ID experiencing adverse events like abuse and neglect. Estimates of post-traumatic stress disorder (PTSD) in people with ID range from 2.5-60% (Mevissen et al. 2010) with problematic post-trauma behavior changes reported to last up to 20 years in people with ID without treatment (Mitchell and Clegg, 2005). People with ID are vulnerable to high rates of potentially traumatic events; however, little progress has been made to identify effective assessments or treatments of post-trauma behavior changes that contribute to stress-disorders, such as PTSD with these individuals (Daveney et al., 2019; Kildahl et al., 2019; Mevissen et al.).

Adverse Experiences and Trauma

“Adverse experiences” have been described by Felitti et al. (1998) as psychosocial stressors (e.g., abuse, witnessing domestic violence, exposure to substance abuse, incarceration of family members, neglect, and others). Higher incidence of adverse experiences in childhood, has been found to predict poor health outcomes and higher incidence of mental illness (including PTSD) (Felitti et al.; Felitti, 2009). I will use the term “adverse events” in a similar way as Felitti et al. described, to indicate a likely unpleasant or painful event that may or may not result in long lasting behavior changes. Unlike Felitti et al.'s description of adverse experiences, I will not limit adverse events to psychosocial stressors. I make this distinction because many of the studies of non-human behavior that I will discuss report changes in behavior and physiology after an organism is exposed to inescapable electric shock (an adverse event), but not necessarily a "psychosocial stressor".

"Trauma" as it relates to PTSD, is defined stringently by the American Psychiatric Association (APA) as "exposure to actual or threatened death, serious injury or sexual violation" (American Psychiatric Association, 2013, p. 271). Other sources have described "trauma" as dependent upon an individual's perception of an adverse event regardless of the likelihood of the event to produce death or serious injury (Fletcher, 2007). Based on my literature review (Chapter 2), I define trauma as an adverse event followed by changes in behavior, physiology, or both, that continue to detrimentally affect quality of life after the adverse event has ended.

PTSD is a specific disorder that may be diagnosed after a person has been exposed to trauma, as defined by the APA. Limitations of the current diagnostic criteria have been noted for specific populations (children and people with ID) (Fletcher, 2007). One limitation noted is that the threshold for what types of experiences meet criteria as "traumatic" may need to be broadened for some populations. Another limitation is that several of the diagnostic criteria require verbal self-report (e.g., the ability to report that thoughts about the past traumatic event interrupt ongoing activities) (Fletcher). Despite these limitations, the current definition of PTSD has been useful in identifying groups of people who benefit from similar interventions. Because the current definition of PTSD has been useful in the development of effective interventions several areas of this paper will use PTSD as a category to identify relevant literature. Additionally, because PTSD is a category that requires multiple criteria be met, and diagnosis by an appropriately licensed professional, this term does not apply to all behavior changes that occur following exposure to trauma. Therefore, the term “post-trauma behavior change” will be used to describe observable behavior changes that have been reported to occur following exposure to trauma regardless of whether or not these changes meet any of the criteria for diagnosis of PTSD.

Assessment of PTSD for People with ID

Few well-validated assessments of post-trauma behavior change for people with ID currently exist (Kildahl et al., 2020a). Most instruments that are used to assess trauma-related behavior change in typically developing populations specifically exclude potential participants with moderate to profound ID from their development and validation research (e.g. Kerns et al., 2017; Silverman et al., 2001; Ung et al., 2014). Current assessments rely heavily on self-report of symptoms that are often not reportable by people with moderate to profound ID due to their communication deficits. Even clinicians who are very familiar with people with ID as well as people with PTSD report great difficulty in differentiating whether problematic behaviors in persons with ID represent post-trauma behavior change or have a basis in some other process (Kildahl et al.). Valid assessments for trauma that do not rely on verbal self-report would improve access to assessments, and by extension to treatment, for people with ID as well as other populations that may have limited verbal communication repertoires (e.g., children, people with autism spectrum disorders, etc.).

People with ID typically have communication impairments that increase in severity as the severity of ID increases (Boat & Wu, 2015). These communication impairments affect the likelihood of exposure to trauma and access to trauma-focused treatment in at least three ways. First, people with ID are less likely than people in the general population to be able to report abuse or neglect and thereby escape potentially harmful situations. Second, communication impairments make it extremely difficult for people with ID to report stress symptoms, which limits their access to treatment for these symptoms (i.e., caregivers may not be aware that stress symptoms exist). Finally, the available effective treatments for stress disorders rely heavily on vocal-verbal ability because most of these therapies are “talk” therapies (Houck & Dracobly, 2022).

Typical stress-disorder symptoms (e.g., intrusive thoughts, nightmares, etc.) are not generally the type of symptoms that form the basis for a treatment referral for persons with ID. Rather, generalized “problem behaviors” are often the reason that caregivers for people with ID seek psychiatric or behavioral services (Kildahl et al., 2020a). The most commonly reported problem behaviors for people with ID are self-injurious behavior (SIB), aggression and repetitive behaviors (Bowring et. al., 2016). Similarly, problem behaviors that have been reported to increase following exposure to trauma include SIB, aggression, property destruction, social withdrawal, difficulty sleeping and uncooperative behavior (Kildahl et al., 2019; Mevissen et al., 2010). When caregivers of people with ID bring them to healthcare providers to treat these problem behaviors, they rarely report exposure to an adverse event as a precipitating factor (Kildahl et al., 2020a).

Treatments for PTSD

There are several efficacious treatments for PTSD (e.g., Maier & Seligman, 2016; Steckler & Risbrough, 2012; Watkins et al., 2018). Most currently available, efficacious treatments are dependent on advanced verbal repertoires in clients. Although each therapy is based on a slightly different understanding of the mechanisms that produce problematic behavior change following trauma, all incorporate two components that involve complex verbal relations:

1) education is provided about the typical effects of trauma and 2) gradual in-vivo or imaginal re-exposure to non-dangerous or pernicious stimuli that became aversive to the individual based on the stimuli's association with a past traumatic event. I will present brief descriptions of the different theoretical underpinnings of these therapies and their procedural variations in the following sections.

Prolonged Exposure Therapy

Prolonged exposure therapy (PE) is based on the idea that "traumatic events are not processed emotionally at the time of the event" (Watkins et al., 2018, p. 3). PE aims to use talk therapy to help a person "emotionally process" the traumatic event. PE is manualized and involves education about PTSD and repeated exposures (in vivo or imaginal) to the original trauma setting/event. When distress in response to these exposures decreases, the event has been "emotionally processed" (Watkins et al.). I did not find any studies that had attempted to evaluate the efficacy of this treatment for people with ID. Furthermore, it would be difficult to provide for people with ID because it requires a relatively advanced verbal repertoire and self-report of distress levels to determine when the treatment has been effective.

Cognitive Processing Therapy

Cognitive processing therapy (CPT) is based on the idea that traumatic events lead people to adopt false beliefs in an effort to "make sense" of the traumatic event. Therefore, the focus of this talk therapy is to identify and correct false beliefs. CPT begins with education on the effects of trauma on the body and cognitions, followed by repeated exploration of the survivor's beliefs about why the event occurred and their beliefs about themselves and others subsequent to the traumatic event (Watkins et al., 2018). I did not find any studies that evaluated the effectiveness of CPT with persons with ID. CPT requires that a person have a vocal-verbal repertoire that allows them to discuss their beliefs – these relations are beyond the capacity of most people with ID.

Trauma-Focused Cognitive Behavior Therapy

Trauma-focused cognitive behavior therapy (TF-CBT) combines aspects of both PE and CPT. Education on common effects of exposure to trauma is included as well as discussion of false beliefs and in vivo or imaginal exposure focused on identifying triggers (Watkins et al., 2018). For children and people who require intensive caregiver involvement, the components of this therapy include training both the individual who has experienced the trauma and their caregivers on common effects of trauma, basic behavior management strategies, relaxation skills, practice in identifying and modulating emotions and coping skills, working through discussion of the trauma narrative to identify and correct false beliefs, in vivo exposure to trauma reminders, and helping the individual and caregivers identify safety skills and/or a safety plan to prevent similar incidents (Cohen et al., 2010). Some of the aspects of this therapy are adaptable for people with ID. In particular, training caregivers in basic behavior management strategies and the development of relaxation skills are interventions that have been used to effectively treat problem behavior for people with ID. The components of this therapy that are focused specifically on addressing trauma, however (e.g., identifying and modulating emotions, identifying and correcting false beliefs), are inaccessible to most people with moderate to profound ID (See Watkins et al. for a review of evidence-based therapies for PTSD; See Mevissen & DeJongh, 2010 and McNally et al., 2021 for a review of trauma-focused, non-pharmacological, treatments for people with ID).

Although each of the above therapies is based on a particular theoretical account of post-trauma behavior change and the procedures best suited to remediate these response patterns there are two components that are similar across all three of these therapies. All involve gradual exposure to stimuli that were present at the time of the trauma (either in-vivo or imaginal). And all include components that state their goal is to increase opportunities for the client to experience control over their environments to teach the person who has experienced trauma that they are not “helpless” or “powerless”. This focus on remediating feelings or beliefs of powerlessness has been influenced heavily by a non-human model of post-trauma behavior change – Learned Helplessness (LH) (Maier & Seligman, 2016).

Learned Helplessness: A Non-Human Model of Post-Trauma Behavior Change

Non-human models of post-trauma behavior change have been useful in expanding knowledge about the physiological and behavioral mechanisms of these disorders (Deslauriers et al., 2018; Maier & Seligman, 2016). Many effective pharmacological treatments for PTSD have been evaluated initially in non-humans (See Hammack et al., 2012 and Steckler & Risbrough, 2012 for a complete review). LH is a specific pattern of responding following exposure to inescapable aversive stimuli (IAS) that has been studied extensively in non-humans since the 1970s (Maier & Seligman). Initial studies reported that, following exposure to IAS, animals failed to learn a new escape response in a different setting. Escape deficits were initially taken as evidence that, following exposure to IAS, organisms operate based on the assumption that they are no longer able to control their environments. The assumption that the organism that has been exposed to IAS or trauma believes that their behaviors do not function to control their environments has heavily influenced the development of therapies that focus on correcting false beliefs (Maier & Seligman). Despite the influence of LH research on the theories underlying current treatments of PTSD, there has been very little comparison of potential behavioral similarities between non-humans exposed to IAS and people who have experienced traumatic events. Similarly, I did not identify any studies that attempted to directly translate assessment or treatment strategies from non-human models to clinical settings with humans. Translation of findings and procedures that have been well researched in non-humans could be useful in developing approaches to assessment and treatment that do not require verbal responding, allowing for greater access to effective services for post-trauma behavior changes.

History of Learned Helplessness

LH was first described in 1967 (Overmier & Seligman, 1967; Seligman & Maier, 1967). This phenomenon was discovered accidentally by Seligman and Maier, who were evaluating the effects of pre-exposure to shock on the acquisition of responses reinforced by escape from shock. Interestingly, pre-exposure to shock did not lead to faster acquisition of escape responses; rather, they found that dogs exposed to inescapable shock failed to learn an escape response in new settings and instead accepted the shock without attempting to escape (Seligman & Maier; Maier & Seligman, 2016). LH was initially seen as a non-human model of depression, but the research on LH, in combination with social movements of the 1970s, began to fundamentally shift away from an account of depression and toward a new way of conceptualizing the effects of trauma (Herman, 1993). In 1980, PTSD was added to the APA's Diagnostic and Statistical Manual of Mental Disorders 3rd edition (DSM-III) and after that time, LH became the primary non-human model of PTSD. Several explanations of the initial findings of LH have been proposed over the ensuing years.

Learned Inactivity Account

Operant scientists proposed that the animals exposed to IAS had learned through "adventitious" reinforcement – during exposure to IAS, stillness of the animal was often temporally correlated with the termination of shocks; thus, being still was reinforced not based on a contingency between stillness and shock cessation but through mere temporal contiguity. Behavior resulting from such relations are referred to as “superstitious” (Skinner, 1948). This explanation was not supported by empirical work (Maier, 1970; Maier & Seligman, 2016). For example, Maier taught three groups of dogs: one group of dogs was exposed to no shock, one group of dogs was taught to be still for progressively longer periods of time to terminate shock, and one group of dogs was taught that shock was inescapable. All groups were then tested in a new setting in which they could jump a barrier to escape shock. The dogs not exposed to shock learned the new response quickest. The dogs taught to stay still to escape shock learned the new response more slowly than the dogs not exposed to shock but more quickly than the dogs that experienced inescapable shock, half of which never learned the new escape response. These results suggested that conditioning dogs to be still to terminate shock did not interfere with acquisition of a new escape response – thus, some other process must account for the failure of dogs who experienced inescapable shock to acquire a new escape response. This study, along with studies that have shown long-term changes in an array of other behavioral and physiological variables (which will be discussed further in the chapter 2), suggest that “learned inactivity” cannot adequately account for the constellation of changes that occur when an organism is exposed to IAS (Maier & Seligman).

Habituation Account

An alternative account for LH was that responding in the context of repeated aversive stimulation decreased as a function of “habituation,” a phenomenon in which repeated exposure to specific stimuli decreases reflexive behavior elicited by those stimuli (e.g., Thompson and Spencer, 1966). Thus, these general decreases in the effectiveness of particular stimuli may result in general decreases in escape and other responses occasioned by those stimuli. The habituation account for LH appeared to be supported by reports that non-humans displaying LH appeared to "passively accept" shock following exposure to inescapable shock (Chen & Amsel, 1977; Seligman & Beagley, 1975).

Although habituation likely occurs when an organism is exposed repeatedly to IAS, it is unlikely that habituation alone accounts for the failure of organisms to learn an escape response in other settings (McSweeney et al., 1996; McSweeney & Swindell, 2002). First, Glazer & Weiss (1976b) found that non-humans exposed to IAS acquired an escape response faster than controls when the movement required to escape is minimal. Additionally, they found that when a nose poke response was required to escape shock in the second setting, the animals that had been exposed to IAS learned the response more quickly than controls that had not been exposed to IAS. They attributed this, in part, to the general decrease in movement observed in the animals that had been exposed to IAS; for this particular task, less movement resulted in the animals being closer and ready to engage in the escape response as soon as the warning tone started. Second, two studies have shown escape deficits even when the aversive stimulus used in IS exposure is different from the aversive stimulus used in post-IS exposure escape training (Altenor et al., 1977; Leftwich & May,1974). For example, Altenor and colleagues exposed some animals to water submersion and other animals to shocks and found that both groups performed poorly on escape tasks that involved exposure to either water or shock. Likewise, Leftwich and May exposed guinea pigs to IS and found that exposure to restraint (a different stressor) resulted in prolonged immobility time compared with animals that had not been exposed to inescapable shock. Given the close relation between US and UR, habituation to a single aversive stimulus should not result in decreased responsiveness to a different and unrelated aversive stimulus. Third, two studies indicate that while non-humans exposed to IAS may not engage in rapid movements or vocalizations after repeated exposures, they do show avoidance of stimuli associated with exposure to shock (conditioned aversive stimuli; CAS). This suggests that exposure to the shock does not reduce the motivation of the animal to avoid the shock despite the absence of active escape responses (Glazer & Weiss; & Karanth, 1991). Taken together, these studies demonstrate that decreases in responding observed in non-humans that have experienced IAS is not fully accounted for by habituation.

Two-Factor Theory Account

As research on the LH effect continued, it became clear that an account of seemingly contradictory findings was needed. Non-humans who displayed LH failed to learn escape responses to terminate aversive stimuli (See Deslauriers et al., 2018, and Maier & Seligman, 2016 for reviews) but succeeded, or performed better than controls, in avoiding the same aversive stimuli used during IAS exposure (Deslauriers et al.; Maier & Seligman, 2016). Two-factor theory has been proposed as an explanation of these findings. Two-factor theory holds that behavior is determined by both respondent and operant processes (Mowrer, 1956). Several revisions to the original account have been made over the years; however, the two-factor theory of LH has remained fairly consistent. According to two-factor theory, exposure to a primary aversive stimulus (PAS; e.g., shock) can have both operant and respondent functions. It will function as an establishing operation (EO) for escape (an operant relation in which the stimulus establishes its own offset as reinforcement) and a stimulus that elicits physiological and emotional responses (respondent relations in which the stimulus directly elicits the response). Two-factor theorists describe these elicited responses as “fear” and assumes that “fear” is aversive. Two-factor theory accounts for LH in this way (Maia, 2010; Mowrer):

1) The primary aversive stimulus (PAS) increases the value of escape.

2) Escape responses in the presence of the PAS undergo extinction.
3) Elicited responses are conditioned as aversive stimuli (conditioned aversive stimuli (CAS)) due to repeated association with the PAS and become EO's for escape (i.e., the offset of these responses is conditioned as reinforcement).
4) Escape responses in the presence of PAS do not occur because of extinction.
5) Responses in the presence of CAS are maintained by immediate reduction of "fear".
6) "Fear" is maintained as an aversive stimulus through respondent conditioning because of occasional pairings with the PAS.

Two-factor theory seemed to account for early LH research, which primarily demonstrated failures to escape for 24-72 hours after IAS exposure (Glazer & Weiss, 1976). Two-factor theory suggests that organisms should not continue to suffer from ongoing stress symptoms following IAS if the "fear" or other CAS are not (at least occasionally) re-paired with PAS. To account for stress symptoms in humans that have been reported to last much longer than 24-72 hours after a traumatic event, researchers proposed a verbal mediation account. Specifically, researchers suggested that stress symptoms last longer in humans with advanced verbal repertoires because thoughts (covert verbal behavior) about a traumatic event function as aversive stimuli and are responsible for persistent behavioral difficulties (e.g., Bagby et al., 1999; Maier et al., 2001). However, some research outcomes seemed to indicate that a verbal repertoire was not necessary for lasting effects. For example, Maier demonstrated that exposure to CAS can prolong the learning deficits in the presence of the PAS for up to six days after the last re-exposure to the CAS and 22 days after the initial exposure to IAS in rodents. Furthermore, Maier found that these effects persisted indefinitely with re-exposure to the CAS and *without* re-exposure to the PAS. These findings cannot be accounted for by two-factor theory as described above, because “fear” and other CAS should undergo respondent extinction if they are experienced without re-pairing with the PAS.

Summary

People with ID are at an increased risk of experiencing post-trauma behavior changes. There are very few available assessment and treatment options for people with ID who experience traumatic events. LH is a empirically-based, nonhuman model of post-trauma behavior change that has been influential in the development of several efficacious “talk” therapies. Unfortunately, these therapies are not widely available for people with ID because of the verbal skills required to participate in these therapies. Given that LH is a nonverbal phenomenon (it is observed in nonverbal organisms), it seems that the literature on LH could be leveraged to develop a framework for understanding the behavioral processes that account for problematic post-trauma behavior change. Such an understanding might enable the development of assessment and intervention approaches that 1) do not depend on verbal repertoires for effectiveness, 2) permit functional and conceptual analyses of associated processes, and 3) permit the development of interventions based on functional accounts of behavioral challenges that are applicable for populations with and without verbal repertoires.

CHAPTER 2

LITERATURE REVIEW

Maier and Seligman (2016) reflected, in their most recent review of LH studies, that the experiential components are perhaps the most critical aspects of "talk" therapies for treating post-trauma behavior change. This aligns with research on the remediation of LH deficits in non-humans, which necessarily is experiential and does not involve verbal mediation. Some have demonstrated that teaching active escape responses to nonhumans through shaping (Maier & Testa, 1975) and prompting (Rush et al., 1983; Seligman et al., 1968) have been effective in remediating some deficits associated with exposure to IAS. One study demonstrated that extended exposure to an enriched environment (21 days) was effective in reducing LH deficits (Sifonios et al., 2009). Identification of the effective components of talk therapies could greatly improve their efficiency and improve access for populations with limited verbal repertoires. Typical talk therapies have not been adapted for or made available to people who do not have expansive verbal repertoires. It seems possible that behavioral interventions that remediate LH deficits in non-humans could prove beneficial in addressing problematic behavior changes following exposure to trauma in humans. Likewise, developing a more complete understanding of the behavioral processes that result in post-trauma behavior change could improve both assessment and treatment of these changes in humans. To this end, I conducted a literature review to 1) describe observable behavior changes reported in two groups: humans with ID and behavior disorders and non-humans that experienced IAS, 2) present a conceptual framework for describing the behavioral effects of trauma in terms of established principles of behavior, and 3) describe ways that a behavior-analytic understanding of post-trauma behavior change may inform applied research and the development of effective assessment and treatment procedures that can be extended to a broader range of populations, including persons with ID.

Literature Review Method

In 2021, I conducted a literature review of two areas: scholarly literature describing human behavior following exposure to traumatic events for people with ID, and scholarly literature describing behavior changes in non-humans exposed to IAS. The search strategy I used included two steps: 1) identification of possible articles from scholarly journals using database searches, 2) identification of articles on related topics from the references of selected articles (Peters et al., 2015). Subsequently, I reviewed the titles and abstracts of articles I identified, to determine the eligibility of each article based on the inclusion criteria described in Table 1. If I could not determine if the article met inclusion criteria based on the title and abstract, I reviewed the entire article.

I searched EBSCO Academic Search Complete, PsychInfo, ERIC, and Psychology and Behavioral Sciences Collection. The search for human research included studies published from 1980-2020, because PTSD was added to the DSM in 1980. The search terms for human studies included: “Intellectual disabil*”, “post-traumatic stress disorder” OR “PTSD” OR “stress disorder” OR “traum*” OR “abuse” AND “assessment” OR “treatment” OR “behavior”, NOT “substance abuse” or “rat”. The search limits for non-human research included studies published from 1967-2020, because LH was first described by Maier & Seligman in 1967. The search terms for animal models included: “learned helplessness” OR “escape extinction” AND “behavior” OR “behaviour” OR “environment” AND “rat” OR “mouse” OR “mice” OR “cat” OR “dog” OR “primate” OR “animal”.

Table 1

Inclusion and Exclusion Criteria for Studies Reviewed

Study Type	Inclusion Criteria	Exclusion Criteria
Human studies	One or more participants were diagnosed with ID	Level of ID for participants was not indicated, or was reported as borderline
	One or more participants were diagnosed with PTSD or had documented exposure to a traumatic event	
	Authors described changes in observable behavior following exposure to a traumatic event	
Non-human Studies	Study was conducted on mammalian, non-humans	Study indicated that the dependent variable was changes in brain structures
	Authors indicated that animals had been exposed to IAS	Study indicated that the only independent variable was pharmacological or genetic manipulations
	Authors described at least one behavior change following exposure to IAS	

Human Studies

The initial search yielded 1167 articles, with duplicates removed. Screening of title, keywords, and abstracts yielded 147 studies for possible inclusion. Review of the full articles yielded 32 articles for inclusion. Additionally, I identified 14 relevant reviews and a review of the references of these reviews yielded an additional nine articles for inclusion, bringing the total number of articles to 36.

Non-Human Studies

The initial search yielded 565 studies, with duplicates removed. Screening of titles, keywords, and abstracts yielded 176 studies for possible inclusion. Review of the full articles yielded 121 articles for inclusion.

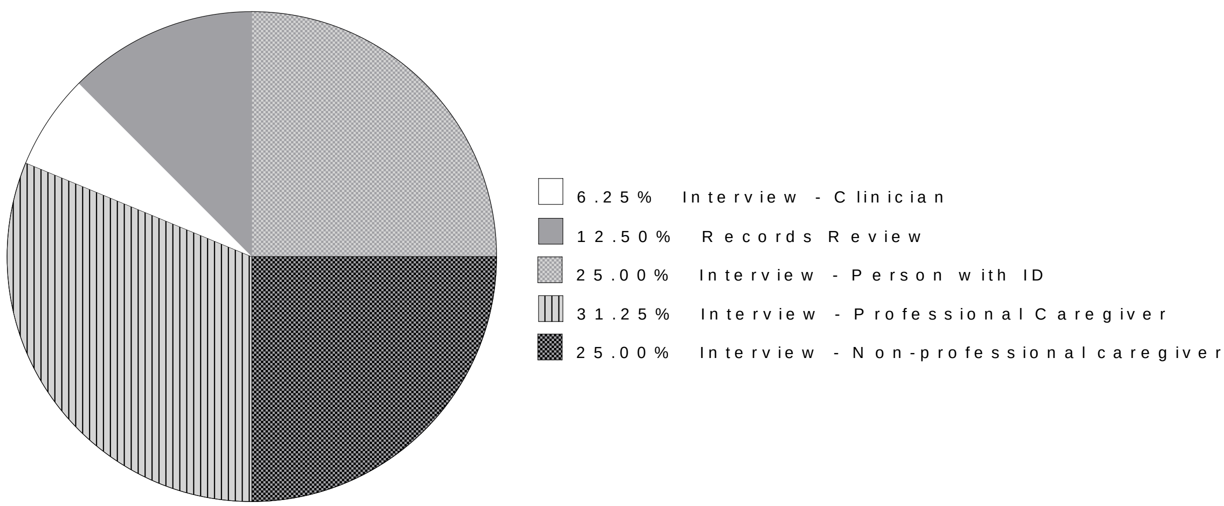
Literature Review Results

I identified 36 studies on the assessment or treatment of PTSD in people with ID written since 1980. I identified an important demographic pattern in these studies. Notably, only nine of these studies were experimental and only five experimental articles included participants with moderate to profound ID. I identified no quantitative studies that evaluated the effects of an evidence-based treatment for PTSD in any person with moderate to profound levels of ID. Finally, of 21 case studies that reported treatment of PTSD, only five case studies reported an attempt to provide an evidence-based treatment for a person with moderate to profound ID.

I also identified several important measurement patterns regarding assessment of post-trauma behavior change. Figure 1 depicts the primary source of information on behavior change in each of the qualitative and quantitative studies. Case studies were not included, because the source of information for most case studies was unclear and information was generally gathered from multiple sources (parents, caregivers, school staff, direct observation of the client, etc.). The clinical professional who had implemented the assessment or treatment was generally the author of the study and also provided their impressions based on their professional experiences. None of these studies used direct behavior measures; that is, researchers did not observe, count, or quantify any of the behaviors reported to change following exposure to traumatic events or treatment of trauma symptoms. In 6.25% of studies, clinicians or professional-level staff provided the information on behavior changes. In 12.50% of studies, record reviews were the primary source of information. In studies designated as “records review”, the experimenters had no direct contact with the participants. In these studies, the experimenters reviewed notes from professional evaluations and reported on the presence or absence of symptoms based on the notes from other professionals. In 25.00% of studies, information on behavior change was provided by the person with ID. In 31.25% of studies, interviews with professional caregivers served as the primary source of information. Finally, in 25.00% of studies, a non-professional caregiver (e.g., a family member) provided information. Whereas the gold-standard assessment for PTSD in the general population is a clinician administered structured interview with the patient (Weathers et al., 2018), for people with ID, their own self-report or behaviors are rarely directly contacted by the clinician conducting the assessment. These results highlight the dependency, of people with ID, on others to report on behavior changes , in order for people with ID to have their post-trauma behavior changes recognized and for access to treatment to be an option.

Figure 1

Sources of information on behavior change in people with ID following exposure to adverse events



Cross-Species Behavior Changes Reported Following Exposure to Trauma

Overall, I identified 13 areas of behavior change described in at least two of the four different types of studies. These 13 areas are listed in Table 2 and described in the following sections. I grouped these changes first according to human and non-human studies, then subdivided the human studies based on whether the study was a quantitative study, a qualitative study, or a case study. All quantitative studies compared scores on a specified measurement tool across groups of participants. Qualitative studies did not provide quantitative comparisons across groups but rather reported themes and similarities and differences across participants without quantitative measurement of behavior. Finally, case studies described an individual's behaviors and the source of information for these studies was frequently not specified. Across non-human and human studies, the behaviors that were reported to change were further grouped into the following sections: 1) increases in behavior, 2) decreases in behavior, and 3) other changes in behavior. Researchers reported increases in avoidance, hypervigilance, SIB, repetitive behavior, and inappropriate sexual behavior (human studies only). Researchers also reported decreases in social engagement, self-care, and interest in previously preferred stimuli. With respect to general change in behavior, researchers reported changes in aggression, sleep patterns, eating habits, and pain sensitivity. Finally, with respect to patterns reported with non-humans but not with humans, researchers reported changes in rate of learning (i.e., increased or decreased effect of operant contingencies) and increased latency to make choices on discrimination tasks.

Avoidance. Avoidance of stimuli related to a traumatic event might be expected following exposure to trauma. Avoidance was reported in many studies with people with ID and in non-humans exposed to IAS. Interestingly, researchers only occasionally reported avoidance of specific stimuli clearly linked to the traumatic event. General increases in avoidance of situations or stimuli was significant in two quantitative studies (Roswell et al., 2013; Shabalala & Jasson, 2011), three qualitative studies (Kildahl et al., 2020a; Kildahl et al., 2020b; Mitchell & Clegg, 2005), and in 23 out of 41 case studies (Alleyne et al., 2020; Bakken et al., 2014a; Bakken et al., 2014b; Barol & Seubert, 2010; Barrowcliff & Evans, 2015; Borghus et al., 2018; Boronat et al., 2013; Carrigan & Allez, 2017; Dilly, 2014; Kroese & Thomas, 2006; Lemmon &

Mizes, 2002; Martinet & Legry, 2014; Mevissen et al., 2011b; Mevissen et al., 2012; Turk et al., 2005; Unwin et al., 2019). However, in only six of those cases, the stimuli the participant was reported to avoid could clearly be linked to the traumatic event (Barol & Seubert; Carrigan & Allez; Lemmon & Mizes; Martinet & Legry; Turk et al.,). More frequently, avoidance was difficult to link to the traumatic event. Avoidance was reported to increase following exposure to IAS in non-humans in 11 studies. Similar, to the human studies, some studies reported avoidance that was clearly linked to the IAS exposure. These included, "defensive burying," – burying an item that previously produced painful stimulation (Overmier et al., 1994; Williams, 1982) and improved performance on tasks in which the consequence was avoidance of painful stimulation (Glazer & Weiss, 1976; Kumar & Karanth, 1991). Other studies reported avoidance of stimuli that did not appear to be related directly to the trauma in a clear way. Examples included avoidance of liquid (to drink) in novel environments (Minor, 1990), increased avoidance of bitter tastes (King et al., 2001; Minor et al., 1994: Prabhakar & Job, 1996), avoidance of new foods (Minor & Saade, 1997) decreased exploration of a new environment (Lucas et al., 2014; Tsoory & Richter-Levin, 2006), and longer latencies to leave a "safe" closed arm in a maze (Belda et al., 2004). In some of these studies the authors described the behavior as "avoidance," but the behavior described could have also been accounted for by "decreased activity engagement." The studies that reported less drinking of different liquids could have also been described as less engagement in drinking, rather than as avoidance of drinking. Given the apparent relationship between increased avoidance responses and trauma across a range of cases, avoidance responses, either a sudden increase in, or a substantial rate change (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

Table 2

Behavior changes reported following inescapable aversive stimulus exposure

	Non-human Studies	Human Studies			
	Quantitative (121)	Quantitative (9)	Qualitative Studies (6)	Case Studies (41)	Overall (56)
Increases					
Avoidance	100% (11/11)	100% (2/2)	50.00% (3/6)	56.10% (23/41)	50.00% (28/56)
Hypervigilance	100% (11/11)	50.00% (1/2)	50.00% (3/6)	39.02% (16/41)	35.71% (20/56)
SIB	100% (1/1)	100% (3/3)	50.00% (3/6)	24.39% (10/41)	28.57% (16/56)
Repetitive behaviors	100% (3/3)	66.67% (2/3)	33.33% (2/6)	24.39% (10/41)	25.00% (14/56)
Inappropriate sexual behavior	N/A	100% (2/2)	66.67% (4/6)	4.88% (2/41)	14.29% (8/56)
Problem behavior	N/A	100% (7/7)	50.00% (3/6)	48.78% (20/41)	53.57% (30/56)
Decreases					
Social engagement	100% (8/8)	50.00% (1/2)	16.67 (1/6)	31.71% (13/41)	26.79% (15/56)
Self-care	100% (7/7)	100% (3/3)	33.33% (2/6)	36.59% (15/41)	35.71% (20/56)
Interest in previous preferences	100% (6/6)	100% (5/5)	66.67% (4/6)	21.95% (9/41)	32.14% (18/56)
Changes					
Aggression	100% (4/4)	100% (3/3)	33.33% (2/6)	51.22% (21/41)	46.43% (26/56)
Sleep Patterns	100% (2/2)	50.00% (1/2)	50.00% (3/6)	48.78% (20/41)	42.86% (24/56)
Eating Patterns	100% (17/17)	100% (1/1)	0% (0/6)	14.63% (6/41)	12.5% (7/56)
Pain sensitivity	100% (7/7)	N/A	0% (0/6)	2.44% (1/41)	1.79% (1/56)

Hypervigilance. Hypervigilance (e.g., startle responses) were also behaviors that were reported to increase in humans and non-humans following exposure to trauma. Although it might seem that these behaviors should increase in situations like those in which the trauma was experienced, the prevalence of reports on these behaviors suggest that they may occur across many settings following exposure to trauma. Hypervigilance and physiological responsiveness were reported to increase following exposure to trauma in six human studies. Hypervigilance and physiological responses included frequent startling (Barol & Seubert, 2010), hypervigilance (Barol & Seubert), vomiting (Boronat et al., 2013), shaking (Martinet & Legry, 2014; Mevissen et al., 2011a), panic attacks (Mevissen et al., 2011b), sweating (Unwin et al., 2019) and incontinence or bedwetting (Turk et al., 2005; Unwin et al., 2019). Hypervigilance and heightened physiological responsiveness were reported to increase following exposure to IAS in 11 non-human studies. Specific physiological or hypervigilance responses included increased durations of "freezing" or periods of immobility (Belda et al., 2004; Conoscenti et al., 2017; Greenwood, 2003; Leftwich & May, 1974; Maier, 1990; Plumb et al., 2015), weight loss (Hu et al., 2010; Wisłowska-Stanek et al., 2016) despite similar food and water intake (Hanum et al., 1976), increased defecation (Gonzalez-Torres & Santos, 2019; Hu et al., 2010), and ulcers (Lanum et al., 1984; Seligman, 1968). Given the apparent relationship between increased hypervigilance responses and trauma across a range of cases, hypervigilance responses, either a sudden increase in, or a substantial rate change (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

Self-injury. Self-injurious behavior (SIB) was reported to increase across species following exposure to trauma. Increases in SIB following trauma were reported in people with ID in three quantitative studies (Howlin & Clements, 1995; Peckham et al., 2007; Roswell et al., 2013), three qualitative studies (Kildahl et al., 2020a; Murphy et al., 2007; Truesdale et al., 2019), and 10 case studies (Bakken et al., 2014a; Bakken et al., 2014b; Barol & Seubert, 2010; Barrowcliff & Evans, 2015; Dilly, 2014; Hauptman et al., 2018; Martinet & Legry, 2014; Turk et al., 2005; Unwin et al., 2019) . SIB was often the primary reason a person was referred for behavioral or psychological treatment (Bakken et al; Barol & Seubert; Barrowcliff & Evans; Dilly; Hauptman; Howlin & Clements; Martinet & Legry; Peckham et al., 2007; Roswell et al.; Turk et al., 2005; Unwin et al., 2019). SIB has also been associated with trauma in non-ID populations (Dyer et al., 2009). SIB was reported following exposure to IAS in one non-human study. Gluck et al. (1985) demonstrated that SIB can be elicited in rhesus monkeys when they are exposed to inescapable shock. Additionally, they found that a tone paired with the shock continued to occasion SIB even after repeated exposure to the tone without the shock. Given the apparent relationship between SIB and trauma across a range of cases, the presence of SIB, either a sudden increase in, or a substantial rate change (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

Repetitive Behaviors. Repetitive behaviors have been reported to increase across species after exposure to trauma. Repetitive behaviors were reported to increase in people with ID following exposure to trauma in two quantitative studies (Peckham et al., 2007; Roswell et al., 2013), two qualitative studies (Kildahl et al., 2020a; Murphy et al., 2007), and ten case studies (Bakken et al., 2014a; Bakken et al., 2014b; Barrowcliff & Evans, 2015; Barol & Seubert, 2010; Kroese & Thomas, 2006; Mevissen et al., 2011b; Mevissen et al., 2012; Mevissen et al., 2011a; Turk et al., 2005). Repetitive behaviors included increases in stereotypy (Barrowcliff & Evans, 2015; Murphy et al., 2007), repetitive re-enactment of the traumatic event (Kildahl et al., 2020a), repetitive talk about similar incidents occurring in the future (Bakken et al., 2014a; Bakken et al., 2014b), and repetitive talk about topics related to the trauma (Mevissen et al., 2012; Turk et al., 2005). In three non-human studies, researchers reported increases in repetitive behaviors following exposure to IAS. Two studies reported that rats exposed to restraint demonstrated repetitive grooming episodes (Hu et al., 2010; Lanum et al., 1984). Caspy & Lubow (1981) found that rats exposed to IAS demonstrated increased repetitive motion, specifically, retracing previously taken steps or paths. Given the apparent relationship between increases in repetitive behaviors and trauma across a range of cases, either a sudden increase in, or a substantial rate change, repetitive behaviors, either a sudden increase in, or a substantial rate change (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

*Inappropriate Sexual Behaviors***.** In eight human studies, researchers reported increases in inappropriate sexual behaviors (ISB) following exposure to trauma (Beail & Warden, 1995; Barol & Seubert, 2010; Borghus et al., 2018; Dunne & Power, 1990; Kildahl et al., 2020a; Kildahl et al., 2020b; Murphy et al., 2007; Peckham et al., 2007). In all studies that reported an increase in ISB, the reported trauma was sexual abuse. Researchers have not reported ISB in any non-human studies; however, a change in sexual behavior was reported in one study in rats (Malkesman et al., 2010). Malkesman found that male rats spent significantly less time sniffing female rat urine after exposure to IAS. Because ISB appears to be related specifically to sexual trauma, it is possible that the mechanism(s) underlying increases in ISB following sexual abuse is functionally distinct from some other, more generalized effects of trauma. The presence of ISB could indicate that assessment for potential sexual abuse, specifically, may be appropriate.

Problem Behavior. “Problem” or “challenging” were reported to increase in people with ID following exposure to trauma. SIB and aggression were not included in this category. This category included studies in which the authors did not describe the specific topography of “problem” or “challenging behavior” as well as studies in which problem behaviors other than aggression and SIB were described (e.g., property destruction, verbally disruptive behavior, bullying, smearing feces etc.). Problem behavior was reported to increase in seven quantitative studies (Beail & Warden, 1995; Howlin & Clements, 1995; Karatzias et al., 2019; Peckham et al., 2007; Rittmansberger et al., 2020; Roswell et al., 2013; Shabalala & Jasson, 2011), three qualitative studies (Dunne & Power, 1990; Kildahl et al. 2020a; Kildahl et al., 2020b) and 20 case studies (Bakken et al., 2014a; Bakken et al., 2014b; Barol & Seubert, 2010; Borghus et al., 2018; Boronat et al., 2013; Goldberg, 1986; Hepper, 1999; Lemmon & Mizes, 2002; Martinet & Legry, 2014; Mevissen et al., 2011b; Mevissen et al., 2012; Turk et al., 2005; Unwin et al., 2019). There were no non-human studies that reported on "problem behavior". This is likely because "problem" behavior is typically defined as a behavior that is not socially acceptable. Behaviors of nonhumans are rarely evaluated in terms of "social acceptability". However, increases in behaviors in nonhumans such as SIB and aggression have been reported following IAS and these are behaviors that are typically categorized as "problem" behaviors. Given the apparent relationship between increased problem behavior and trauma across a range of cases, increased problem behavior, either a sudden increase in, or a substantial rate change (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

Decline in Social Engagement. Social engagement has been reported to decrease in humans and nonhumans following exposure to trauma. Decreases in social engagement were reported for people with ID following exposure to trauma in two quantitative studies (Howlin & Clements, 1995; Rittmansberger et al., 2019), one qualitative study (Kildahl et al., 2020a) and 13 case studies (Alleyne et al., 2020; Barol & Seubert, 2010; Bakken et al., 2014a; Bakken et al., 2014b; Borghus et al., 2018; Boronat et al., 2013; Hepper, 1999; Lemmon & Mizes, 2002; Martinet & Legry, 2014; Mevissen et al., 2012; Turk et al., 2005; Unwin et al., 2019). This included avoidance of social situations (e.g., school, work or leisure activities that involved interactions with other people) and refusing to leave home or bedroom (Mevissen et al., 2012). One quantitative study did not find a significant change in reported social withdrawal (Shabalala & Jasson, 2011). In eight non-human studies, researchers reported increases in social withdrawal following exposure to IAS. Williams (1984) and Boccia et al. (2007) found mother rats exposed to IAS spent significantly less time touching pups. Several studies demonstrated that rats exposed to IAS engaged in significantly less social exploration (Amat et al., 2010; Christianson et al., 2008; Christianson et al., 2010). Additionally, Christianson (2011) found that pre-exposure to a safety signal (a stimulus that was differentially correlated with the absence of shock) mitigated decreases in social exploration following exposure to IAS. Similarly, Greenwood et al. (2012) found that access to exercise during and after exposure to IAS mitigated social exploration decreases. Finally, Kubala et al. (2012) found that exposure to escapable shock in adolescence lessened the effects of IAS on social exploration following exposure to IAS in adulthood. Given the apparent relationship between decreased social engagement and trauma across a range of cases, decreases in social engagement, either a sudden decrease in, or a substantial rate change (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

Decline in Self-Care. Following exposure to trauma, self-care behaviors were reported to decrease for people with ID. Declines in self-care behavior (i.e., not due to a skill loss or deficit), were reported across three quantitative studies (Howlin & Clements, 1995; Peckham et al., 2007; Roswell et al., 2013), two qualitative studies (Kildahl et al., 2020a; Murphy et al., 2007) and 15 case studies (Bakken et al., 2014a; Bakken et al., 2014b; Borghus et al., 2018; Dilly, 2014; Goldberg, 1986; Hauptman et al., 2018; Hepper, 1995; Mevissen et al., 2011a; Mevissen et al., 2012; Turk et al., 2005; Unwin et al., 2019). Declines in self-care included toileting regressions

(Turk et al.; Unwin et al.), decreased participation in washing self, brushing teeth, and changing clothes (Bakken et al., 2014a; Goldberg, 1986; Hauptman et al., 2018; Mevissen et al., 2012; Mevissen et al., 2011a; Turk et al., 2005; Unwin et al.). Self-care, other than voluntary engagement in behaviors such as food intake, water consumption, generalized activity, and sheltering responses, are difficult to measure in non-humans. One study reported decreased food intake when food was freely available following exposure to IAS (Gonzalez-Torres & Santos, 2019). Additionally, seven studies reported general decreases in activity following exposure to IAS (Anisman et al., 1978; Kim et al., 2017; Landagraf et al., 2015; Lanum et al., 1984; Lawry et al., 1978; Rosellini & DeCola, 1981; Rosellini et al., 1982). Given the apparent relationship between decreased engagement in self-care and trauma across a range of cases, decreases in self-care, either a sudden decrease in, or a substantial rate change (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

Decreased interest in previous preferences. Decreased interest in previous preferences has been reported in people with ID following exposure to trauma. In some cases, decreased interest in previously preferred stimuli or activities overlapped with decreases in self-care and increases in avoidance. Decreased interest in previously preferred stimuli following exposure to trauma was reported in five quantitative studies (Howlin & Clements, 1995; Peckham et al., 2007; Rittmannsburger et al., 2019; Roswell et al., 2013; Shabalala & Jasson, 2011), four qualitative studies (Kildahl et al., 2020a; Kildahl et al., 2020b; Murphy et al., 2007; Mitchell & Clegg, 2005) and nine case studies (Barol & Seubert, 2010; Borghus et al., 2018; Fernando & Mendlicott, 2009; Martinet & Legry, 2014; Mevissen et al., 2012; Mevissen et al., 2011b; Turk et al., 2005). In four non-human studies, researchers reported decreased interest, measured as decreases in smelling female rat urine for male rats (Malkesman et al., 2010) and decreased interest in sweet foods (Christianson et al., 2008; Landagraf et al., 2015; Wisłowska-Stanek et al., 2016). Given the apparent relationship between decreased interest in previous preferences and trauma across a range of cases, decreases interest in previous preferences (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

Aggression. Four topographies of behavior (aggression, sleeping, eating and pain sensitivity) were reported to change following exposure to trauma but the direction of the change (increase or decrease) or the type of change (emergence of new topographies) was inconsistent across studies or depended heavily upon the context. Aggression was reported to increase in humans across three quantitative studies (Howlin & Clements, 1995; Peckham et al., 2007; Rittmansberger et al., 2019), two qualitative studies (Kildahl et al., 2020a; Truesdale et al., 2019), and 21 case studies (Bakken et al., 2014a; Bakken et al., 2014b; Barol & Seubert, 2010; Borghus et al. 2018; Boronat et al., 2013; Martinet & Legry, 2014; Turk et al., 2005). In all of these studies, aggression was reported to increase. One study reported that new forms of aggression, that the person had not previously engaged in, emerged following trauma (Martinet & Legry) and one study reported aggression specifically related to attempting to avoid stimuli associated with the trauma - a child who aggressively resisted getting into a car after a car accident (Turk et al.). Finally, one study reported on increases in the participant kicking others whenever she appeared to be emotional (happy, excited, sad, or angry) (Barol & Seubert). In five non-human studies, researchers reported changes in aggression following exposure to IAS (Chen & Amsel, 1977; Corum & Thurmond, 1977; Williams, 1982; Williams & Lierle, 1986; Wood et al., 2008). Chen and Amsel reported, anecdotally, that the shocked rats in their LH experiments became less aggressive and easier to handle as shock sessions continued. Initially, they considered this a form of habituation. Subsequent studies found mixed results regarding changes in aggressive behavior. Two studies found that when rats exposed to IAS were subsequently exposed to novel intruder males, rats in both the IAS and escapable shock groups were less likely to attack intruders than rats never exposed to shock (Corum & Thurmond; Williams). Williams & Lierle (1986) evaluated “social defeat” in rats and found that those exposed to IAS were more likely to sustain injuries and more likely to be “defeated” than rats exposed to escapable shock. Wood et al. (2008) was the only study that evaluated aggressive behavior of rats toward known rats from the same colony. They found that rats exposed to IAS in a familiar environment increased aggression toward familiar rats. These findings are interesting in that aggression is reported to increase in humans following exposure to trauma but more frequently reported to decrease in non-humans exposed to IAS. This discrepancy could reflect species-specific effects of trauma on aggression; alternatively, decreases in aggression may not frequently be reported in human literature because they may not be noticed or may be overlooked as a positive change that requires no further attention. Given the apparent relationship between changes in aggression and trauma across a range of cases, changes in aggression (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

Sleep Patterns. Sleep patterns have been reported to change following exposure to trauma. Changes in sleep habits were reported in two quantitative studies (Howlin & Clements, 1995; Roswell et al., 2013), three qualitative studies (Dunne & Power, 1990; Kildahl et al., 2020a; Mitchell & Clegg, 2005) and 20 case studies (Barol & Seubert, 2010; Barrowcliff & Evans, 2015; Borghus et al., 2018; Boronat et al., 2013; Carrigan & Allez; 2017; Dilly, 2014; Fernando & Mendlicott, 2009; Kroese & Thomas, 2006; Martinet & Legry, 2014; Mevissen et al., 2011a; Mevissen et al., 2011b; Mevissen et al., 2012; Rodenburg et al, 2009; Turk et al., 2005; Unwin et al., 2019). Changes in sleep included reports of increased nightmares (Dilly; Barol & Seubert; Kroese & Thomas), increased difficulty falling asleep and staying asleep (Barrowcliff & Evans; Fernando & Mendlicott), and general increased difficulty sleeping (Borghus; Boronat; Carrigan & Allez; Dunne & Power; Kildahl et al., 2020a; Kroese & Thomas; Martinet & Legry; Mevissen et al., 2011a; Mevissen et al. 2011b; Mevissen et al., 2012; Mitchell & Clegg; Rodenburg et al.; Turk et al.) In two non-human studies, researchers reported changes in sleep patterns following exposure to IAS. Both studies found that during the first 4 hr following exposure to IAS and during subsequent re-exposure to shock, Rapid Eye Movement (REM) sleep or paradoxical sleep (PS) increased in animals that demonstrated failures to escape (Adrien et al. 1991, Fogel et al., 2011). Adrien et al. also found that following initial effects, sleep was not significantly different from controls. However, following brief re-exposure to shock, the greater the latency to escape shock, the shorter the latency to PS and the longer the duration of PS. Given the apparent relationship between changes in sleep patterns and trauma across a range of cases, changes in sleep patterns (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

Eating Patterns. Eating patterns were reported to change following trauma in people with ID in one quantitative study (Howlin & Clements, 1995) and six case studies (Barol & Seubert 2010; Hepper, 1999; Martinet & Legry, 2014; ; Mevissen et al., 2011a; Mevissen et al., 2012; Turk et al., 2005). Specific changes noted in case studies included overeating (Barol & Seubert, 2010; Mevissen et al., 2011a) and refusing food (Hepper; Martinet & Legry; Mevissen et al., 2012; Turk et al.). In 10 non-human studies, researchers reported changes in eating habits following exposure to IAS. Non-humans exposed to IAS demonstrated decreased acceptance of new foods (Minor & Saade, 1997), decreased overall food intake (Gonzalez-Torres & Santos, 2019), decreased drinking of liquid in novel environments (Minor, 1990), increased avoidance of bitter tastes (King et al., 2001; Minor et al., 1994: Prabhakar & Job, 1996), avoidance of new foods (Minor & Saade), and decreased interest in sweet foods (Christianson et al., 2008; Landagraf et al., 2015; Wisłowska-Stanek et al., 2016). Given the apparent relationship between eating patterns and trauma across a range of cases, changes in eating patterns (in combination with other behavior changes) may signal that an evaluation of the potential influence of trauma is relevant.

*Apparent Changes in Reflexive Behaviors***.** Other changes that were reliably reported in non-humans following exposure to IAS were decreases in behavioral indicators that a stimulus is aversive. These changes included decreased vocalizations in response to aversive stimuli and increased "passivity" (i.e., cessation of movement and absence of increased movements in response to acute aversive stimulation; Chen & Amsel, 1977; Seligman & Beagley, 1975). Additionally, several studies have shown that non-humans that demonstrate LH also demonstrate longer latencies to respond to pain (i.e., analgesia; Bersh et al., 1986; Costa et al., 2005; Drugan et al., 1989; Mah et al., 1980, Moye et al., 1981, Maier et al., 1983; Maier & Warren, 1988). Despite reports of lowered responsiveness to instances of aversive stimulation, researchers report consistent increases in measures of "fear" in non-humans, particularly when placed in the environment in which IAS was experienced or in novel environments (Hammack et al., 2012; Deslauriers et al., 2018). A common measure of "fear" in non-humans is "freezing" – time spent immobile (Leftwich & May, 1974). This response is often measured in two ways, immobility time overall and sudden cessation of movement in response to a sound or other stimuli. Although these are not behaviors that are typically measured in humans, two case studies reported long periods of staring off (Bakken et al., 2014a; Bakken et al., 2014b), increased tiredness, passivity, and slow movement (Mevissen et al., 2012). These case studies suggest that this is a behavior that might change in humans following traumatic exposure and this would be a behavior that is amenable to direct measurement and could prove useful in measuring “fear” in humans as well. Direct, objective measures of pain sensitivity, freezing and scanning have not been previously documented in humans with ID who have experienced trauma. These behaviors might be amenable to direct measurement and could prove useful in the development of assessments for post-traumatic behavior change.

Changes in Choice Behaviors. LH studies have shown that non-humans exposed to IAS demonstrate longer latencies to make choices in mazes (Jackson et al., 1980), decreased accuracy on choice discrimination tasks to access escape (Jackson et al.), and decreased accuracy on choice discrimination tasks to access food (Rosellini et al., 1982). In humans, Borghus et al. (2018) reported that their participant demonstrated a general “difficulty in identifying preferences.” Although disruptions in choice-making has not been reported frequently in the literature on human responses to trauma, it would be amenable to measurement in controlled settings without exposing the participant to aversive stimulation as would be needed to adopt classical LH tests. In my review, I did not identify any studies that measured choice latency with people with ID who have experienced trauma. This is a measure that could prove useful in identifying stimuli that are associated with past traumatic events (as discussed in Chapter 3).

Adaptive Changes Following Exposure to IAS

Despite the many problematic behavior changes that occur when an organism is exposed to IAS, there is evidence that some adaptive changes may occur. For example, researchers have observed that organisms experience a “default” biphasic neural response (i.e., increased activity followed by cessation of movement) following exposure to IAS (Maier & Seligman, 2016).

However, if any response during the period of increased activity contacts external reinforcement (e.g., a reduction in intensity or termination of an aversive stimulus), the second part of the biphasic response does not occur (Maier & Seligman). Indeed, it appears that any responses that produce a salient environmental change during exposure to IAS tend to prevent the development of LH. This includes control of the intensity of the shock (Alloy & Bersh, 1979) or access to another animal to aggress towards during IAS (Zhukov & Vinogradova, 1998). If responses do not produce a detectable environmental change (e.g., extinction), the second part of the bi-phasic response occurs. Following the second part of the bi-phasic response, the animal experiences some immediate “benefits”. These benefits include an opioid analgesia (i.e., a temporary decrease in sensitivity to acute pain), which enables certain types of animals to “play dead” - a critical skill to survival in certain situations (Francq, 1969).A second short-term benefit that has been reported is improved sleep quality within the first few hours after re-exposure to aversive stimuli (Adrien et al. 1991). Although the bi-phasic response appears to be elicited, there are findings that suggest the second part of the biphasic response could function as reinforcement. Researchers have observed that opioid analgesia occurs more quickly following brief re-exposures to aversive stimulation (e.g., Drugan et al., 1989; Maier et al., 1980), suggesting a possible operant learning process. The release of endogenous opioids not only reduce pain sensitivity but also produce euphoric effects (Ballantyne & Sullivan, 2017; Froehlich, 1997), which is likely to also function as a potent source of positive reinforcement. Despite the apparent temporary improvements in the organism’s ability to “tolerate” aversive stimuli, the long-term effects of the second part of the biphasic response may contribute to the persistent deficits and health issues associated with LH.

If the second part of the biphasic response can function as a reinforcer, any response that occurs just before will likely increase in frequency, based on either contingent or adventitious relations. This reinforcer may be particularly potent when the organism is exposed to stimuli that increase the value of escape (i.e., aversive stimuli); however, if the response that precedes the second part of the biphasic phase is reflexive in nature (i.e., is elicited by the aversive stimulus), the relations between the aversive stimulus, the response, and the potential reinforcing consequence becomes very complex. As an analogy, sneezing is typically viewed as involuntary, reflexive behavior, elicited by the presence of some sort of irritant in the nasal cavity. Typically, it is difficult for humans to sneeze voluntarily. However, if sneezing produced a powerfully reinforcing consequence, it is possible that a chain of behavior could be established in which voluntary exposure to the eliciting stimulus produces the reflexive response (a sneeze), resulting in reinforcement of both the reflexive response and voluntary exposure to the elicitor. For example, consider a situation in which an individual receives one million dollars each time she sneezes. Although it might be difficult or impossible to produce a “free-operant sneeze”, she could voluntarily contact an irritant (e.g., pepper, substances to which she is allergic), thus increasing the likelihood of sneezing and receiving millions of dollars. In a similar way, if an organism has experienced the analgesic effect of continuous exposure to IAS, the organism could engage in actions like SIB to produce that effect. Interestingly, pharmacological interventions (e.g., naltrexone) that have been shown to block analgesia in LH non-humans and reduce deficits in learning a new escape response (Bluestein et al., 1992; McCubbin et al., 1984; Teixeira et al., 1997) have been shown to decrease SIB with some humans (e.g. Crews et al., 1993; Sandman et al., 1990).

Most studies on LH have found that teaching a response that allows the animal to control aspects of IAS prevents the development of LH deficits in non-humans (Deslauriers et al., 2018; Maier & Seligman, 2016). I found only one study that incorporated teaching an escape response during exposure to the aversive stimulus that still resulted in LH deficits. DiCara & Weiss (1969) taught two groups of rats to either raise or lower their heartrate to terminate shock. The group taught to lower their heartrate to terminate shock did not demonstrate LH deficits. However, the group taught to increase their heartrate to terminate shock demonstrated LH deficits. If increased heartrate is part of the biphasic response, further increasing heartrate when exposed to an aversive stimulus may more quickly elicit the reinforcing physiological outcomes of aversive stimulation. In this way, behaviors such as SIB may develop as an effect of exposure to IAS. If exposure to the second part of the bi-phasic response is critical in the development of LH deficits, increases in responses that causes the organism to enter the second part of the biphasic response faster (such as increased heartrate) would likely exacerbate, rather than ameliorate, LH effects. Thus, changes in behavior caused by aversive stimulation, such as increased heart rate, can be reinforced , despite the cost to the organism as a whole in terms of the physiological changes that tend to co-occur with aversive stimulation and increased heart rate (e.g., ulcers, sleep changes). Furthermore, environmental events that increase the probability of the reinforced response may be conditioned as reinforcement, establishing events that elicit responses like increased heart rate (e.g., injury) as reinforcement and increasing behavior that produces those events. Thus, behaviors that increase the likelihood of tissue damage to the organism (and thus occasion the release of endorphins), such as SIB, may develop or increase. Conversely, preventing the second part of the biphasic phase might inhibit the development of LH. Evidence of this comes from studies showing that naltrexone blocks analgesia in non-humans and reduces behavior changes associated with prolonged exposure to IAS (e.g., Helmstetter & Faneslow, 1987).

Mammalian Responses to Threatening Stimuli

Research on cross-species responses to threatening stimuli may aid in the identification of stimuli that may function as threatening or aversive to people who have experienced trauma. Blanchard et al. (2001a; 2001b) reported on mammalian defensive behaviors, most extensively studied in mice, but observed across most mammals. Defensive behavior patterns have been used as models in the development of many pharmacological treatments for anxiety and panic disorders. Defensive behaviors typically follow a consistent pattern, including 1) flight, 2) scanning, 3) freezing/immobility 4) scanning 5) gradual resumption of normal activity (Blanchard et al.). Mice will scan (establish visual contact with) a possible threat. If a threat is confirmed, mice will engage in other defensive behaviors (including freezing). "Flight" is generally not observed in animals that have been exposed to IAS, whereas scanning and freezing and immobility occur at higher rates or durations. In a study with 160 undergraduate students, Blanchard et al. (2001b) asked participant to predict their responses to a variety of situations and compared these responses to rodent behavior in response to different types of threats. They did not attempt to measure any responses to threats directly. Their results suggested that human responses to threat appeared to parallel rodent responses to threat. Other researchers have noted similarities among organisms in measures of particular defense responses such as freezing in response to threatening stimuli (see Hagenaars et al., 2014 for a review). The prevalence of these responses across species suggests that they may prove useful in assessing whether a stimulus functions as a threat or aversive stimulus for people without verbal communication repertoires. For example, observing and documenting events that occur prior to responses such as flight, scanning, or freezing – common responses to threats – may assist in identifying TRS for persons who are unable to provide self-reports.

Conditioned Aversive Stimuli (CAS)

One of the most important features of LH and post-trauma behavior change is that following prolonged exposure to primary aversive stimuli (PAS; i.e. shock) and the second part of the bi-phasic response, the organism appears to respond to subsequent aversive stimuli and conditioned aversive stimuli (CAS) in at least one similar way – faster production and release of endogenous opioids (Drugan et al., 1989; Maier et al., 1980). Following exposure to IAS, relatively small or brief exposures to inescapable PAS or CAS can lead to analgesia and persistence of LH (e.g., Deslauriers et al., 2018; MacLennan et al., 1982; Maier & Seligman, 2016). The relationship between PAS, CAS, and the second part of the biphasic response appears to be a critical feature of post-trauma behavior change and LH. Once an organism experiences trauma, new stimuli that are paired with the original aversive stimulus can quickly become conditioned as CAS. Interestingly, stimuli that are paired with CAS also acquire aversive functions, even if the CAS has been presented in the absence of the PAS. Thus, the number of stimuli in this class appears to grow and the number of stimuli associated with the “trauma” increases as new stimuli are paired with existing CAS – even if the CAS is no longer associated closely with the original aversive stimulus. Based on this understanding of LH and trauma, I will describe two classes of stimuli that I believe are important in the development and maintenance of post-trauma behavior change. These are not terms or classes I have found described in the literature on post-trauma behavior change but I believe they may be useful in understanding the effects of two subsets of CAS that produce differential effects on behavior. After exposure to a traumatic event, some CAS produce escape responses (Glazer & Weiss, 1976; Kumar &

Karanth, 1991), increased heartrate (DiCara & Weiss, 1969), and increases in startle responses (Barol & Seubertt, 2010). Alternatively, some CAS produce unresponsiveness to negative or positive reinforcement (Seligman & Maier, 1967; Maier & Seligman, 2016), decreased heartrate and freezing (Belda et al., 2004; Conoscenti et al., 2017; Greenwood, 2003; Leftwich & May, 1974; Maier, 1990; Plumb et al., 2015). These differential effects of aversive stimuli that have been inescapable and associated CAS are critical features of the two sets of stimuli described below.

Trauma Stimuli. Trauma stimuli are those stimuli that have been so strongly conditioned (either during the initial trauma or through pairing with stimuli strongly conditioned at the time of the trauma) that they result in decreased movement, decreased sensitivity to pain, difficulty in learning new responses that are reinforced by both positive and negative reinforcement. Following exposure to these stimuli, organisms that demonstrate classic LH deficits also demonstrate improved sleep quality as measured by decreased latency to fall asleep and longer periods in paradoxical sleep than animals exposed to these same stimuli but who have not been exposed to IAS. In the presence of these stimuli an organism is unlikely to learn new responses, and unlikely to respond quickly to escape or avoid aversive stimuli.

Trauma-Related Stimuli. Trauma-Related Stimuli (TRS) are stimuli that were previously neutral that become CAS through pairing with the trauma. These stimuli, can continue to exert control over behavior long after a traumatic event is over. TRS are commonly called “triggers” because they tend to “trigger” physiological responses that are disproportionate to the current situation. The body responds to these otherwise harmless stimuli as threats. Interestingly, studies in rats have shown that even brief re-exposures to TRS at regular intervals prolongs deficits in adaptive functioning that are common for 24-72 hours after a trauma event indefinitely (e.g., Maier, 2001). TRS likely account for at least some behavior changes for people who have experienced trauma.

Identification of TRS for persons with ID is important for at least two reasons. First, for people who are unable to communicate verbally, identification of these stimuli using empirical methods may be the only way for them to access effective treatment. Intermittent prolonged exposure to TRS without an escape response has been shown to prolong, indefinitely, deficits in non-humans following exposure to trauma, even if the TRS are never paired with the dangerous or painful stimulus experienced at the time of the initial trauma ever again (e.g., Maier, 2001). Identification of TRS for a person who cannot verbally communicate distress in response to TRS could be critical in allowing caregivers the opportunity to avoid presenting or teach escape responses from TRS, to aid recovery, and avoid re-traumatization.

Second, people without verbal communication repertoires display problem behaviors at higher rates than their verbal counterparts (Murphy et al., 2005; Newcomb & Hagopian, 2017;). These problem behaviors often include aggression and SIB, both of which have been shown to increase for many organisms following exposure to trauma. Studies of animal behavior suggest that the SIB that develops following exposure to trauma are likely either automatically maintained or elicited (Gluck et al., 1985). If animal models correspond with the mechanisms associated with SIB in some humans, methodologies to identify behavior patterns in the presence and absence of potential TRS may be useful to identify TRS and evaluate their effects. Such advances might provide a more complete account of the development and currently relevant variables influencing trauma-influenced problem behaviors, as well as a foundation for more effective interventions. Interestingly, such advantages may not be limited to persons with limited verbal repertoires but also may be relevant for individuals suffering from trauma-related disorders but who are not able to recall or accurately identify the variables associated with their trauma.

Heartrate and Trauma-Related Stimuli

Heartrate increases in most mammals when confronted with a threatening stimulus, presumably to prepare the organism for “fight or flight” (Blanchard et al., 2001a; Wager et al., 2009). Several studies have found that in people with PTSD, heartrate increases significantly in the presence of TRS (e.g., Adenauer et al., 2010; Blanchard et al., 1996; Ehlers et al., 2010). Additionally, higher resting heartrate soon after exposure to a traumatic event (Bryant, 2006) and higher heart rate reactivity in response to trauma-related pictures (Suendermann, et al., 2010) reliably predicted PTSD diagnosis.

Measurement of heart rate during activities or contact with stimuli that may be associated with trauma may be useful in identifying trauma-related problems for persons with ID. For example, decreases in interest and engagement with previously preferred items may result from an array of influences, or they may be related to exposure to a traumatic event. Heartrate data, in combination with more traditional behavior data on engagement with preferred items during a preference assessment, could be useful in determining if changes in engagement are more likely due benign influences or a post-trauma behavior change.

Commercial Heartrate Monitors

The wide availability of commercial heartrate monitors that are minimally intrusive (e.g., smartwatches) make it possible to measure heartrate in many settings. Studies on the reliability and validity of smartwatch heartrate data, relative to established heartrate monitors, have found mixed results. Two studies found that the Fitbit Charge ® demonstrated high correspondence to medical grade wireless ambulatory physiological monitoring devices (Bai et al., 2017; Nazari et al., 2017). Several studies found that the Fitbit Charge ® underestimated heartrate values when compared to heartrate obtained simultaneously with an electrocardiogram (ECG), particularly when participants were engaging in high intensity physical activity (Jachymek et al., 2021; Jo et al., 2016; Montoye et al., 2017). The Fitbit Sense ® has also demonstrated high correspondence with ECGs when activity levels are low (e.g., Helmer et al., 2022) and greater variability in correspondence to other monitors at higher activity levels (Hajj-Boutros et al., 2022). The Apple Watch ® Series 6 has been evaluated in several studies. All studies reported the heartrate reading from Apple Watch ® had high correspondence with readings from medical grade heartrate monitors (Abt et al., 2018; Gillanov et al., 2017; Huynh et al., 2020; Pipek et al., 2021; Sañudo et al., 2019; Shcherbina et al., 2017). Overall, several devices appear to collect relatively accurate and reliable heartrate measures, are relatively inexpensive and convenient, and thus may be useful in evaluating the effects of stimuli on heartrate, especially if activity level during a session is minimal.

Research Question

In my review of the literature, I found that exposure to trauma increases avoidance, hypervigilance responses, self-injury, repetitive behavior, inappropriate sexual behavior, and general problem behavior across a range of species. Following exposure to trauma, social engagement, self-care, and interest in previously preferred stimuli have been observed to decrease. Finally, following exposure to trauma, changes in aggression, sleep patterns, eating patterns, and pain sensitivity have also been reported across species. Careful and systematic measurement of these behavioral and physiological responses under potentially relevant conditions could be helpful to determine if behavior problems are related to trauma, reveal the variables associated with that trauma, and to develop effective assessment and treatment approaches.

Post-trauma behavior changes in people with ID have been documented primarily in case studies. Research on observable and measurable behavioral and physiological changes that have been shown to correspond with LH and PTSD could improve assessment of post-trauma behavior change for people who lack the vocal/verbal communication skills to complete traditional PTSD diagnostic assessments. The paucity of empirical studies that have evaluated PTSD in people with ID has led to skepticism whether the effects of trauma is relevant for individuals with ID (e.g., “Is post-traumatic stress disorder a helpful concept for adults with intellectual disability?” (Mitchell & Clegg, 2005)). Unfortunately, the inability of persons with moderate to severe ID to verbally report on traumatic events or stress symptoms such as a racing heart or intrusive thoughts may not lessen the impact of these events and symptoms. With the assistance of technology like wristband heartrate monitors, we may be able to access information about the effects of certain stimuli on otherwise unobservable behavioral and physiological variables (e.g., a racing heart). The current studies sought to investigate potential changes in both adaptive skills and problem behavior for in persons with ID who had been identified to experience trauma. Behavioral and physiological variables that have been found to correlate with trauma were measured in the context of assessments of preference and functional analysis of problem behavior. I wanted to evaluate the effects of TRS on behaviors during these assessments because both of these assessments permit systematic analyses of behavior changes in the presence of an array of stimuli and environmental contingencies, and both are frequently used in applied settings. Thus, the general purpose of these studies was to evaluate the effects of TRS (stimuli conditioned as aversive because of their association with a past trauma) – on behaviors during stimulus preference assessments (Experiment 1) and functional analyses (Experiment 2) of problem behavior.

CHAPTER 3

AN EVALUATION OF THE EFFECTS OF TRS ON BEHAVIOR DURING PREFERENCE ASSESSMENTS

Several types of behavior change have been reported to occur when an organism has been exposed to a trauma. I selected eight of these behaviors to measure during preference assessments with individuals who had been reported to experience trauma. In research with nonhumans, these eight measures have been demonstrated to differ in the presence or absence of aversive stimuli or trauma-related stimuli (TRS).

These behaviors included:

1. Latency to make a choice (Jackson et al., 1980; Rosellini et al., 1982)
2. Activity engagement with preferred items (Borghus et al., 2018; Christianson et al., 2008; Landagraf et al., 2015; Wisłowska-Stanek et al., 2016; Kildahl et al., 2020a, Kildahl et al., 2020b; Malkesman et al., 2010; Mevissen et al., 2011; Truesdale et al., 2019; Turk et al., 2005)
3. Time spent immobile ("freeze" time) (Belda et al., 2004; Conoscenti et al., 2017; Greenwood, 2003; Leftwich & May, 1974; Maier, 1990; Plumb et al., 2015)
4. Scanning of the environment (Barol & Seubert, 2010; Blanchard, 2001a)
5. Selection order (Christianson et al; Landagraf et al; Wisłowska-Stanek et al.)
6. Heartrate (Adenauer et al., 2010; Blanchard et al., 1996; Ehlers et al., 2010)
7. SIB (Gluck et al., 1985)
8. Aggression (Ulrich & Craine, 1965)

Although these measures have been reported to change in the presence of conditioned aversive stimuli (CAS) for nonhumans, no research with humans has systematically evaluated these relations. For the current study, I evaluated the effects of TRS on human behavior during preference assessments. Detailed incident reports, surveillance videos, and first-hand caregiver accounts of the incidents were obtained for each participant, and were used to identify one or more stimuli that were present at the time of a traumatic event. All the TRS used for this assessment were items or situations that were commonly present in the participants' environment, were encountered frequently by the participants, and could not be reasonably removed or avoided. For all participants, limiting exposure to the TRS I selected was impossible, dangerous, or could have caused a violation of their rights. For Pedro, the TRS I used were exposure to food and people - necessary parts of a healthy life. For Kara, the TRS I used was being alone. Privacy (being alone) is a normal, healthy part of adult life. Additionally, to require that Kara always have another person with her would have constituted a restriction and potential violation of her right to privacy, as State regulations for Intermediate Care Facilities (ICF) – the type of facility at which Kara resides – require that all people have the right to privacy unless there is imminent risk of harm (Texas Department of Aging and Disability Services, 2013). For Ferdinand, the TRS I used was his current home, in which he had been previously abused. He continued to reside in this home because his interdisciplinary team had decided that it would be more disruptive to expose Ferdinand to a change in residence than for him to continue living in his home.

The purpose of this experiment was to 1) identify potential TRS by identifying stimuli and conditions that were present at the moment of trauma and 2) empirically investigate the effects of these potential TRS on a set of measures that have been shown to vary as a function of the presence or absence of TRS: choice latency, activity engagement, time spent immobile, scanning, items selection order, heartrate, SIB and aggression.

Method

Participants and Setting

All three participants were residents of a large residential ICF facility for adults with ID. All participants had been referred to a university-affiliated, specialized clinic for the treatment of severe problem behavior. Kara was 54-years-old and diagnosed with generalized anxiety disorder, bipolar disorder, and a moderate intellectual disability. She was referred to the specialized clinic to address SIB (hand biting and leg hitting) and refusal to walk. Her trauma history included several falls that had resulted in injuries requiring treatment at a hospital. At the time of two of these falls, Kara was alone and did not receive immediate assistance. The potential TRS evaluated for Kara was being alone. Being alone was selected because it was common across the two falls that were reported to be the most significant, both in terms of injury and in terms of the emotional responding, as reported by staff following these incidents. Kara's psychiatrist reported a significant increase in Kara's startle response during observations subsequent to these falls. During a prior assessment, direct care staff had reported that sometimes Kara would get up and walk to get preferred items but did not do so when staff were around. To test this, an assessment was conducted in which preferred items were placed around the room and staff told Kara they would be back in a few minutes. Kara was then observed via a video-feed. She did not walk and instead became very emotional, engaged in frequent scanning of the room, crying, and SIB. Although being alone appeared to be distressing to Kara, she was alone for brief periods every day and several times a week. Furthermore, she was occasionally observed to seek out places to be alone (e.g., leaving the group and going in her bedroom closet alone.) She was also occasionally observed to engage in leg hitting and hand biting in these locations when she was alone. Because being alone was associated with her traumatic events, was commonly experienced by Kara in her normal routine, and appeared to at least occasionally be distressing, being alone was selected as the TRS to evaluate for Kara.

Ferdinand was 30-years-old and diagnosed with a moderate intellectual disability, autism, and posttraumatic stress disorder. He was referred to the specialized clinic to address aggression. His trauma history included two documented incidents of physical abuse that caused injury and several incidents of suspected physical abuse from caregivers. Two incidents of abuse occurred in the hallway of Ferdinand's home. Because Ferdinand had previously experienced difficulty tolerating and adjusting to changes in his residence, his interdisciplinary team determined that it was best for Ferdinand to continue living in the home where abuse had occurred. A hallway in Ferdinand's home had been the location of at least two incidents of physical abuse, and it was necessary for Ferdinand to be in the hallway frequently as a part of his normal daily routine. Thus, I chose the hallway as the TRS to be evaluated for Ferdinand.

I evaluated a second potential TRS for Ferdinand – standing staff (as opposed to sitting staff). Ferdinand was observed to ask staff to sit down and to engage in lower rates of aggression during interactions with staff when they were seated at a table with him in the clinic rather than standing next to him. Because standing staff appeared to be distressing to Ferdinand and because he was exposed to standing staff on a daily basis, I evaluated standing staff as a second potential TRS for Ferdinand.

Pedro was 29-years-old and diagnosed with an intellectual disability and posttraumatic stress disorder. He was referred to the specialized clinic to address SIB, aggression, food refusal, and self-restraint. His trauma history included abuse and neglect from birth until age five, when he was adopted by his mother from a Romanian orphanage. Pedro's mother had observed and documented his care in the orphanage for over a year before she was able to adopt him. She reported that feedings in the orphanage for Pedro consisted of a cart being rolled to his crib and food being deposited in his mouth, often forcefully. His nose and mouth would then be held shut until he swallowed the food. His direct-care staff at the facility reported that Pedro also had great difficulty adapting to new staff and that he would often engage in SIB when less-familiar staff were nearby. Because Pedro had to be exposed to food on a daily basis, and there was a known traumatic history with food, I chose food as the first potential TRS to evaluate for Pedro. Because the presence of people other than a select few who were Pedro's preferred staff and his mother were stimuli Pedro was exposed to every day and because infrequently encountered people were associated with Pedro's past trauma in the Romanian orphanage, I chose "people" to evaluate as a second TRS for Pedro.

Institutional Review Board, Human Rights, Consent, and Assent.

Prior to the start of the study, all procedures were reviewed and approved by the institutional review board (IRB) at the University of North Texas and by a human rights committee (HRC) at the residential facility. Consent to participate in this study was obtained from the guardians of all three participants. All guardians were given the option to have the participant they cared for receive assessment and treatment for their respective behavior disorders without participating in research. All guardians were informed of their right to withdraw consent for participation in this study at any time without interfering with the participants access to appropriate assessment and treatment. Before each session, each participant was either invited to come to the specialized clinic where sessions were conducted or if a session was occurring in their home, invited to participate in the session. If a participant did not want to come with the researchers to the clinic or did not want to participate in the session in their home, then they were not required to come to the clinic or experience the session in their home. Throughout the study, Ferdinand and Kara frequently independently sought-out the researchers to initiate sessions. Occasionally, problem behavior was observed if Ferdinand or Kara saw the researchers, requested to go to the clinic, and the researchers were unable to conduct sessions at that time, due to logistical constraints.

Instruments

Behavior data was collected using Countee ® data collection application on iPod Touches ® or using BDataPro on Microsoft Surface Tablets ®. Heartrate data was collected using a Fitibt Sense ® (Kara's first assessment), a Fitibit Charge ® (Ferdinand's first assessment), or an Apple Watch 7 ® (Pedro, and Ferdinand's second assessment).

Procedures

The basic stimulus-preference assessment procedure for all participants was a multiple stimulus preference assessment without replacement (Deleon & Iwata, 1996). The basic procedures differed from Deleon & Iwata's procedures because items were never removed from the participant's possession. I conducted two session types. In TRS absent conditions, the TRS was not present. During TRS present sessions, the TRS was present throughout the session. One min after the start of the session, the therapist offered six leisure items or drinks to the participant on a tray (or in clear plastic drawers that were uncovered for Kara), with the instruction "pick one." After the participant selected an item, the therapist presented the item to the participant and the remaining items were removed or covered. One min after the selection of an item, the therapist re-arranged the remaining items were and offered them again. These procedures continued until either all items were selected, 1-min elapsed from the selection of the last item, or 10-min elapsed from the start of the session. Once the participant selected an item or the participant indicated he or she did not want an item (either by verbally stating "no" or pushing the tray away), the therapist removed the tray or covered it for 1 min.

The TRS I selected for Kara was being alone (the absence of other people in her visual field). Because a preference assessment typically involves a therapist presenting and removing items, the items in her preference assessment had to be delivered in a different way than the other participants. For Kara, J placed all items in clear drawers that could be covered and uncovered from outside the room by a box. Therapists presented items this way for all preference assessments for Kara. In the TRS Present condition, Kara was alone in the session room and a therapist observed the session from behind a one-way mirror. In the TRS Absent condition, a therapist sat inside the room with Kara but did not interact with her during the session. All other procedures were identical to the TRS absent condition.

The TRS for Ferdinand was the location of abuse. Therapists conducted TRS Absent conditions at the specialized clinic located on the residential campus where Ferdinand lived and worked. For TRS present conditions, Therapists conducted Ferdinand's sessions in his home (the location of abuse) which was a short walk from the university clinic. The second TRS used for Ferdinand was the presence of a standing staff. I conducted this assessment in the clinic. In the TRS Present condition, a therapist stood and offered the tray of available items to Ferdinand. In the TRS Absent condition, a therapist sat at a table and presented items to Ferdinand.

All of Pedro's sessions were conducted in his bedroom, to limit the number of other residents or staff who were present. Pedro's mother conducted all of his sessions. In TRS Absent sessions, the data collectors stood outside of Pedro's room and recorded data through a window. During TRS Present sessions, graduate student data collectors came into Pedro's bedroom and stood in the bedroom within 3 m of Pedro while recording data. During Pedro's TRS (Food)

Present conditions, a therapist placed a food cart with food within 3 m of Pedro. During TRS Absent conditions, no food was present in the room.

Session Arrangement 1

The session arrangement for Ferdinand's first assessment and Kara's first assessment were identical. During both assessments, two sessions were conducted per day. I chose the first session type (TRS present/absent) at random each day and then conducted the opposite session 5 min after the end of the first session. I continued sessions in each condition until I observed a stable pattern of responding, indicated by either a clear differentiation in preference or no differentiation in preference among at least three items. Kara's choice latencies, and activity engagement were differentiated across conditions within the first three sessions. Her preference for two items was clear within the first three sessions in the TRS Absent condition. Ferdinand's choice latencies, activity engagement were not differentiated, so I continued conducting sessions for a total of seven days (14 sessions). After completing this assessment, I decided to use a different session arrangement, to potentially allow for better detection of any carry-over between conditions and decrease the need for repeated sessions, as preference assessments typically do not require multiple days or 14 sessions. However, the instability in Ferdinand's behavior rates required that I continue his preference assessments for longer than would have normally been needed to establish a preference. In session arrangement two, sessions were conducted in pairs with two of the same session type conducted on two days of the assessment and two different sessions conducted on two days of the assessment, in a counterbalanced order. This allowed us to evaluate the stability in responding across two sessions of the same type and the variability in responding between session types.

During session arrangement 1, freezing, scanning and activity engagement were added as measures of interest. This late addition resulted in discrepancies in the number of sessions for which IOA was collected on these measures. Additionally, Ferdinand participated in 2 preference assessments (one for leisure items and one for drinks). The session for drinks were shorter overall and more variable in length. Therefore, the data from the leisure items only is shown for choice latency, activity engagement, freeze, scanning, SIB, aggression and heartrate. However, the data for selection order for drinks is shown because leisure items were broken during Ferdinand's first assessment and I was not able to replace some with identical items.

Session Arrangement 2

Session arrangement 2 was consistent across Ferdinand's second assessment, Ferdinand's third assessment, and both of Pedro's assessments. Because Kara had already started a treatment before I developed Session Arrangement 2, her assessment was not repeated. Session arrangement 2 was adapted to allow for an assessment of carryover across session types, while still limiting the overall duration of the assessment. In the second session arrangement, two sessions were conducted each day across four days as follows:

1. Day 1: TRS Absent, TRS Absent
2. Day 2: TRS Absent, TRS Present
3. Day 3: TRS Present, TRS Absent
4. Day 4: TRS Present, TRS Present

Definitions

I used the same definitions across all participants. Choice latency was the duration from the therapist offering items to the participant to the participant either taking an item off the tray or from the drawer (Kara only) or saying, "no" or pushing away the tray. To calculate choice latency, data collectors recorded both the therapist offering the items and the participant's reponse. Activity engagement was recorded as a duration measure, that started anytime the participant was touching an item chosen during the assessment and ended any time the participant was no longer touching an item chosen during the assessment. Freeze was recorded as a duration measure, that started when the participant had not moved (other than movements related to breathing) for 1 s and ended after the participant moved again for at least 1 s following the onset of the freeze key. Scan was recorded any time the participant moved their eyes across the span of the room or turned his or her head to look behind themselves, not including moving their eyes to look at the therapist.

I defined problem behavior separately for each participant. For Kara, SIB included any time she hit her palms or fists on her legs hard enough to produce an audible sound, and any time Kara's lips or teeth made contact with her hands or arms. For Ferdinand, SIB included Ferdinand hitting any part of his body to a hard surface, hitting himself with a closed fist, kicking himself by hitting his heel to his ankle, poking or pinching existing injuries, biting himself or hitting the backs of his hands to his eyes. For Ferdinand, aggression included hitting, kicking, punching, pushing, throwing furniture at, or scratching, others. For Pedro, SIB included hitting his hand to any part of his body from greater than 15 cm away with continuous motion, hitting his head onto any hard surface, hitting his feet on hard surfaces from greater than 15 cm away with continuous motion, or scratching his face. For Pedro, aggression included hitting or kicking another person with any part of his body from greater than 15 cm away with continuous motion or his mouth making contact with another person.

Inter-observer agreement

A second observer observed a mean of 42.18% of sessions for each measure in Experiment 1. Freeze and scan were added as measures after Kara completed the assessment, so these were scored from videos after the assessment was completed. For Ferdinand, activity engagement was not included on the reliability data collection device for two sessions. This was an error in the set-up of the data collection device. Inter-observer agreement (IOA) was calculated using the proportional within interval agreement method. Sessions were divided into 10-s intervals. Within each interval, the smaller number of instances or seconds of behavior was divided by the larger number of instances or seconds. The values for each interval were summed, divided by the total number of 10-s intervals, and multiplied by 100. Tables 3 and 4 provide interobserver agreement for Experiment 1 by behavior, participant, and application.

Procedural Fidelity

Procedural fidelity was scored using a paper checklist of critical components of each condition. Procedural fidelity was scored for 57.69% of sessions. Tables 5 and 6 provide procedural fidelity scores for Experiment 1 by behavior, participant, and application.

Table 3

Inter-observer agreement for Experiment 1, arrangement 1 (pilot) sessions

	Total Number of Sessions	Sessions with IOA	Percent with IOA	Range	Mean
Kara					
Choice Latency	6	4	66.67	95.11-97.5	95.94
Activity Engagement	6	4	66.67	96.23-99.15	97.83
Freeze	6	2	33.33	66.67-73.33	70.00
Scan	6	2	33.33	90-90	90.00
SIB	6	4	66.67	98.30-100	99.47
Aggression	N/A	N/A	N/A	N/A	N/A
Selection Order	6	4	66.67	100-100	100
Ferdinand					
Choice Latency	14	3	21.43	92.51-97.64	94.53
Activity Engagement	14	1	7.14	N/A	100
Freeze	14	3	21.43	96.72-100	98.35
Scan	14	3	21.43	89.17-100	96.39
SIB	14	3	21.43	98.36-100	99.45
Aggression	14	3	21.43	86.39-100	94.63
Selection Order	14	3	21.43	100-100	100

Table 4

Procedural fidelity for arrangement 1 (pilot)

	Total Number of Sessions	Sessions with Procedural Fidelity	Percent with Procedural Fidelity	Range	Mean
Kara	6	4	66.67	100-100	100
Ferdinand	14	2	14.29	100-100	100

Table 5

Inter-observer agreement for Experiment 1, Arrangement 2

	Total Sessions	Sessions with IOA	Percent with IOA	Range	Mean
Ferdinand (Location)					
Choice Latency	8	4	50.00	93.76-100	96.29
Activity Engagement	8	4	50.00	85.77-100	93.15
Freeze	8	4	50.00	94.36-100	98.59
Scan	8	4	50.00	89.36-98.33	95.29
SIB	8	4	50.00	97.87-100	99.26
Aggression	8	4	50.00	95.72-100	98.41
Selection Order	8	4	50.00	100-100	100
Ferdinand (Standing Staff)					
Choice Latency	8	2	25.00	94.68-96.27	94.76
Activity Engagement	8	2	25.00	86.8-89.58	88.19
Freeze	8	2	25.00	100-100	100
Scan	8	2	25.00	90.83-94.17	92.5
SIB	8	2	25.00	99.17-100	98.75
Aggression	8	2	25.00	97.43-98.95	98.19
Selection Order	8	2	25.00	100-100	100
Pedro (Food)					
Choice Latency	8	4	50.00	87.44-93.44	89.41
Activity Engagement	8	4	50.00	96.72-100	96.56
Freeze	8	4	50.00	98.36-100	98.77
Scan	8	4	50.00	96.72-100	99.18
SIB	8	4	50.00	92.62-100	96.93
Aggression	8	4	50.00	91.08-100	97.77
Selection Order	8	4	50.00	100-100	100
Pedro (People)					
Choice Latency	8	6	75.00	82.29-95.00	96.67
Activity Engagement	8	6	75.00	88.33-100	96.41
Freeze	8	6	75.00	100-100	100

Scan	8	6	75.00	91.11-100	96.57
SIB	8	6	75.00	91.57-99.44	98.84
Aggression	8	6	75.00	93.33-100	96.39
Selection Order	8	6	75.00	100-100	100

Table 6

Procedural fidelity for arrangement 2

	Total Number of Sessions	Sessions with Procedural Fidelity	Percent with Procedural Fidelity	Range	Mean
Ferdinand (Location)	8	8	100	87.42-99.17	95.54
Pedro (Food)	8	6	75.00	92.82-96.71	94.78
Pedro (People)	8	8	100	76.77-97.22	88.72
Ferdinand (Standing Staff)	8	2	25.00	100-100	100

Results

Kara – Assessment 1

Figure 2 displays Kara's behaviors from Experiment 1. The top left graph shows that Kara's mean latency to make a choice was 20.82 s in the TRS Present condition, which was significantly longer than the mean choice latency of 14.42 s per choice in the TRS Absent condition. The top middle graph depicts Kara's engagement with the items she selected during the assessment. Average activity engagement in the TRS Present condition was 67.06% of the session, whereas activity engagement was 84.36% of the session in the TRS Absent condition. The top right graph depicts the percent of the session that Kara spent "frozen" or not moving at all. In the TRS Present condition Kara spent 6.20% of the session "frozen" and in the TRS Absent condition Kara spent 0.61% of the session "frozen". The middle left graph depicts the rate of scanning. In the TRS Present condition, Kara engaged in scanning at an average rate of 0.3 scans per minute whereas in the TRS Absent condition, Kara engaged in scanning at an average rate of 0.17 scans per minute. The middle graph depicts the rate of SIB. In the TRS Present condition, Kara engaged in SIB at an average rate of 0.13 responses per minute. In the TRS Absent condition, Kara engaged in SIB at an average rate of 0.06 responses per minute. The bottom left graph shows a violin plot of Kara's heartrate in the TRS absent and present conditions. The violin plot provides a visual of the distribution of heartrate values across the session. The dashed line shows the median and the two solid lines above and below the dashed line show the first and third quartiles. Kara's median heartrate was significantly higher in the TRS present condition at $p<.0001$ on a Mann-Whitney U test. Additionally, Kara's heartrate spiked to higher values in the TRS present condition than in the TRS absent condition. Finally, the bottom middle and right graphs depict the order in which Kara selected items during the preference assessment. In the TRS present condition, there was no clear preference for a specific item across the three sessions. In the TRS absent condition (middle graph), Kara chose the puzzle and coloring within her first three selections across all three sessions in that condition.

Ferdinand – Assessment 1.

Figure 3 displays Ferdinand's results from Experiment 1. The top left graph shows that on the first assessment day, Ferdinand's mean choice was longer in the TRS Present condition (163.00 s) than in the TRS Absent condition (83.75 s). Overall, the mean choice latency in the TRS Present condition was 28.38 s and the mean choice latency in the TRS Absent condition was 17.45 s. However, after the first day of assessment, Ferdinand's choice latency was undifferentiated across the two conditions. The top middle graph depicts Ferdinand's engagement with the items he selected during the assessment. His mean activity engagement in the TRS Present condition was 49.14% of the session and his mean activity engagement in the TRS Absent condition was 55.93% of the session. Activity engagement was more variable in the TRS Present condition than in the TRS Absent condition. The top right graph depicts the percent of the session that Ferdinand spent "frozen" or not moving at all. Initially, Ferdinand froze only in the TRS Absent condition. However, within three sessions, Ferdinand stopped freezing in the TRS Absent condition. Ferdinand's freezing remained variable in the TRS Present condition, with the most freezing in third TRS Present session. Additionally, while freezing remained at zero in the TRS Absent condition, freezing began increasing in the final two TRS Present sessions. The middle left graph depicts the rate of Ferdinand's scanning. In the TRS Present condition, Ferdinand engaged in scanning at a mean rate of 0.43 scans per minute. In the TRS Absent condition, Ferdinand engaged in scanning at a mean rate of 0.01 scans per minute. The middle graph depicts the rate of SIB that Ferdinand engaged in during this assessment. In the

TRS Present condition, Ferdinand engaged in a mean rate of 0.26 SIB per minute. In the TRS Absent condition, Ferdinand engaged in a mean rate of 0.24 SIB per minute. The middle right graph depicts the rate of aggression Ferdinand engaged in during this assessment. In the TRS Present condition, Ferdinand engaged in a mean rate of 1.14 aggression per minute. In the TRS Absent condition, Ferdinand engaged in a mean rate of 1.37 aggression per minute. The bottom left panel displays a violin plot of Ferdinand's heartrate readings during the CLA. Ferdinand's median heartrate was significantly higher in the TRS present condition at $p<.0001$ on a Mann-Whitney U test. Additionally, the violin plot shows that Ferdinand's heartrate spiked to higher values in the TRS present condition than in the TRS absent condition. Finally, the bottom middle and right graphs depict the order in which Ferdinand selected items during the preference assessment. In the TRS Present condition, Ferdinand did not demonstrate a clear preference for five of six items and only demonstrated a clear non preference for water. In the TRS Absent condition (middle graph), within three sessions, Ferdinand demonstrated a clear preference for Dr. Pepper ® , Coke ® and tea, a moderate preference for Fanta ® and a clear non preference for water and seltzer.

Figure 2

Choice Latency Analysis for Kara in the presence/absence of her TRS ("being alone"). In TRS Present conditions Kara was alone in the session room. In TRS Absent conditions a staff sat in the room with Kara but did not interact with her.

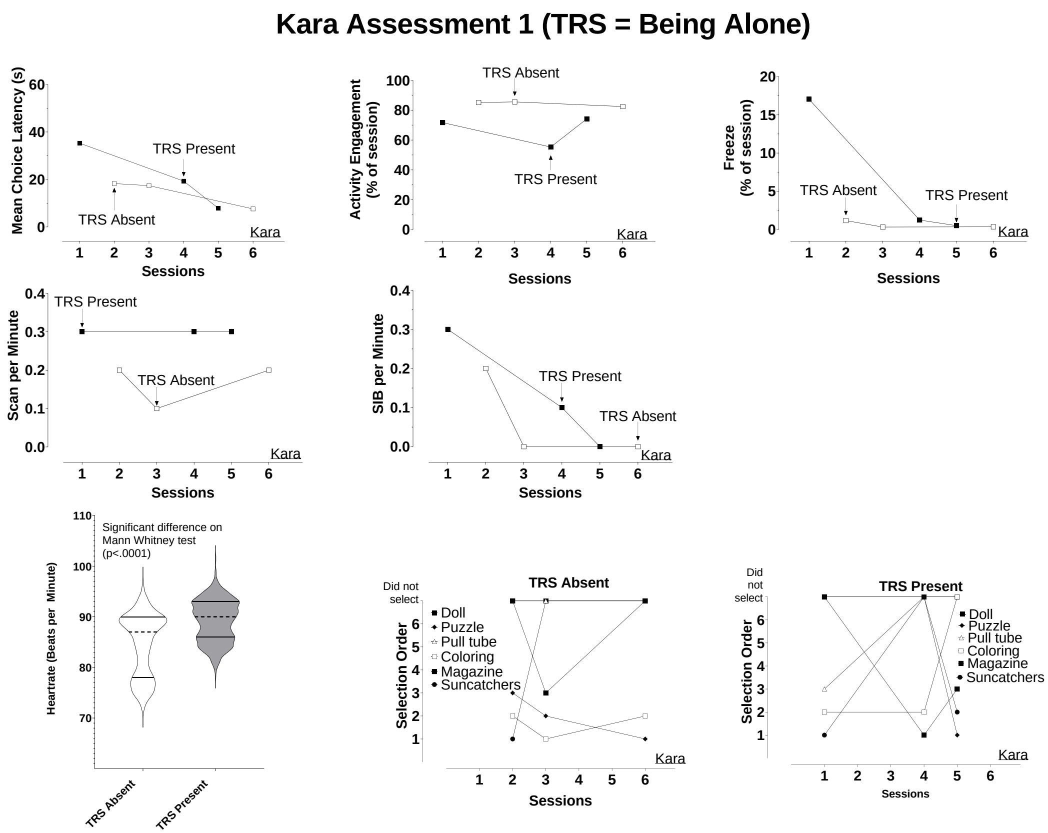
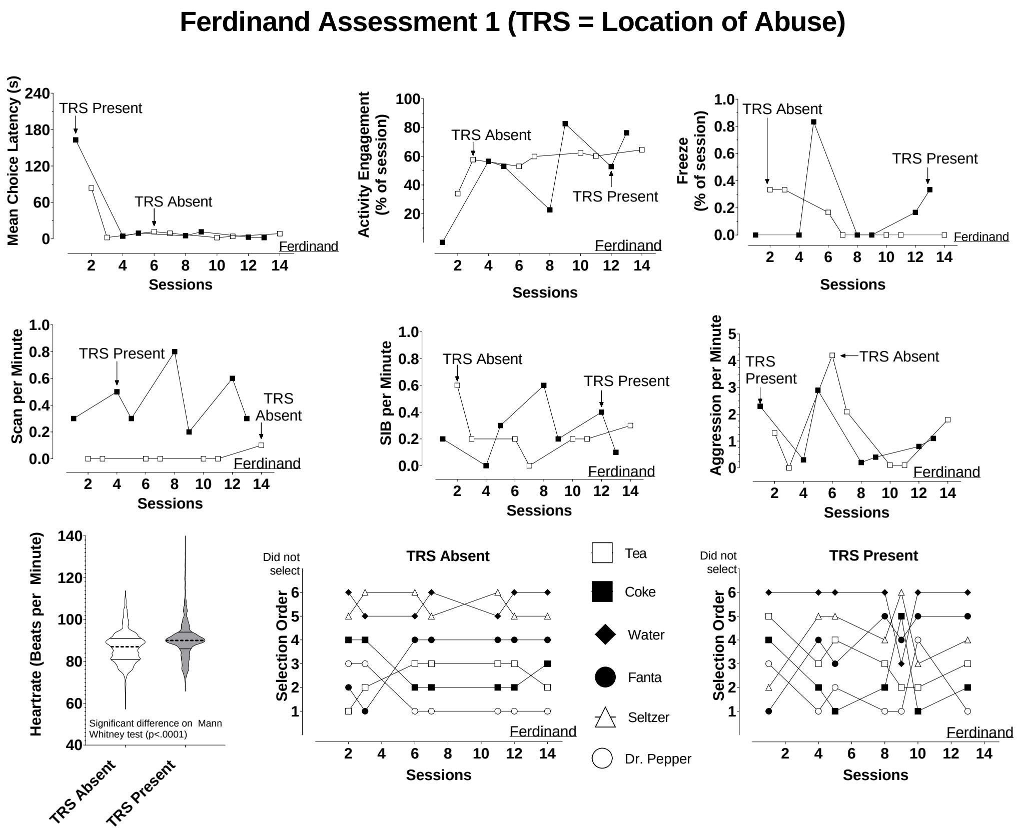


Figure 3

Choice Latency Analysis for Ferdinand in the presence/absence of his TRS (home). In TRS Present conditions Ferdinand was in his home. In TRS Absent conditions Ferdinand was at the clinic.



Ferdinand – Assessment 2

Figure 4 displays Ferdinand's behaviors from Experiment 1, Assessment 2. This assessment was done in the same settings as Assessment 1. Assessment 2 differed from Assessment 1 in the session arrangement, and the heartrate monitoring device used. Instead of alternating session types randomly (as I did in Assessment 1), the session arrangement for Assessment 2 was set as Day 1 (TRS Absent, TRS Absent); Day 2 (TRS Absent, TRS Present); Day 3 (TRS Present, TRS Absent); Day 4 (TRS Present, TRS Present). In Assessment 2, an Apple Watch Series 7 ® was used instead of the Fitbit Charge ® to measure heart rate. The top left graph depicts the mean latency to make a choice in each session. In the TRS Present condition, Ferdinand's mean choice latency was significantly longer (115.13 s) than in the TRS Absent condition (10.45 s). The top middle graph depicts Ferdinand's engagement with the items he selected during the assessment. His mean activity engagement in the TRS Present condition (10.42% of the session) was significantly lower than activity engagement in the TRS Absent condition (50.52% of the session). The top right graph depicts the percent of the session that Ferdinand spent "frozen" or not moving at all. Ferdinand's freezing was minimal in most sessions of this assessment. He froze for 3.96% of session 2 in the TRS Absent condition and did not freeze in any other TRS Absent sessions. Overall, in the TRS Present Condition, Ferdinand froze for a mean of 1.31% of each session. In the TRS Absent Condition, Ferdinand froze for an average of .06% of each session. The middle left graph depicts the rate of scanning. In the TRS Present condition, Ferdinand engaged in scanning at mean rate of 2.30 scans per minute. In the TRS Absent condition, Ferdinand engaged in scanning at a mean rate of 0.33 scans per minute. The middle graph depicts the rate of SIB that Ferdinand engaged in during the CLA. In the TRS Present condition, Ferdinand engaged in a mean rate of 0.26 SIB per minute. In the TRS Absent condition, Ferdinand engaged in a mean rate of 0.24 SIB per minute. The middle right graph depicts the rate of aggression Ferdinand engaged in during the CLA. In the TRS Present condition, Ferdinand engaged in a mean rate of 1.23 aggression per minute. In the TRS Absent condition, Ferdinand engaged in a mean rate of 0.18 instances of aggression per minute. Ferdinand's median heartrate was significantly higher in the TRS present condition at $p<.0001$ on a Mann-Whitney U test. Additionally, Ferdinand's heartrate spiked to higher values in the TRS Present condition than in the TRS Absent condition. Finally, the bottom middle and right graphs depict the order in which Ferdinand selected items during the preference assessment. In this session arrangement, because each graph of selection order only includes data from one condition, the first three sessions are not included on the TRS Present graph because sessions one, two, three, and six were TRS Absent conditions which are shown on the TRS Absent graph. In the TRS Present condition, Ferdinand demonstrated a clear preference for the drum but did not select any items in the last session. In the TRS Absent condition (middle graph), within three sessions, Ferdinand demonstrated a clear preference for the drum and the motorcycle, a moderate preference for the ball and Dory toy, and he selected all the items during every session.

Ferdinand - Assessment 3

Figure 5 displays Ferdinand's behaviors from Experiment 1, Assessment 3. In this assessment, I evaluated the effects of a standing staff in the room. I used leisure items in this assessment, as these items allowed me to better assess activity engagement relative to food and drink items. The top left graph shows that Ferdinand's mean choice latency in the TRS Present condition (3.30 s) was significantly shorter than in the TRS Absent Condition (13.04 s). The top middle graph depicts Ferdinand's engagement with the items he selected during the assessment. Ferdinand's mean activity engagement in the TRS Present condition was 46.87% of the session, whereas his mean activity engagement was 52.71% of the session in the TRS Absent condition. Overall, activity engagement was not differentiated across the conditions. The top right graph depicts the percent of the session that Ferdinand spent “frozen” or not moving at all. In the TRS Present condition, Ferdinand spent a mean of 0.38% of each session “frozen” and in the TRS Absent condition, Ferdinand spent a mean of 6.76% of each session “frozen”. Ferdinand spent more time immobile in the TRS Absent condition. The middle left graph depicts the rate of scanning. In the TRS Present condition, Ferdinand engaged in scanning at a mean rate of 1.5 scans per minute and in the TRS Absent condition, Ferdinand engaged in scanning at a mean rate of 0.28 scans per minute. Ferdinand engaged in more scanning in the TRS present condition. The middle graph depicts the rate of SIB. In the TRS Present condition, Ferdinand engaged in a mean rate of 0.55 SIB per minute. In the TRS Absent condition, Ferdinand engaged in a mean rate of 0.15 SIB per minute. The middle right graph depicts the rate of aggression across the two conditions. In the TRS present condition, Ferdinand engaged in a mean rate of 1.43 aggressions per minute compared to a mean rate of 0.38 aggression per minute in the TRS absent condition.

The bottom left graph shows a violin plot of Ferdinand’s heartrate in the TRS Present and TRS Absent conditions. There was no significant difference in Ferdinand’s heartrate in the TRS Present or TRS Absent conditions ($p=.4194$ on a Mann-Whitney U test). Finally, the bottom middle and right graphs depict the order in which Ferdinand selected items during the preference assessment. Ferdinand selected items in a similarly variable order across both TRS Present and TRS Absent conditions.

Figure 4

Choice Latency Analysis for Ferdinand in the presence/absence of his TRS (home). In TRS present conditions Ferdinand was in his home. In TRS Absent conditions Ferdinand was at the clinic.

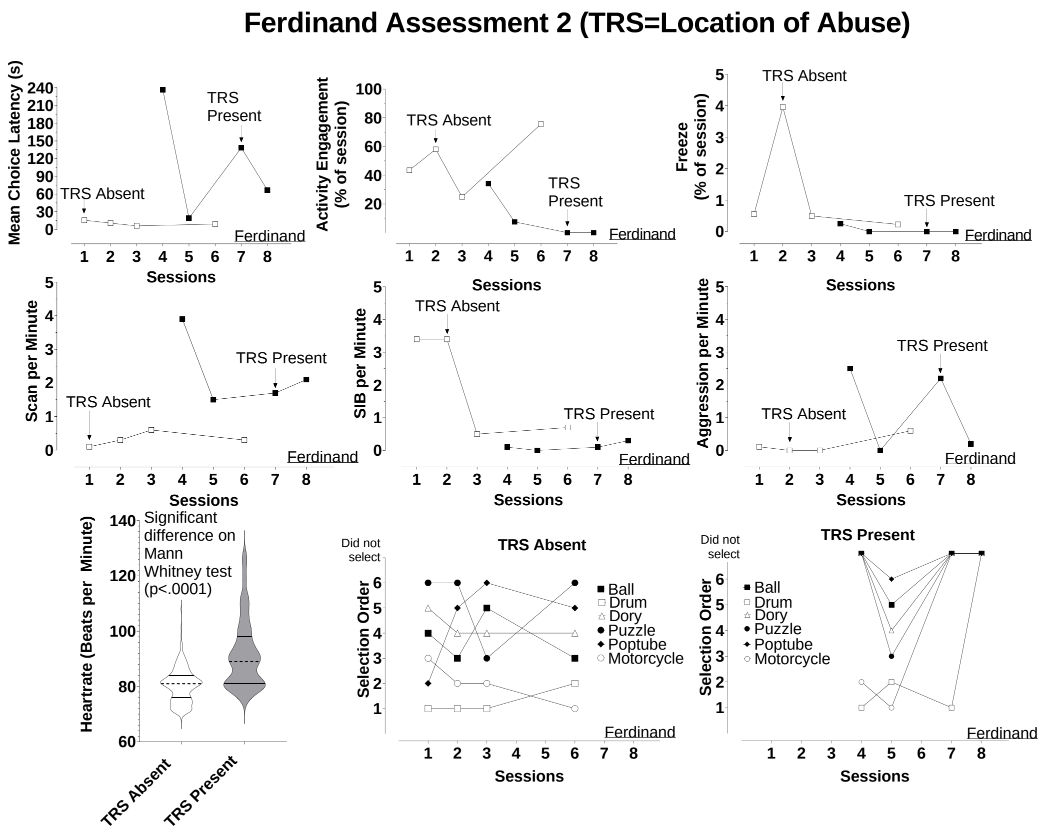
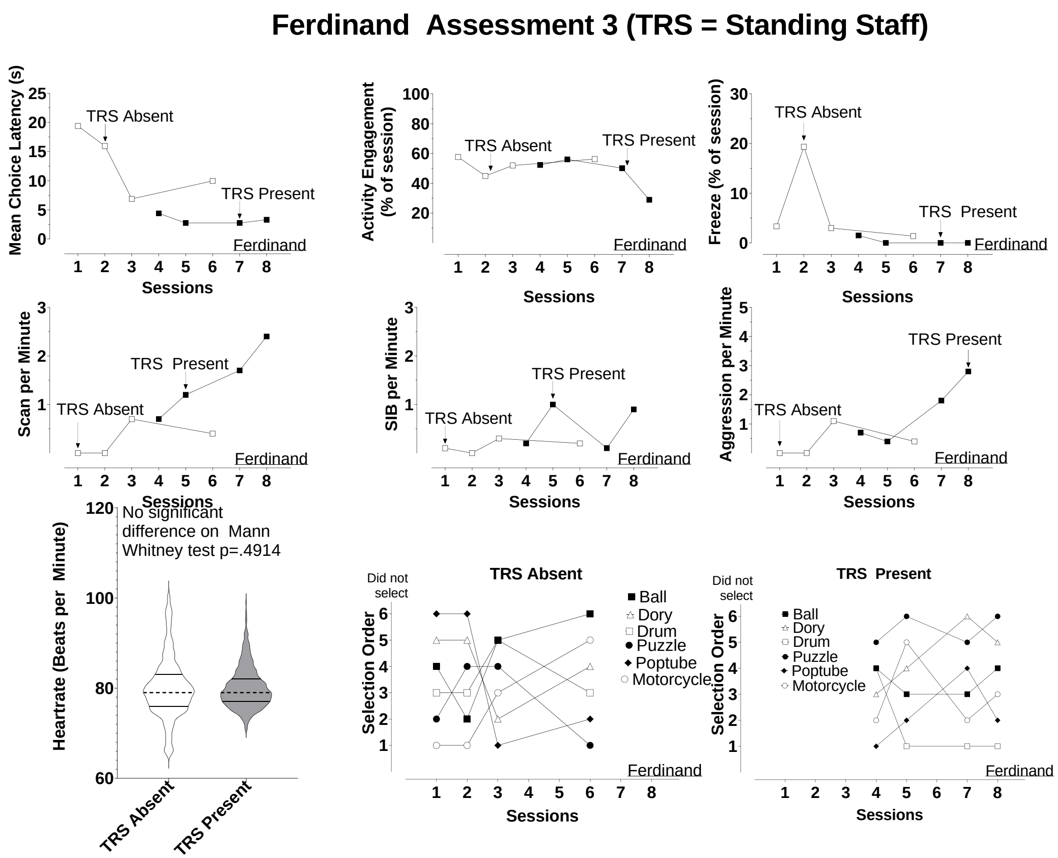


Figure 5

Choice Latency Analysis for Ferdinand in the TRS Present (standing staff) and TRS Absent (sitting staff) conditions. In the TRS Present condition, Ferdinand was in a clinic room with a staff standing next to him. In the TRS Absent condition Ferdinand was in a clinic room with staff seated next to him.



Pedro – Assessment 1

Figure 6 displays Pedro's behaviors from Experiment 1, Assessment 1. In this assessment, the TRS was the presence of food. The top left graph shows that Pedro's mean choice latency in the TRS Present condition was 10.39 s and his mean choice latency in the TRS Absent condition was 10.24 s. Pedro's latency to make choices was not differentiated across the TRS Present and Absent conditions. The top middle graph depicts Pedro's engagement with the items he selected during the assessment. His mean activity engagement in the TRS Present condition was 39.42% of the session whereas his mean activity engagement was 80.54% of the session in the TRS Absent condition. Overall, activity engagement was higher in the TRS Absent condition. The top right graph depicts the percent of the session that Pedro spent "frozen" or not moving at all. During the TRS Present condition, Pedro spent a mean of 0.46% of the session frozen. This was significantly less time that he spent frozen in the TRS Absent condition, a mean of average 2.50% of each session. The middle left graph depicts the rate of scanning. In the TRS Present condition, Pedro engaged in scanning at a mean rate of 0.56 scans per minute. In the TRS Absent condition, Pedro engaged in scanning at a mean rate of 0.23 scans per minute. Pedro engaged in more scanning in the TRS present condition. The middle graph depicts rates of SIB. In the TRS Present condition, Pedro engaged in a mean rate of 0.9 SIB per minute. In the TRS Absent condition, Pedro engaged in a mean rate of 0.25 SIB per minute. The middle right graph depicts rates of aggression. Pedro did not engage in any aggression during this assessment.
The bottom left graph shows a violin plot of Pedro's heartrate in the TRS Absent and TRS Present conditions. Pedro's median heartrate was significantly higher in the TRS Present condition at $p<.0001$ on a Mann-Whitney U test. Additionally, Pedro's heartrate spiked to higher values in the TRS Present condition than in the TRS Absent condition. Finally, the bottom

middle and right graphs depict the order in which Pedro selected items during the preference assessment. Pedro demonstrated a clear preference for the bouncy ball across both session types. The bouncy ball was the only item taken consistently across the assessment. During the fourth session, Pedro selected two other items (the ribbon and craft cord) but he did not select these items again during this assessment.

Pedro – Assessment 2

Figure 7 displays Pedro's behaviors from Experiment 1, Assessment 2. During this assessment, the TRS was people (besides Pedro's mother and two most highly preferred staff) in close proximity (3.05 m). The top left graph shows that Pedro's mean choice latency in the TRS Present condition (14.14 s) was significantly longer than in the TRS Absent Condition (7.59 s). The top middle graph depicts Pedro's engagement with the items he selected during the assessment. Pedro's mean activity engagement in the TRS Present condition was 72.33% of the session whereas his mean activity engagement was 95.04% of the session in the TRS Absent condition. Overall activity engagement was higher in the TRS Absent condition. The top right graph depicts the percent of the session that Pedro spent "frozen" or not moving at all. Pedro spent no time "frozen" during this assessment. The middle left graph depicts the rate of scanning. In the TRS Present condition, Pedro engaged in a mean rate of 0.43 scans per minute. In the TRS Absent condition, Pedro engaged in a mean rate of 0.13 scans per minute. Pedro engaged in higher rates of scanning in the TRS present condition. The middle graph depicts rates of SIB. In the TRS Present condition, Pedro engaged in a mean rate of 0.50 SIB per minute. In the TRS Absent condition, Pedro engaged in SIB in a mean rate of 1.70 SIB per minute. Pedro engaged in lower rates of SIB in the TRS Present condition than in the TRS Absent condition but the overall trend of SIB was decreasing across all sessions. The middle right graph depicts rates of aggression. In the TRS Present condition, Pedro engaged in a mean rate of 0.23 aggression per minute. In the TRS Absent condition, Pedro engaged in a mean rate of 0.13 aggression per minute. Pedro engaged in higher rates of aggression in the TRS Present condition than in the TRS Absent condition. The bottom left graph shows a violin plot of Pedro's heartrate in the TRS Absent and Present conditions. Pedro's median heartrate was significantly higher in the TRS present condition at $p<.0001$ on a Mann-Whitney U test. Additionally, Pedro's heartrate spiked to higher values in the TRS Present condition than in the TRS Absent condition. Finally, the bottom, middle and right graphs depict the order in which Pedro selected items during the CLA. Pedro picked the ball across all sessions. He picked more items in the first two sessions of the TRS Absent condition than in any of the other sessions.

Summary

Table 9 provides a summary of results from my assessment of the effects of TRS on behaviors during stimulus preference assessments. With respect to preference, I found that TRS systematically disrupted either selection or interaction with items. I found that choice latencies were longer in the TRS present condition in four out of six assessments. I found that activity engagement was lower for four out of six participants. I found that scanning was higher in the presence of TRS for all participants. I found that both self-injury and aggression were not consistently differentiated across TRS Present/Absent conditions. I found that heartrate was higher during the TRS present condition for five out of six assessments. Finally, I found that selection order was more variable and clear preferences were more difficult to identify in the TRS Present Condition.

Figure 6

Choice Latency Analysis for Pedro in the presence/absence of his TRS (food). In the TRS Present conditions Pedro was in his bedroom or sitting on the patio of his home and a food cart with food on it was placed within 3 m of where he was seated. In the TRS Absent condition, Pedro was in his bedroom or sitting on the patio with no food within 3 m.

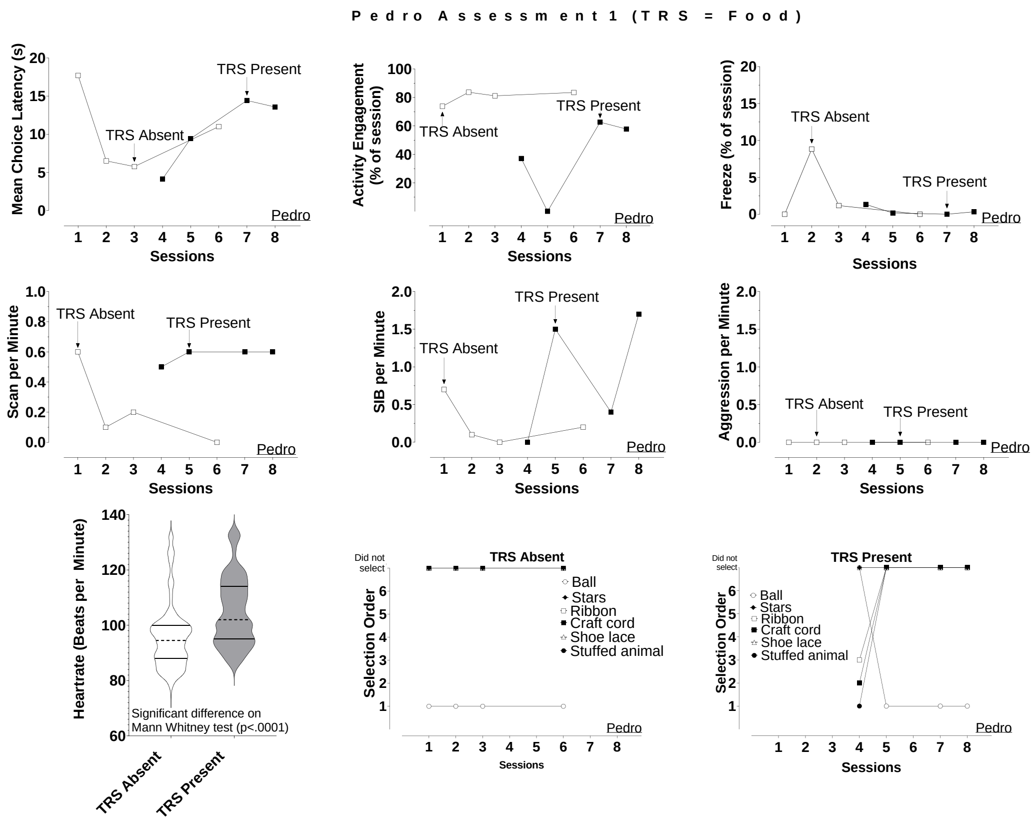


Figure 7

Choice Latency Analysis for Pedro in the presence/absence of his TRS (People). In the TRS Present condition, Pedro was in his bedroom or on the patio with his mother and one of his two most familiar staff and less familiar staff within 3 m . In the TRS Absent condition, Pedro was in his bedroom or on the patio with only his mother and one of his two most familiar staff.

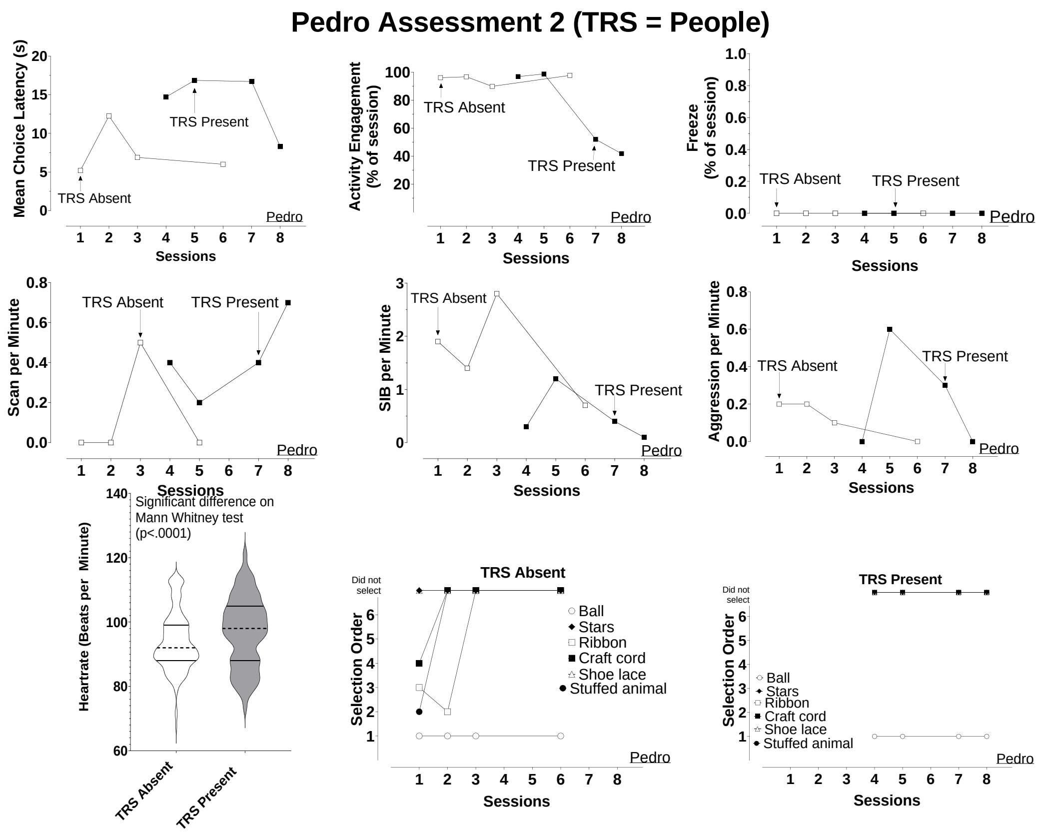


Table 7

Summary of behaviors in the TRS present condition relative to the TRS absent condition during choice latency analysis (CLA)

Participant	Kara (Pilot)	Ferdinand (Pilot)	Ferdinand	Ferdinand	Pedro	Pedro
TRS	Being alone	Location	Location	Standing Staff	Food	People
Choice Latency (Mean Duration)	***Longer***	Undifferentiated	***Longer***	***Longer***	Undifferentiated	***Longer***
Activity Engagement (% of session)	***Lower***	More variable	***Lower***	Undifferentiated	***Lower***	***Lower***
Freeze (% of session)	Higher	Higher	Undifferentiated	Lower	Undifferentiated	Undifferentiated
Scan (rate)	***Higher***	***Higher***	***Higher***	***Higher***	***Higher***	***Higher***
Self-injury (rate)	Higher	Undifferentiated	Lower	More variable	More variable	Undifferentiated
Aggression (rate)	N/A	Undifferentiated	More variable	Undifferentiated	Undifferentiated	More Variable
Heartrate (BPM)	***Higher***	***Higher***	***Higher***	Undifferentiated	***Higher***	***Higher***
Selection Order	***More variable***	***More variable***	***More variable***	Undifferentiated	***More variable***	Less Variable

CHAPTER 4

AN EVALUTATION OF THE EFFECTS OF TRS ON BEHAVIOR DURING FUNCTIONAL ANALYSIS

Trauma-related stimuli (TRS) have been shown to influence rates of aggression (Chen & Amsel, 1977; Corum & Thurmond, 1977; Williams, 1982; Williams & Lierle, 1986; Wood et al., 2008) and SIB (Gluck et al., 1985; Novak, 2003) in non-humans. Exposure to traumatic events has been reported to result in increased SIB and aggression in humans (e.g., Bakken et al., 2014a, 2014b; Barol & Seubert, 2010; Borghus et al., 2018; Boronat et al., 2013; Martinet & Legry, 2014; Turk et al., 2005). Differences in rates of aggression and SIB in the presence or absence of TRS have not been systematically and empirically evaluated in humans. Differences in the rate or function of aggression and SIB in the presence or absence of TRS could suggest that different treatment strategies are needed in the presence or absence of TRS to produce robust, consistent treatment effects. Differences in rate or function of problem behavior in the presence or absence of TRS would also suggest that failure to assess for problem behavior in both contexts may lead clinicians to develop treatment plans that are more or less effective in different settings, depending on the presence or absence of TRS. The purpose of Experiment 2 was to evaluate the effects of TRS, that were demonstrated in Experiment 1 to differentially affect behavior during preference assessments, on aggression, SIB and heart rate during a standard functional analysis.

Method

Participants and Setting

The participants from Experiment 1 all participated in Experiment 2 in the same setting(s) as in Experiment 1. Based on the results from Experiment 1, the TRS for Kara was being alone, the

TRS for Ferdinand was the location of abuse, the TRS for Pedro was both food and people combined.

Institutional Review Board, Human Rights, Consent and Assent.

All procedures for institutional review, human rights, consent and assent were identical to Experiment 1. Participant assent was obtained before each session and two participants (Kara and Ferdinand) continued to request to participate in sessions without being asked.

Instruments

Behavior data was collected using Countee ® data collection application on iPod Touches ® or using BDataPro on Microsoft Surface Tablets ®. Heartrate data was collected using a Fitibt Sense (Kara) or an Apple Watch Series 7 ® (Ferdinand & Pedro).

Procedures

The basic procedure for all participants was a functional analysis (FA; Iwata et al., 1982/1994) with the addition of a tangible condition (Day, et al., 1988) (See Beavers et al., 2013; Hanley et al., 2003; for reviews). A separate FA was conducted for each participant in the presence and absence of their TRS, with the exception that for Ferdinand, for whom an FA of aggression was not completed in his home because his aggression towards peers was escalating outside of sessions and it was determined it would not be safe for peers or staff to conduct an FA in his home. All sessions conducted in the specialized clinic were conducted in a small room with two chairs, a table, and a one-way mirror for unobtrusive observation. Blocking pads were always present in the room and used to block dangerous SIB or aggression. All sessions were 10 min in duration, except for one session for Ferdinand that was 8 min and 29 s. This session was terminated after Ferdinand hit his head hard on the one-way mirror. Ferdinand was taken to medical staff for an evaluation and was subsequently cleared for additional FA sessions. Sessions for Kara and Ferdinand were conducted by graduate and undergraduate students. Pedro's mother served as the therapist for all of his sessions.

Alone. Alone sessions were only conducted during the first phase of Ferdinand's assessment in the specialized clinic. He was seated alone in the session room observed through the one-way mirror. Prior to the start of the session, a therapist told Ferdinand, "I need you to wait here. I'll be back in a few minutes".

No interaction. The participant was seated in the session room and a therapist sat or stood in the room with the participant but did not interact with the participant.

Attention. Prior to all attention sessions, the therapist talked with the participant and provided physical attention as requested (high fives, holding hands, patting on the back, etc.) for 2 min. At the start of the session, the therapist said, "I have to do some work right now, you can play with the things on the table if you'd like to." The therapist then looked at papers or a phone and did not interact with the participant unless target behavior occurred. If target behavior occurred, the therapist provided brief comfort statements or requested for the participant to stop engaging in the target behavior and provided non-blocking physical contact. The therapist continued verbal and physical attention for 30 s before returning to what they were doing before the target behavior occurred. Adaptations to these procedures had to be made for Kara because her TRS was being alone. The walls of the treatment rooms at the specialized clinic did not extend to the ceiling, therefore it was easy for Kara to hear the therapist's comments even when the therapist was not in the room with her. During the attention condition, 30 s of continuous vocal attention was delivered contingent on problem behavior.

Demand. During demand sessions, the therapist delivered demands to complete tasks each participant commonly encountered in their everyday life. For Kara, therapists asked her to walk from one chair to another chair that was 1.8 m away. The therapist also offered his or her hand to assist Kara in moving to the other chair. This instruction was re-stated every 10 s. Following SIB, the therapist said, “Ok you don’t have to” and stopped asking Kara to move to another chair for 30 s. For Ferdinand and Pedro, the therapist asked each to complete simple daily living and workshop tasks that they were often asked to complete at home or in their sheltered workshops. These tasks included completing puzzles, sorting items by color, folding laundry, and putting items into bins to “clean up”. The therapist delivered the instructions continuously unless target behavior occurred. If the participant did not comply within 3 s of the initial instruction, the therapist restated the instruction and modeled the action. If the participant still did not comply within 3 s, the therapist attempted to guide the participant to complete the action. If the participant resisted physical prompts, the therapist completed the task and immediately presented the next instruction. When target behavior occurred, the therapist said, “Ok you don’t have to” and moved work materials away from the participant for 30 s. Adaptations to these procedures had to be made for Kara since her TRS was being alone. During the demand condition, the therapist stated an instruction every 10 s. If problem behavior occurred the therapist said, “Ok you don’t have to” and then waited 30 s before delivering the next verbal instruction. Because model or physical prompts could not be delivered from outside the room, no model or physical prompts were delivered during TRS absent or TRS present conditions for Kara.

Tangible. During the tangible condition, prior to the start of the session, the therapist provided 2-min access to highly preferred items, identified using a stimulus preference assessment completed within three months of the FA). For Kara, highly preferred items included necklaces, lip gloss, Dr. Pepper and Milky-ways. For Ferdinand, highly preferred items were an iPad playing Teenage Mutant Ninja Turtles and Dr. Pepper, Coke, or sweet tea (chosen at the beginning of each tangible session). For Pedro, highly preferred items were a can of Sunkist or Dr. Pepper and a bin with small bouncy balls, ribbons, and shoelaces. At the start of the session, the therapist removed the highly preferred items. If target behavior occurred, the therapist gave the participant the items for 30 s. Because Kara’s TRS was being alone, all tangible items were delivered via a box that was lowered into the room from outside of the room. Each item was inside of a plastic cup. Kara would take plastic cups out of the box and access the tangible item inside the cup. The box was lowered, and Kara could continue taking items out of the box for the 30 s after target behavior occurred. After 30 s, the therapist removed the tangible items (Ferdinand and Pedro) or raised the box of items to where Kara could no longer reach them.

Session Arrangement

During the multi-element phases of Experiment 2, for Kara and Pedro, therapists chose sessions to conduct at random in blocks of five. I selected a randomized order because in similar assessments, Kara and Pedro quickly learned fixed session orders and I observed systematic changes in responding at the end of one session in anticipation of the next session. For example, during tangible sessions, Kara would say, “Just wait five more minutes and then you can listen to music” in anticipation of the control session; likewise, immediately following demand sessions, Kara started asking to leave the clinic in anticipation of the alone condition. Pedro was observed during a different assessment to begin guiding therapists from his room and hiding under his blankets before the sessions were started simply based on the materials that were being set up by the therapists for a specific session type. For Ferdinand, sessions were conducted in a consistent order (alone, attention, tangible, control, demand), as Hammond et al. (2013) demonstrated this session arrangement maximized the establishing operation (EO) for each condition. Additionally, for Pedro, a control session was always completed first before the typical session order. This was done in an attempt to ensure that putting on the heartrate monitor was never immediately followed by a “worsening” of conditions, as Pedro was observed in Experiment 1 to occasionally attempt to smash the watch or ask staff to take the watch off during the TRS Present sessions.

Definitions

All definitions of SIB and aggression were the same as in Experiment 1 with one exception. For Pedro, due to the severity of his SIB, the therapist attempted to block all instances of SIB with blocking pads or their body. An SIB attempt was scored each time that Pedro attempted to engage in one of his SIB topographies but was intercepted by a pad or the body of the therapist. If the direction of the motion would have produced SIB but did not, due to another person’s body being in the way, this was scored as a SIB attempt and not as aggression.

Inter-observer agreement

A second observer was present for a mean of 40.39% (32.38%-44.87%) of sessions in Experiment 2. Inter-observer agreement (IOA) was calculated using the proportional within interval agreement method. Sessions were divided into 10-s intervals. Within each interval, the smaller number of instances of behavior was divided by the larger number of instances. The values for each interval were summed, divided by the total number of 10-s intervals, and multiplied by 100. Table 7 provides interobserver agreement for Experiment 2 by behavior, participant, and application. Mean agreement on SIB across all sessions for Kara was 94.00% (82.54 % - 100%). Mean agreement Ferdinand for SIB was 99.24% (95.77-100). Mean agreement for Ferdinand for aggression was 96.82% (81.53-100). Mean agreement for Pedro for SIB was 98.34% (range: 93.31% - 100%). Mean agreement for Pedro for SIB attempts was

98.36% (range: 85.53% - 100%). Mean agreement for Pedro for aggression was 96.72% (range: 74.67% - 100%).

Procedural Fidelity

Procedural fidelity was scored by analysis of data on therapist and participant behaviors. I assessed all critical components of each condition based on the data collected during these sessions. Each component needed to occur within 10 s of the scheduled time based on the protocol. Procedural fidelity was scored for 52.69% of sessions. Table 8 provides procedural fidelity scores for Experiment 2 by participant. For Kara, the mean procedural fidelity score was 98.71% (range: 70.83% - 100%). For Ferdinand, the mean procedural fidelity score was 99.16% (range: 80.95% - 100%). For Pedro, the mean fidelity score was 93.61% (range: 76.96% - 100%).

Results

Kara

Figure 8 depicts the results of Kara's functional analysis. The top panel shows the rate of SIB Kara engaged in during the assessment. In the first phase (TRS absent), Kara engaged in no SIB in the control condition. She engaged in low levels of SIB occasionally in the tangible and attention conditions. She engaged in SIB at higher, variable levels in the demand (mean 1.9 instances per minute) and no-interaction (mean 2.04 instances per minute) conditions. There were two no interaction sessions in which Kara did not engage in SIB. These sessions were either the first session of the day or the second session of the day, following a control session. To determine if SIB was occurring in the no interaction sessions consistently, indicating an automatic function of SIB, I ended Kara's first functional analysis with three consecutive no interaction sessions. Kara did not engage in SIB in any of these sessions. Therefore, the results of my first functional analysis for Kara indicated that her SIB was maintained by access to escape from instructions.

In the second phase of Kara's assessment, she was alone in the session room. Other than the absence of a staff, all procedures were the same. She was observed to engage in low levels of SIB in the control (mean 0.27 instances per minute), tangible, and attention conditions. She engaged in moderate levels of SIB in the no interaction condition (mean 1.72 instances per minute). She engaged in high levels of SIB during the demand sessions (mean 5.81 instances per minute). To determine if SIB persisted in the no interaction condition sessions, I ran three consecutive no interaction sessions . Kara engaged in high rates of SIB in all three of these sessions (mean 4.03 instances per minute). The results of Kara's functional analysis in the presence of the TRS indicated that SIB was maintained by automatic reinforcement and escape from demands.

The bottom panel of Figure 8 depicts Kara's heartrate during the functional analysis. Heartrate was analyzed in 1-min intervals. Heartrate zones were determined for each participant based on their maximum heartrate being 220 minus their age in years (CDC, 2022). Maximum heartrate was calculated for each participant and three zones (below 50%, over 50% and over 60%) were assigned based on this maximum. The highest heart rate reading for each minute was used to assign a zone for that minute. The percent of minutes with a maximum heartrate reading in each zone is depicted on the bottom panel of Figure 8. If heartrate readings were not collected due to the participant removing the watch or moving the watch so that heartrate readings were not regularly collected, no bar is shown. White bars outlined in gray show the percent of minutes under 50% of maximum heartrate. Gray bars show the percent of minutes between 50.00% and 59.99% of maximum heartrate. Black bars show the percent of minutes with heartrate readings over 60.00% of maximum. During the TRS Absent phase, Kara infrequently had heartrate readings in the over 60.00% of maximum range. Across all sessions in the TRS Absent phase she had heartrate readings in the over 60.00% of maximum range for an average of 7.83% of each session. During the TRS Present sessions, she had a significant increase in heartrate readings over 60.00% of maximum heartrate range. Across all sessions in the TRS Present phase, she had heartrate readings in the over 60.00% of maximum range for a mean of 21.14% of each session.

Ferdinand

Figure 9 depicts the results of Ferdinand's functional analyses. The first graph in Figure 9 depicts Ferdinand's rates of SIB. In the first phase, the TRS Absent condition, SIB was primarily observed in the alone condition (mean 0.85 instances per minute) and the no interaction condition (mean 1.01 instances per minute). In the control condition, Ferdinand engaged in mean of 0.10 instances of SIB per minute. The fourth alone session was terminated at 8 min 29 s because Ferdinand hit his head with great force against the one-way observation mirror. Following that session, alone sessions were not conducted and were replaced with no interaction sessions so that staff could block SIB when needed. In the TRS Present phase, SIB persisted at low levels across all test conditions (mean SIB in the tangible condition was 0.24 instances per minute; mean SIB in the demand condition was 0.06 instances per minute; mean SIB in the attention condition was 0.10 instances per minute; mean SIB in the no interaction condition was 0.18 instances per minute) with no conditions being clearly differentiated from the control condition (mean SIB in control sessions was 0.32 instances per minute). SIB was observed to persist when the contingency was placed on aggression, with the highest rates of SIB occurring in the no interaction condition (mean 1.91 instances per minute). The results of my analysis of

SIB suggest that SIB is maintained by automatic reinforcement in both the TRS present and TRS absent conditions, with higher rates overall in the TRS present condition.

The second graph depicts the rate of aggression Ferdinand engaged in during his FA. In the first phase (TRS Absent), I programmed the FA contingencies for SIB. During these sessions, although the contingencies were in place for SIB, aggression persisted in the attention (mean 1.60 instances per minute) and demand conditions (mean 1.10 instances per minute) compared to the rates in the control condition (mean 0.10 instances per minute). In the second phase (TRS Present), with the contingencies still in place for SIB, aggression persisted across all test conditions (mean aggression in the tangible condition was 0.38 instances per minute; mean aggression in the demand condition was 0.06 instances per minute; mean aggression in the attention condition was 0.36 instances per minute; mean aggression in the no interaction condition was 1.00 instances per minute) compared to the control condition (average rate of aggression in control was 0.14 instances per minute). During consecutive control sessions with the TRS absent, aggression was reduced to zero instances per minute across four consecutive sessions. In the final phase, TRS Absent with the contingencies in place for aggression, I found that rates of aggression were highest in the tangible condition (mean 0.91 instances of aggression per minute) and in the attention condition (mean 0.90 instances of aggression per minute) relative to the control condition (mean 0.02 instances of aggression per minute). Overall, my results indicate that the function of Ferdinand's aggression in the TRS absent condition was access to tangible items and attention. In the TRS present condition, however, Ferdinand's aggression appeared to be automatically maintained with highest rates in the TRS Present, no interaction condition (mean 0.79 instances of aggression per minute) compared to the no interaction condition in the TRS Absent condition (mean 0.17 instances per minute).

The bottom of Figure 9 depicts Ferdinand’s heartrate during the functional analysis. Heartrate was analyzed in 1-min intervals. Heartrate zones were determined for Ferdinand in the same way that they were determined for Kara. The highest heart rate reading for each minute was used to assign a zone for that minute. The percent of minutes with a maximum heartrate reading in each zone is depicted on the bottom panel of Figure 9. If heartrate readings were not collected due to the participant removing the watch or moving the watch so that heartrate readings were not regularly collected, no bar is shown. White bars outlined in gray show the percent of minutes under 50% of maximum heartrate. Gray bars show the percent of minutes between 50.00% and 59.99% of maximum heartrate and black bars show the percent of minutes with heartrate readings over 60.00% of maximum. During the TRS Absent phase, Ferdinand had a higher heartrate at the beginning of the assessment. His heartrate decreased across the TRS absent phase and only very occasionally peaked above 60.00% of his maximum heartrate (190 beats per minute). In the TRS absent phase, Ferdinand’s heartrate was significantly higher. Upon returning to the TRS absent phase his heartrate was lower. A reversal to the TRS present phase increased Ferdinand’s heartrate again. Finally in the last TRS Absent phase, Ferdinand’s heartrate consistently stayed below 50.00% of maximum. Across all sessions in the TRS Absent phase, Ferdinand’s heartrate peaked above 50.00% of maximum heartrate in 16.93% of minutes. In the TRS Present phase, Ferdinand’s heartrate peaked above 50.00% of maximum heartrate in 36.87% of minutes.

Table 8

Inter-observer agreement for Experiment 2

	Total Number of sessions	Sessions with IOA	Percent with IOA	Range	Mean
Kara					
SIB	156	70	44.87	82.54-100	94.00
Ferdinand					
SIB	127	41	32.38	95.77-100	99.24
Aggression	127	41	32.28	81.53-100	96.82
Pedro					
SIB	129	53	41.09	93.31-100	98.34
SIB Attempt	129	53	41.09	85.53-100	98.36
Aggression	129	53	41.09	74.67-100	96.72

Table 9

Procedural fidelity for Experiment 2

	Total Number of Sessions	Sessions with Procedural Fidelity	Percent with Procedural Fidelity	Range	Mean
Kara	156	68	43.59	70.83-100	98.71
Ferdinand	127	52	40.94	80.95-100	99.16
Pedro	129	96	74.42	76.96-100	93.61

Figure 8

SIB and heartrate during functional analysis of SIB in the absence and presence of TRS for Kara.

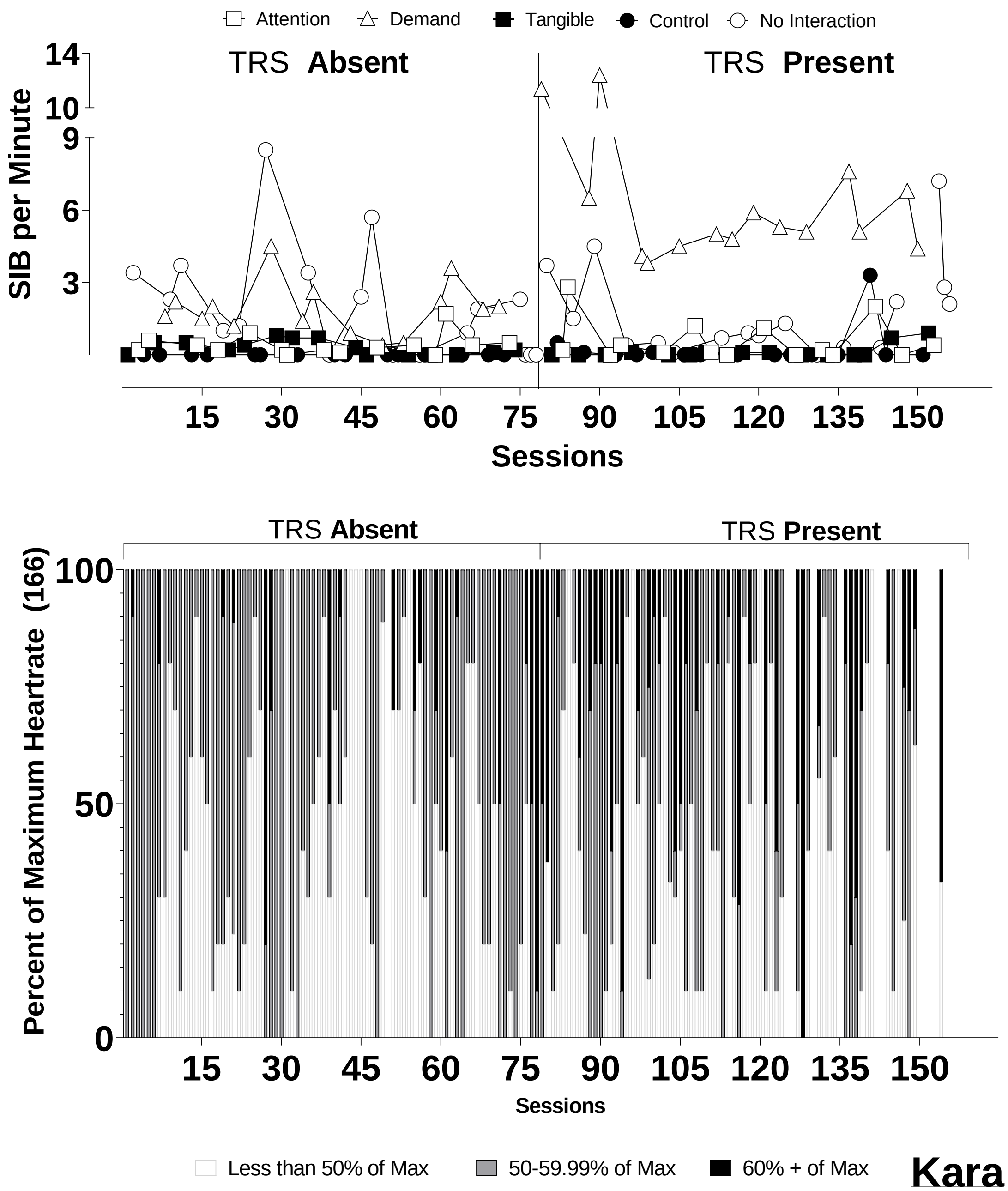
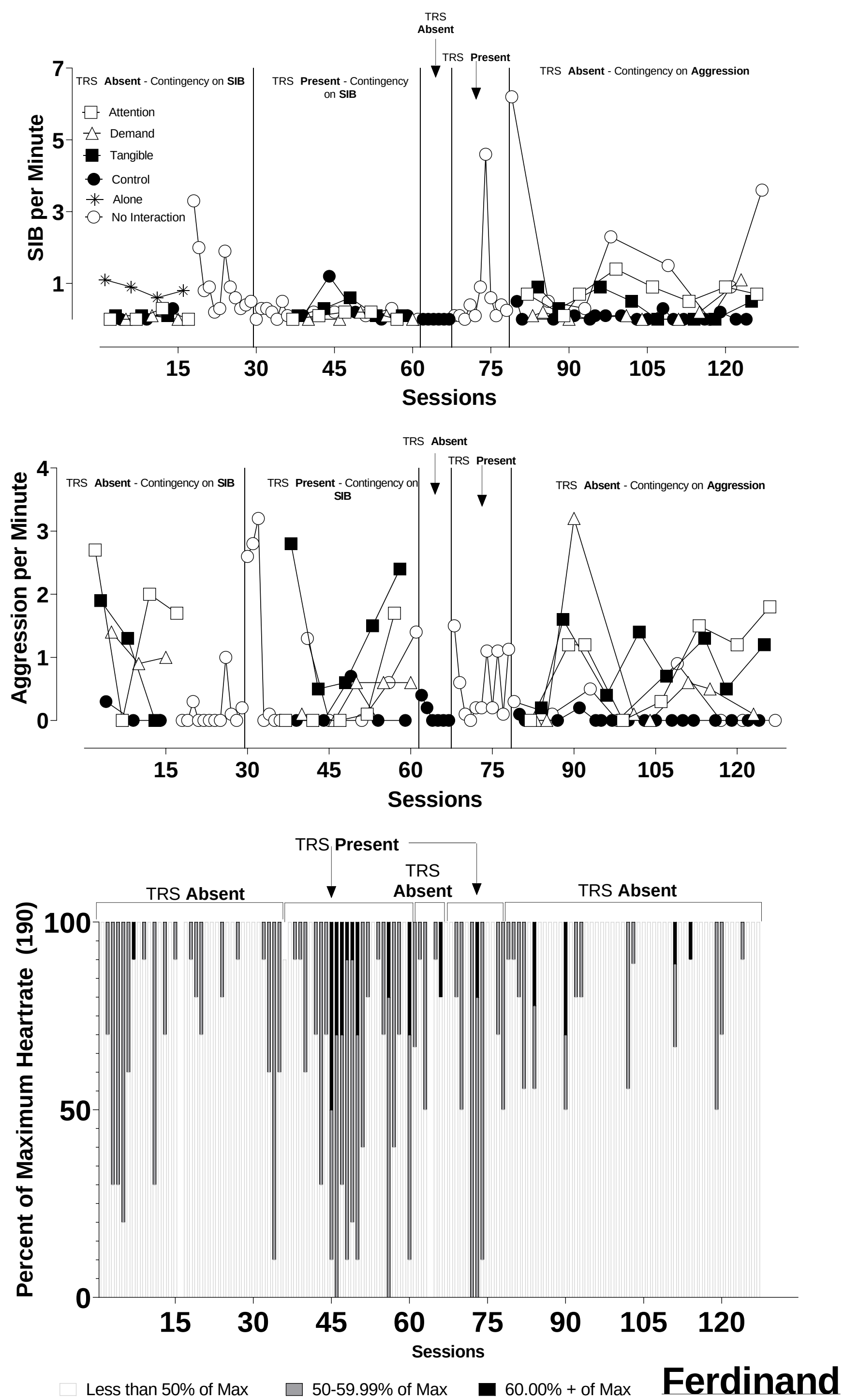


Figure 9

Aggression, SIB and heart rate during functional analysis of aggression and SIB in the absence and presence of TRS



Pedro

Figure 10 depicts the results of Pedro's functional analyses. The top panel shows the rate of aggression Pedro engaged in during the assessment. In the first phase, the TRS was absent, and the contingencies of the assessment were placed on aggression. During these sessions, aggression consistently decreased across all session types to near zero levels in all sessions. In the second phase (TRS present) aggression increased in all conditions. When I programmed the contingencies for SIB (with the TRS present), aggression persisted in all conditions. Following a return to the TRS absent condition with the contingencies programmed for SIB, aggression decreased in all conditions except the attention condition. The response pattern in the first phase (TRS Absent) did not show a clear function of aggression. The response patterns in the second, third and fourth phase (TRS Present) all suggest an automatic function of aggression.

The second graph in figure 10 depicts Pedro's rates of SIB. In the TRS absent condition with the contingencies programmed for aggression, SIB decreased across all session types except the demand condition. In the TRS present condition (with the contingency on aggression), SIB increased in all conditions relative to the TRS absent condition. In the third phase, the TRS was still present but I programmed the contingencies for SIB. SIB further increased in this condition. In the fourth phase, the TRS was absent and I programmed the contingencies for SIB. In this phase, SIB persisted in all conditions. The results of this analysis suggest that Pedro's aggression is maintained by automatic reinforcement in the TRS present condition. Pedro's SIB appear to be maintained by automatic reinforcement in both TRS present and TRS absent conditions. In the TRS Absent condition, it appeared that an escape and access to tangible items may have been reinforcers but responding in these conditions was not consistently differentiated from control sessions. Overall, Pedro engaged in higher rates of SIB in the TRS Present condition (mean 1.31 instances per minute) compared to the TRS Absent condition (mean 0.73 instances per minute).

The bottom panel of Figure 10 depicts Pedro's heartrate during the functional analysis. Heartrate was analyzed in 1-min intervals. Heartrate zones were determined for Pedro in the same way that they were determined for the other two participants. The highest heart rate reading for each minute was used to assign a zone for that minute. If heartrate readings were not collected due to the participant removing the watch or moving the watch so that heartrate readings were not regularly collected, no bar is shown. White bars outlined in gray show the percent of minutes under 50% of maximum heartrate. Gray bars show the percent of minutes between 50.00% and 59.99% of maximum heartrate and black bars show the percent of minutes with heartrate readings over 60.00% of maximum. During the TRS Absent phase, Pedro had a higher heartrate at the beginning of the assessment. His heartrate decreased across the TRS absent phase and only very occasionally peaked above 60.00% of his maximum heartrate (191 beats per minute) by the end of the first phase. In the TRS present phase, Pedro's heartrate initially increased and then was variable for the duration of the TRS present phase. Upon returning to the TRS absent phase, his heartrate was lower than in the previous phase but remained variable. Across all sessions in the TRS Absent phase, Pedro's heartrate peaked above 60.00% of maximum heartrate in 24.76% of minutes. In the TRS Present phase, Pedro's heartrate peaked above 60.00% of maximum heartrate in 12.84% of minutes. However, there was a very substantial difference across iteration s of the TRS Absent phases. In the first TRS Absent phase, Pedro's heartrate peaked above the 60.00% of maximum heartrate in 40.90% of minutes. In the last TRS Absent phase, his heartrate peaked above the 60.00% of maximum heartrate in 6.09% of minutes.

Figure 10

Aggression, SIB and heart rate during functional analysis of aggression and SIB in the absence and presence of TRS.

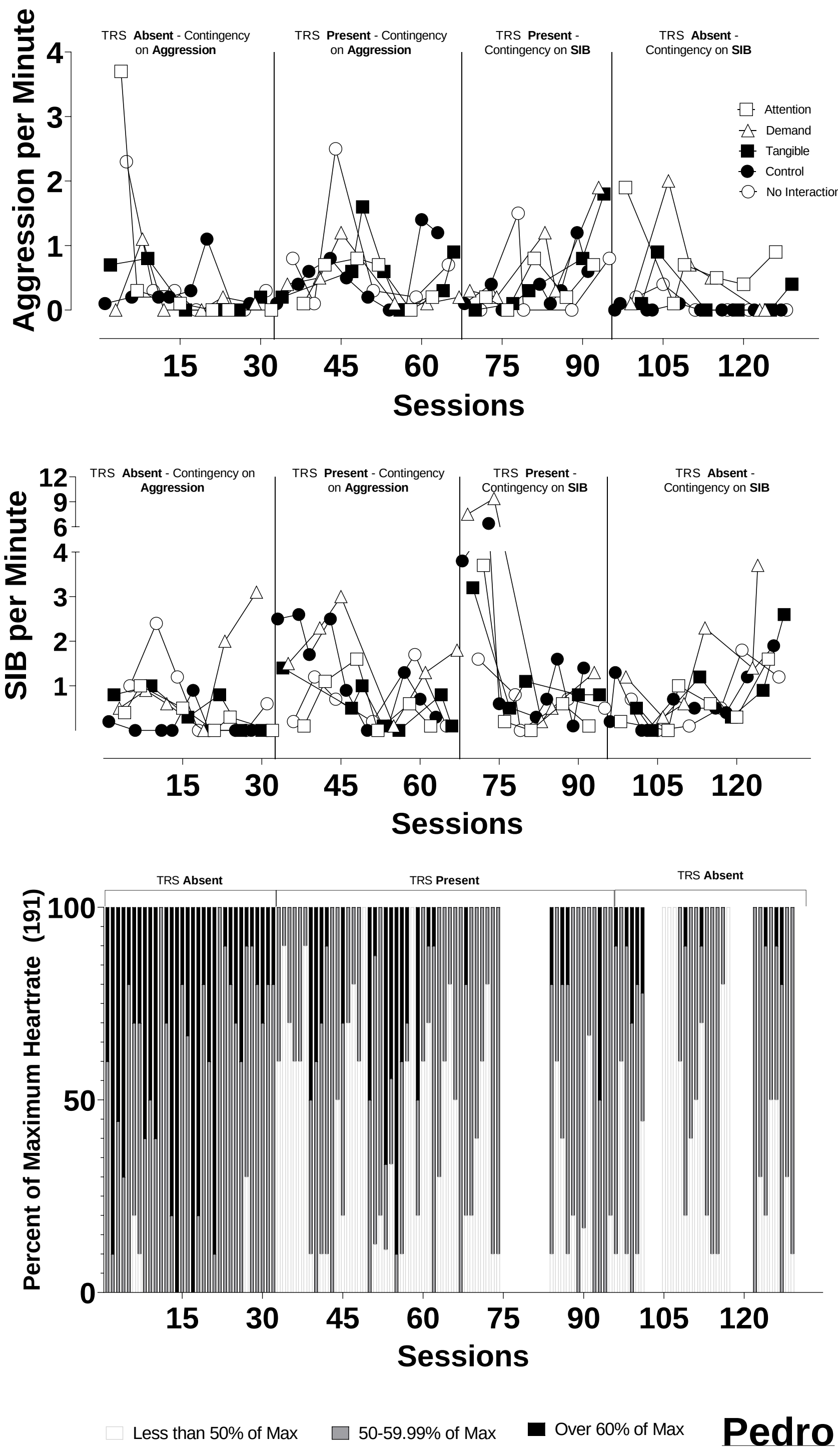


Table 10

Summary of behaviors in the TRS present condition relative to the TRS absent condition during functional analysis

	Kara		Ferdinand		Pedro	
	TRS Absent	TRS Present	TRS Absent	TRS Present	TRS Absent	TRS Present
SIB	Escape	Automatic	Automatic	Automatic	Automatic	Automatic
Aggression	N/A	N/A	Tangible & Attention	Automatic	N/A	Automatic

Summary

In Experiment 2, I conducted an FA for each participant in the presence/absence of TRS. Table 10 provides a summary of the results of Experiment 2. I found that for two of my participants the functions of problem behavior were different in TRS Present and TRS Absent conditions (Kara and Ferdinand). Pedro's SIB was automatically maintained in the TRS Present and TRS Absent conditions, but he engaged in higher rates of SIB in the TRS Present condition. Aggression was automatically maintained in the TRS Present condition but was undifferentiated and appeared to be ceasing in the TRS Absent condition. Overall, the results of Experiment 2 demonstrate that the presence or absence of TRS can differentially affect both function and rates of problem behavior. Differences in function of problem behavior across TRS Present and TRS Absent conditions suggest further research is needed in this area as failure to identify TRS and assess the differential effects of TRS could prove problematic for the development of effective interventions for problem behavior.

CHAPTER 5

DISCUSSION

In both Experiment 1 and 2, I found that participant's behaviors differed across TRS Present and TRS Absent conditions. In Experiment 1, I found that the presence of TRS differentially affected choice latencies and other behaviors during preference assessments, but these effects were idiosyncratic to each participant. I found that in the presence of TRS, scanning was higher in all analyses, choice latencies were longer in four of six analyses, activity engagement was lower in four of six analyses, and selection order was more variable in four of six analyses. Interestingly, rates of aggression and SIB were not consistently different in the TRS Present and TRS Absent sessions during the CLA. In Experiment 2, I found differences in rates of problem behavior in the TRS Present and TRS Absent conditions. For two participants, the function of problem behavior appeared to be differentially affected by the presence or absence of the TRS. All participants demonstrated an automatic function of aggression and SIB in the TRS Present condition. Overall, the results of both Experiments suggest that in some cases, TRS affect the function and rate of SIB and aggression for people with ID and trauma histories. In this chapter I will 1) describe the limitations of my experiments, 2) suggest a radical behaviorist account of LH and post-trauma behavior change and 3) discuss implications of this conceptualization of post-trauma behavior change and my experiments for the assessment and treatment of post-trauma behavior change in people with ID.

Limitations

There are several limitations of these experiments. First, there are several procedural limitations that should be noted. In Kara's demand condition in Experiment 2, during the TRS Absent condition, staff offered Kara a hand to assist her with walking from one chair to another.

In the TRS Present condition, staff could not offer a hand to assist her to walk from one chair to another because they were not in the room with her. Kara had not walked without holding the hand of another person for several months prior to this assessment. However, she did not walk during any of the FA sessions, with or without the offer of a person to walk with her.

A second limitation is the instruction used in Kara's demand may have also been conditioned as a TRS. The instruction to walk would not have been present at the time of her falls, but it is possible that this instruction had been conditioned as a second-order TRS. Kara would frequently become visibly shaky or sweat when asked to walk, even though she rarely stood up when given this instruction. It may have been better to use instructions other than instructions to walk because her trauma incidents were falls when she was walking without assistance. It's possible that this influenced the results of Kara's functional analysis and could have produced carry-over effects to other sessions. This may have been part of the reason that SIB occurred in the no interaction sessions that followed demand sessions in the TRS absent phase of Kara's assessment.

Third, for Pedro and Kara, I did not provide three demonstrations of the effect of the TRS on SIB (Kara ad Pedro) and aggression (Pedro). For all participants, after the initial FAs, I did not want to further expose people to TRS without having a clear clinical reason for exposing them to their respective TRS. For Ferdinand, because of Covid restrictions, the order of conditions was influenced by facility regulations on whether sessions could be conducted in the home or at the clinic. This resulted in more demonstrations of the effect of TRS for Ferdinand. Additionally, I could not conduct a TRS Present FA of Ferdinand's aggression due to safety concerns. Because of this, it is not possible to draw strong conclusions about whether or not the social functions of aggression were consistent across both TRS present and absent conditions for Ferdinand.

Fourth, across Experiments 1 and 2, I used three different heartrate monitoring devices. The Fitbit Charge ® and Fitbit Sense ® have produced mixed results in comparisons with established heartrate monitors. However, I used the same device for each participant for the duration of each assessment. Therefore, although the FitBit ® devices may have been less accurate, I was still able to make a comparison within each participant across the different conditions. That is, because my comparisons are within participants, it is less important that the devices provide an accurate heartrate reading than that any inaccuracies relative to another device are consistent across phases.

In addition to the procedural limitations noted above, there were two methodological limitations because there is limited research on the effects of conditioned aversive stimuli (CAS) with people with ID. Although I had access to relatively detailed information about each participant's traumatic events, there is no way to know all the stimuli that were present at the time of those events. Even if all stimuli could have been identified and replicated in my assessments, the aspects of specific stimuli that make them more or less likely to become CAS based on their association with the traumatic event is not well understood. Similarly, it is possible that the stimuli I selected to evaluate were aversive to these participants for reasons completely unrelated to the traumatic events I identified. It is possible that infrequently encountered people are aversive to Pedro simply because social attention is aversive to him. I have no reason to suspect that attention generally is aversive to Pedro, but the results of my assessments might be expected if any aversive stimulus was present during the TRS present conditions. Additionally, it is possible that additional people or food were aversive prior to

Pedro's trauma. However, due to the remote, but prolonged, history of his trauma, there is not a current behavioral methodology to make such a comparison. This limitation applies to all participants. However, given that all the participants needed and did interact with their respective TRS on a daily basis, whether or not the effects of these stimuli are because of a conditioning history with a traumatic event, these stimuli still produce differential effects on behavior and these effects will likely need to be addressed in intervention plans to reduce these participant's problem behaviors and increase their adaptive behaviors in the presence of these unavoidable stimuli.

Despite these limitations, the results of my experiments suggest that the effects of TRS can be evaluated in people with ID through measurement of non-verbal behavior and the use of commercially available heartrate monitoring devices. These results also suggest that consideration of TRS in the assessment of problem behaviors for people with ID who have experienced trauma could be important in the development of effective treatments. Finally, the pattern of behaviors I observed in the TRS Present/Absent conditions in humans are consistent with the behavior patterns reported on in other species when exposed to IAS and subsequently to CAS. These similarities suggest that the mechanism through with LH develops could be the same mechanisms that result in post-trauma behavior changes in humans. I will suggest a radical behaviorist account of LH and trauma based on my literature review and the results of my experiments.

A Radical Behaviorist Account of Learned Helplessness & Post-Trauma Behavior Change

The two-factor theory account of LH has been the predominant understanding of how LH is developed and is maintained (Maier & Seligman, 2016). Two-factor theory suggests "fear" as a mediator to maintain the effects of CAS on behavior. However, I suggest that a radical behaviorist approach can account for LH effects without appeals to “fear” as a necessary mediator. Initially, the IAS functions as an establishing operation (EO) that increases the value of escape. With exposure to this EO, behaviors previously reinforced by escape from other aversive stimuli increase. These behaviors decrease as the IAS also becomes a signal that escape is not available (S^{Δ}). With repeated exposure to this contingency, responding will likely cease, as is typical of behavior undergoing extinction (e.g., Ferster & Skinner, 1957). An IAS experienced non-contingently should lead to cessation of any behavior occurring after the onset of the IAS that does not result in termination of the IAS (extinction).

Evidence that the aversive stimulus used during IAS exposure begins to function as an S^{Δ} comes from studies involving assessment of stimulus generalization. For example, researchers found escape responses were least likely to occur during stimulus generalization tests when the novel aversive stimulus was similar to the previously experienced IAS (e.g., Rosellini & Seligman, 1978). Additionally, LH deficits occur primarily in the presence of CAS, even when the IAS is absent (e.g., Bersh et al., 1986; Minor et al., 1990). Finally, escape responses (to reduce or terminate exposure to CAS or novel aversive stimuli) are more likely to occur when “safety” signals paired consistently with periods in which the IAS was never experienced are present (e.g., Bersh et al.; Minor et al.).

Along with the evidence of operant processes described above, there is evidence that respondent processes are also critical in the development of LH. The physiological responses to painful stimuli and the responses of animals that “play dead” are very likely respondent. Exposure to IAS initially elicits behavior (respondent). Elicited behaviors include increased heartrate, increased movement, and vocalizations (e.g., Anisman et al., 1978; Moran & Lewis-Smith, 1979). If some of the increased movements are closely followed by escape, those respondent behaviors may be reinforced and continue to occur in the future as part of an operant contingency. The primary aversive stimulus (PAS) and CAS are both EO's and can become S^Ds for escape. The more similar an aversive stimulus is to others that have been escaped, the more likely the previously reinforced escape response is to occur as the aversive stimulus then functions as an EO and as an S^D. When no movement is reinforced (extinction), observable movement ceases as the PAS becomes an S^Δ signaling that escape is not available. This is adaptive in some cases, as when playing "dead" is the best option to escape from a predator (Francq, 1969). The cessation of behavior in this case co-occurs with physiological changes that are immediately adaptive for an organism, including a reduction in the physiological response to pain (e.g., King et al., 2001; Maier et al., 1983; Moye et al., 1981). The initial burst of activity (movement, vocalizations, etc.) followed by cessation of movement, vocalizations, decreased sensitivity to pain, and other responses, has been referred to as the "biphasic response" of organisms to IAS (Maier & Seligman, 2016). This biphasic response pattern includes contingencies that are both respondent (elicited) and operant. This experience of the second part of the biphasic response appears to be critical in the development of subsequent physiological and behavior problems and these responses can be understood without appeals to "fear" (or vocal/verbal behavior) as mediators of the long lasting effects of exposure to trauma.

Based on this literature on LH and PTSD reviewed thus far, I propose a functional-analytic definition of LH and trauma exposure:

1) An organism is exposed to an aversive stimulus that is high intensity (either through prolonged exposure or repeated exposures) that produces a bi-phasic response consisting of:

a. An initial increase in frequency and variety of responses in the presence of the primary aversive stimulus (PAS). Some of these responses may be elicited by aversive stimuli (respondent) and some may have previously been reinforced by escape (the PAS functions as an EO)

b. Prolonged or repeated exposure to the PAS no longer produces observable movements (extinction) and physiological changes occur that reduce sensitivity to external stimuli (second part of the biphasic response to aversive stimuli - respondent).

2) Following exposure to both components of the biphasic response, exposure to

a. Trauma stimuli (TS; the PAS experienced) function as an $S^{\Delta \text{ (escape)}}$ and are likely to elicit stillness and reduced sensitivity to both pain and external reinforcers.

b. Trauma related stimuli (TRS; previously neutral stimuli conditioned at the time of the trauma as CAS) now function as EOs for escape.

c. Inescapable exposure to TRS are likely to shift these stimuli to having similar effects as the TS.

d. Physiological changes occur that are detrimental to the physical health of the organism in the long-term, such as increased sleep disturbances, ulcers (e.g., Lanum et al., 1984; Seligman, 1968;), chronic inactivity (Belda et al., 2004; Conoscenti et al., 2017; Greenwood et al, 2003; Maier 1990; Plumb et al., 2015; Seligman, 1968), and weight loss (Hu et al., 2010; Wisłowska-Stanek et al., 2016).

Implications for Assessment and Treatment of Post-Trauma Behavior Change

The current psychological definition of "trauma" as it relates to diagnosis of PTSD requires certain topographically described events to occur (e.g., sexual violation, exposure to threatened death, etc.). This definition has required adaptations for specific groups, including children and people with ID (Fletcher, 2007). However, important features of responses to trauma likely extend beyond diagnostic scenarios. It has been noted that although many of the life events on the adverse childhood experiences scale do not qualify a person for a diagnosis of PTSD, higher numbers of these experiences do reliably predict many of the health issues that are common across people and non-humans that have been exposed to IAS (e.g., Felitti et al., 1998). A functional definition of trauma based on an analysis of behavior at the individual level may prove useful in the broad identification of people who could benefit from trauma-focused treatments. Such a definition must be applicable to individuals to be clinically useful. Although most studies on LH report data only on the group level, early studies noted that some non-humans exposed to IAS did not demonstrate the classic LH deficits (Maier & Seligman, 2016). For example, the mean escape latency increased for the group, but the escape latency of individual organisms varied. Some animals stopped escaping altogether whereas others learned to escape as quickly as controls (Musty et al., 1990). Thus, a functional definition of trauma exposure cannot rely only on the structure of the IAS. Alternately, analysis of the behavioral and physiological effects of IAS on the individual level could circumvent these problems. The DSM specifies the types of events that must occur for a person to be diagnosed with PTSD, and the qualifying events have had to be adjusted to accommodate post-trauma behavior change that occurs following events that do not meet he DSM criteria, specifically for children and people with ID (Fletcher, 2007). If identification of trauma is based on the effects of a particular stimulus on behavior, and the ongoing effects of TRS on behavior, then there is no need to determine a priori what stimuli are, "bad enough" to be traumatic. There are certainly situations that would be objectively more likely to produce post-trauma behavior change but those situations do not always produce post-trauma behavior change. Additionally, research focused on individual analyses could expand our understanding, enhancing our capacity to intervene in clinical settings. Further, it may be important to understand subtypes of IAS and their idiosyncratic effects on behavior and physiology in order to best develop a definition flexible enough for widespread use but specific enough to illuminate individual treatment needs.

During preference assessments for all participants, in the TRS Present condition choice latency, activity engagement, scanning, and heartrate were significantly different from rates of those behaviors in the TRS Absent condition. Session Arrangement 2 allowed for these differences to be clearly observed with minimal exposure to TRS for all participants. There are two benefits of this assessment. First, preference assessments are a simple, routine part of clinical practice. Second, this assessment could be administered fairly quickly, in order to determine if the further effects of TRS should be considered in functional analysis and the development of treatment strategies for people with ID and histories of trauma who engage in problem behavior. Further research should be done with this assessment to determine if this is a useful method for identifying TRS for participants when less detailed information about past traumatic events is available.

Interventions to Address Post-Trauma Behavior Change

During Experiment 2, all participants showed differences in the rate or function of problem behaviors in the presence or absence of TRS. These findings suggest that assessment of these differences may be critical to the development of effective behavior intervention plans for people with ID who have experienced trauma. Interventions that may be effective in the absence of TRS may be ineffective in the presence of TRS. For example, if problem behavior functions to gain access to tangible items in the absence of TRS but is automatically maintained in the presence of TRS, functional communication training alone is likely to be ineffective in treating problem behavior across all settings. Additionally, treatment failures that occur due to the presence or absence of TRS may suggest to clinicians that there are treatment fidelity problems in alternate settings when, in fact, the items that are reinforcing in the absence of TRS may not be the reinforcers of problem behavior in the presence of TRS.

Studies evaluating behavior interventions to reverse LH have focused primarily on methods to reduce the classically described "escape deficit." Due to this "escape deficit," the non-human, when exposed to an aversive stimulus from which escape is possible, does not emit an active response to escape the aversive stimulus. Interestingly, these studies have not evaluated whether re-acquiring escape responses following treatment for LH produces changes in the physiological effects of LH. The physiological effects of LH can significantly decrease the quality of life for people who have experienced a high number of adverse events (e.g., Felitti et al., 1998). Evaluating the effects of behavioral interventions on physiological changes could be useful in prioritizing treatments that prevent or diminish the physiological consequences of prolonged stress. For example, some studies have shown that ulcers develop subsequent to IAS exposure for animals that display LH escape deficits (e.g., Lanum et al., 1984; Seligman, 1968). It would be interesting to know if remediation of the LH escape deficit through shaping and prompting of the escape response also decreases the number or severity of ulcers. Likewise, it would be interesting to know if the sleep changes observed in non-humans are ameliorated by training active escape responses.

There are several findings that have been repeatedly demonstrated in non-human studies that may be important for behavior analysts to consider when working with people who have been exposed to trauma. First, studies with non-humans have shown overall decreased activity (e.g., Anisman et al., 1978; Kim et al., 2017; Landagraf et al., 2015; Lanum et al.; Lawry et al., 1978; Rosellini & DeCola, 1981; Rosellini et al., 1982). When troubleshooting lack of skill development during interventions to teach new skills, it may be helpful to note that responses that require greater overall body movement, especially in the presence of TRS, are less likely to be acquired than responses that require less overall movement. Second, with respect to conducting preference assessments and teaching new skills, non-human studies have demonstrated decreased rates of responding to gain access to food on a variety of tasks (e.g., Ferrandiz & Pardo, 1990; Lucas et al., 2014; Rosellini, 1978; Rosellini, 1984; Seligman, 1968; Widman et al., 1992), deficits in demonstrating behavior change when exposed to punishment contingencies (e.g., Baker, 1976), decreased accuracy on choice discrimination tasks to access food (e.g., Rosellini et al. 1982), decreased accuracy on choice discrimination tasks to access escape (Jackson et al.), and longer latencies to make choices in mazes, (e.g., Jackson et al., 1980). These changes in responding on discrimination tasks are likely important to consider as these responses are likely to affect the outcome of preference assessments and the rate of learning for most skills. Evaluating the function of preferred items as reinforcers for different types of responses could be critical to treatment success for individuals with ID. Likewise, when significant changes in preference are noted across location or sets of stimuli, this could signal to clinicians that a possible exposure to trauma may have occurred, even if the person is unable to verbally disclose the event.

Finally, non-humans have been shown to improve on their performance in escape tasks with shaping and prompting but not with exposure to escape extinction (Rush et al., 1983). This is an important finding to consider, as some have described the effective exposure treatments operating via extinction; however, studies on LH suggest extinction is unlikely to be the mechanism by which these treatments are effective. Roche et al. (2008) suggested that it may be more beneficial to provide exposure to CAS that are less closely related to the primary aversive stimulus rather than exposure to either closely related stimuli or the primary aversive stimulus itself (see Dymond & Roche, 2009 for a full discussion). This form of graduated exposure (i.e., incrementally increasing durations of, or proximity to, a CAS while escape responses are blocked) has been described as a form of escape extinction, which some researchers have described as unexpected (e.g., Dymond & Roche). There is a possible alternative explanation. By avoiding high-intensity aversive stimulation, the graduated-exposure effect may prevent the second part of the biphasic response, removing the previous automatic reinforcement for fearful responses and providing the removal of low-magnitude CAS's (successful escape) contiguously with calm responses. That is, if the organism is directly exposed to the primary signal or aversive stimulus, the second phase of the biphasic response is elicited quickly, and this elicited response makes it unlikely that external consequences will be effective in changing behavior patterns. Graduated exposure, then, reduces the likelihood of this second phase, thereby allowing behavior to be more sensitive to operant contingency change mechanisms (reinforcement, extinction, or punishment). Likewise, graduated exposure could be more useful in teaching an appropriate, calm escape response to replace inappropriate, fearful escape responses and displace the elicited response of the organism to TS (Katz & Rosales-Ruiz, 2022). This could be critical to teaching new skills for organisms that have experienced trauma as there is evidence that the elicited response – the second part of the bi-phasic response - reduces the organism's sensitivity to pain and provides some element of escape from the aversive stimulus (Bersh et al., 1986; Mah et al., 1980; Moye et al., 1981; Maier et al., 1983; Maier & Warren, 1988). Therefore, rather than seeking to block escape responses, particularly those that the clinician or experimenter does not control (the second part of the biphasic response), it may be more effective to teach active escape responses to unavoidable TSs through shaping and prompting that terminates the TS before the biphasic response is occasioned, displacing it so that other more adaptive skills can be taught.

Prevention of Post-Trauma Behavior Change

One of the most consistent findings in LH research is that pre-exposure to escape training is protective against the development of LH deficits in non-humans (e.g., Alloy & Bersh, 1979; Anisman et al., 1983; Kubala et al., 2012; Vincente et al., 2006; Seligman et al., 1975; Moye et al., 1981; Troisi et al., 1991; Williamss & Lierle, 1986). These finding suggest that there is value in teaching and providing consistent practice for people in escaping from aversive contexts. Many people with moderate to profound levels of ID live in settings in which they have very minimal control over their environments (e.g., Mpofu et al, 2020). Providing consistent exposure to aversive stimuli and opportunities for escape responses to occur and be reinforced could be beneficial in protecting people with ID from the development of post-trauma behavior changes.

Conclusion

Exposure to adverse and traumatic events disproportionately affects people with intellectual disabilities and other vulnerable populations (e.g., children). Behavior analysts have played a limited role in developing an understanding of how trauma affects behavior. Non-human models of post-trauma behavior change (LH) could be useful in developing behavioral interventions for alleviating post-trauma behavior change using trauma-related behavior change as an indicator of treatment outcomes. There is similarity between the topographies and direction of behavior change across species when exposure to IAS occurs. These similarities suggest a functional definition of trauma can be developed. Based on the available literature describing LH and PTSD, when discussing the behavior of humans, I suggest that the term “trauma” be used to refer to exposure to an IAS that has resulted in the biphasic response and the subsequent behavior patterns most fully described in non-human studies in which exposure to IAS can be tightly controlled.

Behaviors that have been reported across species following exposure to IAS/trauma include: 1) increases in avoidance, hypervigilance, SIB, repetitive behavior, and inappropriate sexual behavior 2) decreases in social engagement, self-care, and interest in previously preferred stimuli, and 3) changes in aggression, sleep patterns, eating habits, and pain sensitivity. The empirical literature on LH suggests several interventions that may be helpful in resolving the behavior deficits seen in humans after exposure to trauma. It is unknown if this will improve the physiological symptoms of stress that often accompany trauma exposure and LH. However, given the role of exposure to contingencies in the development of these disorders, I hope that these physiological symptoms could be reversed through exposure to new contingencies. Exposure to specific operant contingencies (e.g., discontinuation of PAS and shaping-based escape response training for unavoidable CASs) appears to prevent the elicitation of the second part of the biphasic response observed during exposure to IAS. Additionally, exposure to operant contingencies is also effective in reducing the behavioral deficits associated with LH. Given these findings, it seems possible that future research could identify ways that exposure to operant-based interventions could be useful in ameliorating the problematic behavior and physiological changes that are known to reduce quality of life for people who have experienced trauma. Unlike the currently available interventions (e.g., PE, CPT, and TF-CBT), these interventions are likely to be accessible to people with limited communication repertoires. Further research using direct measures of behavior changes in people with ID following exposure to traumatic events is needed. Given the limits of verbal communication for some people with ID, it is critical that more objective assessments for the effects of trauma exposure be developed that do not rely on self-report of events or symptoms. Further research into effective assessment and treatment strategies are desperately needed. Toward these ends, translational research involving direct behavior measures that have proven useful with non-human species could be useful in developing the necessary improvements in assessments and treatments to produce critical improvements in the lives of individuals with ID. Post-trauma behavior change produces devastating effects on adaptive repertoires and quality of life. A better understanding of how and why exposure to inescapable aversive stimuli produces these results could drastically improve the lives of people who have and will experience horrific situations. Improving our understanding of trauma, to allow us to recognize, quantify, and treat the post-trauma behavior change of people with ID, would move us one step closer to restoring the dignity and humanity of this vulnerable and worthy population.

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