

The Effects of a Hug: 6-Week Evaluation of Temple Grandin's Squeeze Machine on Maladaptive Behaviors

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Introduction

Increasing prevalence and visibility of autism in the past two decades has led to a surge in the creation and application of a variety of interventions. In particular, sensory based strategies have become one of the main therapies with individuals on the autistic spectrum, as the estimates of sensory processing disorder incidence for persons with autism ranges from 42% to 95% [1-3]. However, there is a disjuncture between this prevalent usage of sensory based treatment modalities and the amount of evidence validating them.

Due to the limited language that often accompanies moderate to severe autism, rare first-person accounts of autistic individuals living with sensory processing disorders (SPD) are addressed in research. One of the most valuable first-person account comes from Temple Grandin [4]. Resulting from her own sensory experiences and needs, Grandin created what she affectionately terms the 'squeeze' or 'hug' machine [5]. The machine reportedly reduces anxiety, creates calming reactions, and increases tolerance to touch through the application of pressure along both sides of an individual's body – compressing it – for an extended period of time [5]. However, despite the theory underlying the success of this approach with animals i.e. calming cattle, there is little research concerning the efficacy of this machine when used with people, especially those with non-verbal language and lower cognition [5].

The following paper begins by (1) defining the diagnosis of Autism Spectrum Disorders, (2) defining sensory processing disorders, (3) operationalizing maladaptive behaviors and the ASD literature concerning 25 them, (4) discussing the current literature surrounding sensory integration interventions as well as its critiques, (5) specifically exploring research surrounding 'deep pressure', and (6) concluding with a critical examination of the small amount of literature available concerning the squeeze machine itself.

Autism Spectrum Disorders (ASD)

Autism, a neurodevelopmental disorder, presents on a spectrum, ranging from mild to moderate, severe and profound. Yet, even

if two individuals fall on the same plane of the spectrum, their clinical symptoms can vary greatly. First described in the 1940s by Kanner, there are three core diagnostic features at the basis of autism spectrum disorders (ASD): socializing impairments, verbal and nonverbal communication impairments, and repetitive and restrictive behavior patterns [6, 7].

One of the main issues within the diagnostic of ASD is the sharp increase in prevalence within developing countries [8]. In the United States, the Centre for Disease Control reported a 78% increase in autism rates between 2002 and 2008 [9]. There is a debate, however, whether this stark increase is explained through increased awareness of the broader categorization and application of the term by health care professionals in order to access services for their clients, cohort effects or is genuinely an increase in incidence due to environmental and genetic factors, such as advanced parental age [10-12].

Despite debate concerning causes, the increasing occurrence and awareness of individuals with ASD requires a greater understanding and applicable treatment modalities to managing the disorder. An area garnering greater attention both within the clinical and research communities is how sensory processing relates to ASD not only clinically but also as a means of combatting or reversing a variety of maladaptive behaviors.

Sensory Processing Disorders (SPD)

Also labeled "sensory defensiveness, disorder, dysfunction, or overload", sensory processing issues can be displayed in defensiveness to sensory modalities, from tactile to oral to auditory or sensory seeking of certain others [13, 14]. Dr. Jean Ayres is credited with creating the theory underlying sensory processing disorders (SPD), initially labeling it Sensory Integrative Dysfunction (SID) (1963). However, the past four decades have led to a diagnostic evolution of the term, with SPD becoming the diagnostic norm within the current field, defined as a group of disorders where problems in integration, discrimination, organization and modulation of sensory input impact daily activities and emotions of an individual [15, 16].

The multifaceted nature of SPD has continued to cause differing classifications of the term. Miller, Anzalone, Lane, Cermak and Osten proposed three subtypes under the label of sensory processing disorders (SPD), different than the six SID ones initially identified by Ayres (1989), and based upon Dunn's proposed model. However, there are still controversies abounding in the field of SPD [17, 18].

ASD & Sensory Processing Disorders

In the decades following Ayres' initial work, sensory integration theory and subsequent Ayres Sensory Integration Therapy (SIT) have been utilized in a variety of populations, from typically developing children to those with ADHD to individuals who fall within the autism spectrum [15]. Lane, Young, Baker and Angley displayed within their study examining specific patterns of sensory processing in children with autistic disorders, that there are three distinct sensory processing subtypes: sensory based inattentive seeking, sensory modulation with movement sensitivity and sensory modulation with taste/smell sensitivity [19]. However, Ben-Sasson, Hen, Fluss, Cermak, Engel-Yeger and Gal state that, despite such classifications, there is a high heterogeneous presentation of sensory modulation symptoms within ASD [20]. This has implications for research as well as treatment, as each intervention addressing sensory symptoms must be tailored to the individual themselves rather than the population as a whole.

Within the field of autism in particular, there has been an inordinate focus upon children. Ben-Sasson et al.'s meta-analysis found that there are no studies that focus on SPD in adolescents or adults with ASD relative to control groups [20]. The same review also displayed problems in the literature in relation to SPD and SIT – the lack of consistency, diagnosis and clarity within studies. One of the main issues within the field of sensory processing, decades after Ayre's initial creation of sensory integration theory is the effectiveness of interventions targeting SPD continues to be inconclusive [21].

The most recent release of the DSM-V has resulted in a validation of SPD characteristics within the diagnostic category of Autism Spectrum Disorder by identifying "Hyper- or hypo reactivity to sensory input or unusual interests in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement)" as one of the diagnostic criteria [7]. The inclusion of SPD within the diagnostic criteria not only creates potential for greater focus on SPD issues within the context of ASD, but subsequent misuse of SPD therapies and interventions.

Maladaptive Behaviors and SPD

Without the ability to process and integrate sensory information properly, individuals with a SPD often react to, do not react, or purposely seek sensory experiences through communicative or gestural behaviors; examples of these include covering ears to block out noise, not displaying a response to pain, or body rocking [22]. However, these behaviors can often turn maladaptive (also termed as 'problem', 'aggressive', or 'challenging' behaviors). Maladaptive behaviors within ASD are defined as those that are dangerous either to self or others, hinder learning, and impede daily living skills, with self-injurious behavior and aggression often stressed as being of the most import [23].

However, the debate that surrounds SPD as a universal aspect of

ASD also translates to the behaviors that accompany them. Research concerning rates and age of onset of sensory behaviors, and the measurement of them, have not been consistent [24]. As well, there is only a small amount of literature that overtly associates maladaptive, or problem, behaviors with SPD, as sensory research concerning ASD tends to often only examines overall behaviors and ASD literature only targets maladaptive behavior as it is associated with the developmental disability itself [20, 23, 25-29].

'Deep Pressure' Sensory Strategies

As shown by Adamson, O'Hare and Graham's study, the majority of children with ASD also exhibit sensory modulation difficulties [30]. Objects or manual touch in order to provide "deep pressure" is a commonly accepted clinical method of addressing behavioral challenges with children with developmental disabilities, though protocols and the purpose of utilizing them differ between therapists themselves. This approach can involve therapeutic touch, such as massage, or a machine, such as a 'squeeze' machine or weighted garments. However, there is little discussion or evidence of their effectiveness within the published literature [31].

Field et al. examined the effects of massage on children with autism, displaying positive changes in attentiveness and responsiveness post-treatment, yet these results were not substantiated with physiological measures. Case reports provide positive but methodologically weak results of using massage, pressure garments and pressure wraps on autistic individuals [32-34]. Weighted vests have been studied empirically within literature, through small sample sizes and case studies with alternating treatment designs but their efficacy remains inconclusive [31, 35-37]. Yet, there continues to be a disconnect between the clinical and informal usage of the weighted vests and blankets and the empirical uncertainty of their benefits, as Green et al. shows in their survey of treatments used by parents of autism, with 12.8% using them at the time of the survey and 25.7% reporting to have used them in the past.

Temple Grandin's Squeeze Machine

Several challenges are faced by researchers in the field of ASD and SPD. The first is variation in categories and definitions within the literature, making studies difficult to generalize and compare, causing problems for evidence-base practice and methodological errors in the relatively large number of published studies [17]. Maladaptive behaviors are often examined for those with ASD, but rarely as a response to SPD. Secondly, the age groups of adolescents and adults with ASD are neglected within the literature. Thirdly, the disharmony between research outcomes and faithfulness of interventions raises fidelity issues within this field. Until research addresses fidelity in outcomes, effectiveness in practice cannot be determined [21]. Although the limited studies on SIT have displayed generally negative results, Watling, Diez, Kanny & McLaughlin's study of current practice of occupational therapy for children with autism displayed that the most common technique utilized is a sensory integration approach and 82% of respondents always use a sensory integration frame of reference when working with that population [38, 39]. There is also a reverse argument to negative results – critics have not been able to prove that it *does not work*, reinforcing the need for further study whether by critics or proponents of the intervention [40, 41].

This need for further study is particularly applicable to Grandin's 'squeeze' machine. While 'deep pressure' techniques are commonly

used in clinical practice, it is unknown how often the ‘squeeze’ machine itself is being utilized in clinical therapy, as it has little empirical evidence supporting it [2]. The small amount of research generated has displayed mixed results, and has often utilized small sample sizes, resulting in lessened validity or low generalizability. Imamura et al.’s study of the machine’s effects on the behavior of nine children was inconclusive and methodologically flawed with no effects on five children and a reduction in hyperactivity in four [42]. Edelson, Edelson, Kerr & Grandin’s also employed a small sample size within their placebo-controlled study and, due to half of the sample being non-verbal autistic children, self-reporting was unavailable, yet displayed beneficial results through both behavioural reporting and physiological galvanic skin response (GSR) after deep pressure given to children with high arousal levels [43]. However, Goldstein’s commentary on both the hug machine and other auditory, visual and motor interventions raises the same questions that are found throughout interventions for autism – sensory interventions widely utilized in therapy are often unproven [44]. The following study adds to this small research body concerning the efficacy of deep pressure approaches (i.e. squeeze machine) on sensory modulation, seeking to determine whether it is a means of reducing maladaptive behaviors in adults with ASD.

Materials and Methods

Purpose

The purpose of the study was to evaluate the impact of Temple Grandin’s Squeeze Machine on maladaptive deep pressure seeking behaviours in individuals with autism spectrum disorder following six weeks of intervention. Retrospective pre and post testing was adopted to obtain baseline information about problematic behaviour frequency of each individual and changes during the squeeze machine intervention. Ethics approval for evaluation was obtained through the ethics review board (PSY397-13).

Participants

Five participants, four male and one female, over the age 18 were selected for the initial trial by an Occupational Therapist (OT). Selection criteria included observational indicators of seeking or avoiding sensory stimuli. All participants lived in a 24-7 supervised residential group home with a confirmed diagnosis of ASD and were admitted in their adolescent years due to high levels of problematic behaviours and co-morbid diagnoses. The sample also mirrored male

to female residency ratios at the residential home, creating a more representative sample of actual autism spectrum disorder and SPD diagnosis seen in the larger population.

Four of the five participants, all male individuals, presented with problematic behaviours since childhood. Two presented with self-injurious behaviors, and two displayed occasional pica. All four have displayed aggression towards others and have physically aggressed against staff numerous times, ranging from slapping, forcefully striking out to breaking bones. One individual, the female participant, is legally blind and deaf therefore requiring significant physical prompting in any environment. All individuals have been diagnosed with Intellectual 209 Disability; however, IQ levels were not included in the analysis of the individuals. Each individual has two residential workers on average attending them, to ensure safety for both client and staff.

All five participants had significant communication impairments. Four were non-verbal and used a small amount of sign language, while one had several words. They could all follow one-step requests and communicate through gestures.

All had indications and subjective reports by staff and family that they sought deep pressure, whether requesting firm touch, strong hugs from staff members, cocooning between mattresses or wrapping themselves tightly in sheets or wet blankets.

Measures

Objective evaluation of sensory processing was completed by the OT using a combination of various sensory caregiver reporting checklists, clinical judgment and behavior analysis approaches. Standardized sensory assessments were performed, with results for each indicating dysfunction within the tactile system affecting sensory modulation and maladaptive deep pressure seeking behaviours (see Table 1) therefore potential candidates for the squeeze machine intervention. It was hypothesized by the occupational therapist conducting the assessment and supported by the clinical team that several of the problematic behaviours were due to deep pressure sensory seeking behaviours. The assessment of each individual was done by one occupational therapist certified in Ayres Sensory Integration Therapy and approximately 5 years of clinical experience with this population.

Table 1: Characteristics of Participants

	M/F	Diagnosis	Additional Diagnosis	Problematic Behaviours	Evidence of Deep Pressure Seeking	Daily Medication
R1	F	ASD	Severe intellectual disability; OCD; Seizure disorder; Legally blind and deaf	Self-injurious behaviours–self-stimulates by striking face with hands, and hitting ears with shoulders. Has detached both retinas, causing blindness, and ears, causing partial deafness.	Often applies staff members’ hands to her chin or cheek using strong pressure. Seeks being squeezed by staff or wrapped in a blanket. Wedges self between two objects. Wedges arms under clothing/ pant legs.	Anti-psychotics, PRN
R2	M	ASD	Severe intellectual disability; Tourette’s Syndrome; ADHD	Aggressive towards others (striking); elopement	Grabs staff and pulls them down on top of him–uses physical struggles for deep body pressure	Stimulants, Anti-psychotics, PRN

R3	M	ASD	Severe intellectual disability; Psychosis	Pushes others aggressively, fixation with water activities leading to hyponotremia; pica; polydipsia; SIB	Seeks out staff to give “pushing” feedback with body and arms; prefers to sleep with heavy or wet blankets; wedge self between mattress and bed frame; cocoons	Anti-psychotics, PRN, Anti-convulsants, Anxiolytics
R4	M	ASD	Severe intellectual disability; Queried Tourettes Syndrome	Aggressive behaviours towards others (biting, charging, grabbing and hitting; self-injurious behaviour; pica	Seeks out chewy, crunchy foods and inedible objects; seeks deep pressure; Pinching/biting	Anti-psychotics, Anxiolytics
R5	M	ASD	Severe intellectual disability; Stephen Johnson Syndrome; ADHD	Aggressive behaviours towards others (lashing out, scratching, gross motor activities that cause harm, i.e., jumping on others	Frequently jumps, crashes, stomps; often seeks pressure through head and hands by applying hands to both sides of his head and pushing forcefully.	Propranolol

Problematic behaviours were identified by functional analysis, analogue assessments and target behavior definitions. Frequencies of behavioural incidents were obtained through the group home computer data base created by staff documentation of daily reports. Monitoring of positive behavior support plans and intervention tracking was developed in collaboration with a psychologist and two behaviour therapists.

Behavior Data Tracking

All residents at the support home had standardized behavioral tracking sheets completed by staff and primary workers reporting on frequency and response to behavioral incidents. These target behaviours included individual’s pica, aggression, self-injurious behavior (SIB), and emotional distress, as well as staff response in use of non-violent crisis interventions such as verbal distraction, physical redirection or PRN use and restraint for more severe behaviors. All staff received standardized trained in usage of crisis interventions and behavioral tracking, increasing the reliability of the data collection.

Squeeze Machine Documentation

Each squeeze machine session was documented using a standardized protocol in which all staff and facilitators were trained. The protocol included an individual’s time spent in the machine, setting, amount of pressure applied, whether the client initiated the squeeze, who administered the squeeze and comments concerning observed behavior during the session. During the six-week trial period, these sheets were completed by three facilitators, two behavioral therapists and one occupational therapist, who had standardized their responses through pre-session inter-reliability trials.

Procedure

The trial was completed as part of a positive behavioral support plan for clients residing within the residential home. Written consent was obtained for the sensory intervention from the individual’s physician as well as their substitute decision maker.

Four individuals started their intervention on the same day except for one participant, who started his almost two months later. However, all individuals completed the trial within a 6-week span, with four consistently participating in a squeeze machine session twice a week during this time period. One individual missed four sessions during the six week time period. However, he was still included within

the study, and his case is indicative of the flexibility required when working in this population.

Each session encouraged placement within the machine for approximately 20 minutes. This duration was chosen to align with suggested guidelines provided by [5]. Least intrusive methods were used to encourage the participant to enter the machine and sessions were non-contingent on behavior. During the first session only, entry into the machine was first modeled to the client, then a verbal prompt to enter the machine and initiate the ‘squeeze’ was provided. Following entry, clients received little to no verbal/physical direction, so as not to interrupt their preferred approach. At approximately 1 minute prior to the end of the 20 minute session, clients were provided a verbal and visual notification indicating the end of session. Clients were observed by the staff and facilitator present to determine their preference for number of squeezes, length of squeeze, as well as avoidance of squeeze. Clients were scheduled to receive the intervention during week days only, at predetermined times, and were accompanied by the same full-time main liaison at each session. Individuals who presented as unwell, declined participation, demonstrated agitation or had received an emergency medication (PRN) within two hours of their scheduled session were rescheduled.

Data was collected from squeeze machine documentation, behavioral data tracking sheets and case files for all five individuals. Data was collected concerning weekly frequency of behavioral incidents including type of target behavior including aggression, pica, SIB, or emotional distress, use of PRNs, and medication type. Data collected for each squeeze machine session concerned the length of time in the machine, pressure applied, machine setting and number of squeezes and observed behavior of participant.

Analysis

Incidence of behaviors occurring during the 6 weeks prior to the intervention was compared to those during the intervention itself. This was done through a paired T-Test comparing pre-intervention and post-intervention data.

Results

Differences between pre and post frequencies of maladaptive behaviours were not statistically significant. Data was not documented in full for the fifth participant, thus was not able to be analyzed.

Research Limitations

Staff reporting

This study is potentially impacted by several factors that may limit the quality of findings including a) *social desirability bias* wherein the staff may have reported a change or improvement to fit the program or researchers' expectations or to inflate perceived improvement on those items that are most important to them personally. Given the reliance on staff facilitation during all intervention administrations and subsequent tracking of behavioural data, responses may be affected by this form of bias. Furthermore, given the limited sample size, heterogeneous characteristics of the population, variances in comorbid diagnoses, high treatment needs and communication ability greatly limit the generalizability of results to others, even those with comparable diagnosis.

Discussion

Based on these results and the limited sample size, the authors cannot make conclusions about the benefits or treatment efficacy of the squeeze machine. However, this evaluation adds to the sparse literature concerning Grandin's 'hug', or 'squeeze', machine for individuals with moderate to profound ASD displaying maladaptive behaviors.

This paper attempts to describe a procedural approach used with a complex population that is closely aligned with previously suggested protocols (i.e., rhythmic pulsation types, duration). Furthermore, it highlights the challenges in providing an intervention 'in-vivo' with clientele who have complex functional and cognitive profiles, in addition to diagnosis. Anecdotally, several support workers expressed their belief in the effects of the machine in improving behaviors. For example, staff reported increasing ease during transitions, clients appeared to enjoy and seek out the machine, as well as improvement in client's ability to tolerate novel activities longer. However, other staff found behavioural monitoring difficult and inefficient. Observing subtle differences in the clients across mood levels, engagement and independence was not analyzed in this study and is heavily reliant on observations made by those who care for them each day. Evidenced-based changes in these areas are unknown and likely impacted greatly by staff attitudes and perception. Staff perception is an area that should be explored in the future, due to the impact this can have in mediating what are perceived as problematic behaviors rather than the standard responses of verbal and physical redirections, restraints or emergency medications i.e. PRN's.

Conclusion

While there was no statistical significant difference overall in changes to maladaptive behaviours during the six-week period, the authors recommend analysis over a greater period of time with a larger sample size with greater similarity in characteristics and profile, for those interested in using the intervention. Furthermore, incongruence between informal staff reporting of change and recorded behavioural outcomes warrants additional investigation into the use of the machine as a positive sensory tool during difficult transitions [45-47].

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