Behavioral Interventions
Behav. Intervent. **28**: 48–57 (2013)
Published online 29 October 2012 in Wiley Online Library
(wileyonlinelibrary.com) **DOI**: 10.1002/bin.1355

THE BEHAVIORAL EFFECTS OF A PROCEDURE USED BY PEDIATRIC OCCUPATIONAL THERAPISTS

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Pediatric occupational therapists often use specific activities associated with deep pressure touch as a modality when providing services based in sensory integration theory. This study investigated the effects of these activities contingent on choice responding. Initially, preference assessments identified that activities such as being swaddled in a blanket or sandwiched between halves of a therapy mat were potential reinforcers for each of the three participants. Then, the stimuli were presented contingently under a two-response concurrent schedule. The results suggested that for each participant, the application of these activities functioned as a positive reinforcer. Given that such activities are often used in pediatric occupational therapy interventions, the clinical implications of these findings are discussed.

INTRODUCTION

Deep pressure touch is a sensation produced when an individual is hugged, squeezed, stroked, or held (Krauss, 1987). Activities associated with deep pressure are frequently used in occupational therapy interventions. For example, pediatric occupational therapists often use equipment such as mats, pillows, beanbag chairs, mattresses, trampolines, trapeze bars, chin-up bars, and climbing structures that are thought to provide deep pressure stimulation (Mailloux & Roley, 2001). Other methods that occupational therapists have used include compression garments such as those worn by burn victims to prevent scarring, wrapping the limbs or body in tight elastic material (Zisserman, 1992), weighted vests (Morrison, 2007), brushing protocols (Foss, Swinth, McGruder & Tomlin, 2003), or the use of a mechanical apparatus to squeeze the body such as Temple Grandin's Hug Machine (Edelson, Edelson, Kerr & Grandin, 1999). It is hypothesized that these procedures produce a long-term calming of the individual

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similar to those produced by medications that mediate neurotransmitter release (Ayres, 1979; Edelson *et al*, 1999; VandenBerg, 2001).

Unfortunately, the behavioral impact of such interventions has not yet been well researched. For example, most studies that have been conducted by occupational therapists on the effects of deep pressure activities have used a single AB manipulation, pretest/posttests, or informal case studies (Zisserman, 1992; VandenBerg, 2001; Baranek, 2002). An exception is a study by Fertel-Daly, Bedell and Hinojosa (2001) that evaluated the effects of weighted vests on the behavior of five preschoolers with pervasive developmental disorders using a withdrawal design. The results showed the vests were associated with lower rates of self-stimulatory and off-task behavior in three of the five participants.

Mason and Iwata (1990) studied the effects of non-contingent presentation of visual, auditory, and tactile stimuli on the rate of self-injurious behavior exhibited by three youths with developmental disabilities. Functional analyses conducted in the baseline condition indicated that the self-injurious behavior was maintained by contingent attention for one participant, by automatic reinforcement for the second participant, and by contingent escape from demands for the third participant. The data showed that the non-contingent presentation of a flashing light, vibrating pillow, and jazz music did not produce significant changes in the rate of self-injurious behavior for any of the participants. Interestingly, the participant whose behavior was maintained by automatic reinforcement actually engaged in higher rates of self-injury when exposed to the sensory stimuli. Although Mason and Iwata (1990) did not include activities associated with deep pressure touch in their study, the data demonstrate that although many pediatric occupational therapy procedures have not been thoroughly studied, they may still be behaviorally active. Activities such as massaging or swaddling may enter into contingencies such that these events may strengthen or weaken important behavior that precedes the onset of the event or interaction via reinforcement or punishment processes, respectively.

To wit, occupational therapists often provide deep pressure procedures contingent on problem behavior in an effort to calm the individual (Ayres, 1979; Edelson et al., 1999; VandenBerg, 2001). If these procedures function as a form of reinforcement, then the problem behavior will be inadvertently strengthened. It is acknowledged that sensory stimuli have long been known to function as positive reinforcers (Lovaas, Newsom and Hickman, 1987; Ferrari and Harris, 1981), and recent studies of matched stimulation have suggested that some sensory stimuli may function as abolishing operations (Piazza, Adelinis, Hanley, Goh & Delia, 2000; Rapp, 2007). However, the potential reinforcing effects of deep pressure activities, which are commonly used in occupational therapy interventions, have not yet been studied. This study sought to investigate the reinforcing efficacy of deep pressure activities.

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METHOD

Participants and Setting

Three children with autistic spectrum disorders participated in this study. The children were receiving applied behavior analysis (ABA) therapy in a private clinic. The three children selected to participate in the study had shown favorable responses to deep pressure activities in the past, according to parent and therapist anecdotal report, and demonstrated the physical ability to reach forward to touch a shape.

Bennett was a seven-year-old boy previously diagnosed by a developmental pediatrician with autism and hypertonia. He communicated primarily via vocalizations, in two word utterances, with intermittent use of American Sign Language to aid in intelligibility. He was able to mand for over 50 reinforcers, as well as tact and receptively identify over 100 common items, eight colors, and five shapes. He had received ABA and occupational therapy services for approximately four years.

Logan was a five-year-old boy previously diagnosed by a developmental pediatrician with autism. Logan relied primarily upon vocalizations to communicate with familiar adults who could understand his speech. Logan used less than 10 mands in non-contrived contexts in his day-to-day activities. He possessed strong listener skills and could receptively identify common items, colors, and shapes. He had received ABA and occupational therapy services for approximately four years.

Carter was a two-year-old boy previously diagnosed by a developmental pediatrician with a pervasive developmental disorder. He communicated primarily using American Sign Language, while intermittently emitting vocal approximations of words. He had a manding repertoire of more than 20 signs and a tacting repertoire of over 10 signs. Carter was also able to imitate over 10 arm and hand movements and comply with simple one-step commands. He had received ABA services for approximately one year prior to participating in the study.

All sessions were conducted in a 3.05 m $\times$ 2.44 m room located in a private clinic. The room contained deep pressure materials relevant to the study and a video camera.

Procedure

Preference Assessment

Prior to the start of the study, a multiple stimulus without replacement preference assessment was conducted for each participant (DeLeon & Iwata, 1996). The primary researcher, a nationally registered and state licensed occupational therapist, placed objects commonly used to apply deep pressure, such as a gym mat, pillows, and a blanket, in front of each participant. The participant was then physically prompted to touch each object and then engage with the object non-contingently for 10 s.

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After this exposure, the participant was then asked to 'Pick one.' Following the child's selection, the activity was provided. The gym mat was used to 'sandwich' the child and squeeze him between the two halves of the mat. Pillows were used to push down upon the back, shoulders, and limbs. The blanket was used to snugly roll up and swaddle the child. Throughout these activities, the child's head and neck were free of pressure or restraint, as a safety measure to ensure that the child could turn his head and breathe comfortably. The primary researcher wore disposable rubber gloves while pushing or squeezing to the child's limbs.

Participants were permitted to contact each item for 15 s before it was removed. Each participant was then asked to select from the remaining items, until all of the possible choices had been exhausted. This procedure was repeated three times to establish an average relative ranking according to the order in which the items were selected. The highest-ranking item was used in the subsequent evaluation. Logan and Carter preferred lying in a prone position between two halves of a therapy mat, while the therapist pushed down and patted the top layer of the mat. Bennett preferred being tightly wrapped in a blanket as he lay in a prone position on top of a therapy mat.

Baseline

The primary researcher held up a yellow plastic file folder, with a purple triangle taped on the participant's left side and a purple circle taped on the participant's right side. The child was instructed to 'Pick one'. If the child selected either shape, or did not select a shape at all, he was permitted to have 15 s of free time before he was again asked to select a shape. Each session comprised 20 trials. The position of each shape remained constant throughout the study, with the triangle on the left side of the folder and the circle on the right side of the folder.

Contingent Preferred Activity

Following a baseline of four sessions, the first intervention phase was introduced in which the preferred activity identified in the preference assessment was presented for selecting one of two shapes. For Bennett and Logan, choosing the triangle produced the activity for 15 s. If the circle was chosen, the participants were physically guided up out of the chair to signal the end of the trial and were then permitted to freely play and move about the room, interact with the primary researcher, or sit back down in the chair if they so chose. Note that the only materials in the room were the deep pressure materials used in later conditions. For Carter, the preferred activity was provided for selecting the circle, and the free time was given for the triangle. At the beginning of each session, 10 forced-exposure trials were provided. The primary

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researcher held up either the circle or triangle and physically guided the child to select the shape. The programmed consequence for selecting that shape, as previously described, was provided. There were 10 forced-exposure trials, with five for each shape, in a semi-randomized sequence, such that no shape was presented more than twice consecutively. After the forced-exposure trials, the primary researcher provided 20 choice trials (Paclawskyj & Vollmer, 1995). The choice trials were conducted in the same manner as in Baseline, except that selecting each shape produced the same scheduled consequences as those in the forced-exposure trials.

Contingency Reversal

After a visual analysis indicated that there had been an increase in selections consequated by the occupational therapy procedure, the contingency was reversed for each participant. Bennett and Logan's circle selections were followed by application of the preferred activity, and Carter's triangle selections were followed by the activity. Forced-exposure and choice trials were executed as previously described.

Contingent Preferred Activity

Following this phase, the contingency was once again reversed. Specifically, Bennett and Logan's triangle selections were followed by the preferred activity, and Carter's circle selections were followed by the preferred activity. The sessions were conducted in the manner described in the aforementioned intervention phases.

Measurement

The dependent variable in this study was the number of times that the child independently selected the laminated circle or a laminated triangle within 5 s when given a choice between the two; failure to select either shape was also recorded. All sessions were videotaped. Inter-observer agreement (IOA) was calculated in approximately one out of three randomly selected sessions for each participant. For Bennett, 10 out of 30 sessions were selected and reviewed. For Carter, seven out of 19 sessions were reviewed, and for Logan, seven out of 20 sessions were reviewed. A Board Certified Assistant Behavior Analyst who was blinded to the aim of the study served as the secondary data collector. This observer was trained using explanations of the procedure with feedback in a training session. The secondary data collector reviewed the videotapes, and IOA was calculated using a frequency ratio. An agreement was when both observers recorded that the participant selected the same shape on a given trial. The number of agreements between the primary and

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secondary data collectors was divided by the number of agreements plus disagreements, and the quotient was then multiplied by 100 (Kazdin, 1982). Using this procedure, IOA was 100% for all sessions.

Treatment integrity was also calculated using the same videos that were reviewed for inter-observer agreement. The same secondary data collector reviewed the videos for treatment integrity, using a fidelity checklist for each trial. Using the checklist, the reviewer recorded whether the stimuli were presented as specified in the protocol, whether the observer waited 5 s for a response, and whether the correct consequence (the preferred activity or free time) was provided for 15 s. Treatment integrity was calculated by counting the number of treatment elements that were implemented correctly, dividing this by the total number of elements observed, and multiplying the quotient by 100. Using this procedure, treatment integrity was 100% in the selected sessions.

RESULTS

Figure 1 shows the data for all three participants. The data show that in all intervention conditions, when the preferred activities were delivered contingent upon selecting a given shape, selecting of that shape increased substantially. And, Logan and Carter's data suggest that their choice responding was quite sensitive to the contingency. As evidence, their responding changed rapidly upon the reversal of the contingencies. Interestingly, Bennett's choice responding was not as sensitive in the initial intervention condition. Here, the preferred activity was contingent on selecting the triangle, but he showed preference for the circle, as he had in Baseline. After session 12, it was discovered that Bennett had contracted a cold virus and accompanying cold sores within his mouth, which may have functioned as an abolishing operation for being wrapped in a blanket. Bennett did not return to the study for session 13 until his mouth sores had healed. Then, his choice responding was quickly allocated to the preferred activity. In the subsequent conditions, his choice responding continued to be directed to the preferred activity.

DISCUSSION

The results of this study suggest that the activities occupational therapists often use in an attempt to administer deep pressure can function as a positive reinforcer for children with autism and related spectrum disorders. This may hold several important implications for clinical practice. It may be beneficial for behavior analysts to consider the use of activities associated with deep pressure as a potential reinforcer

DOI: 10.1002/bin

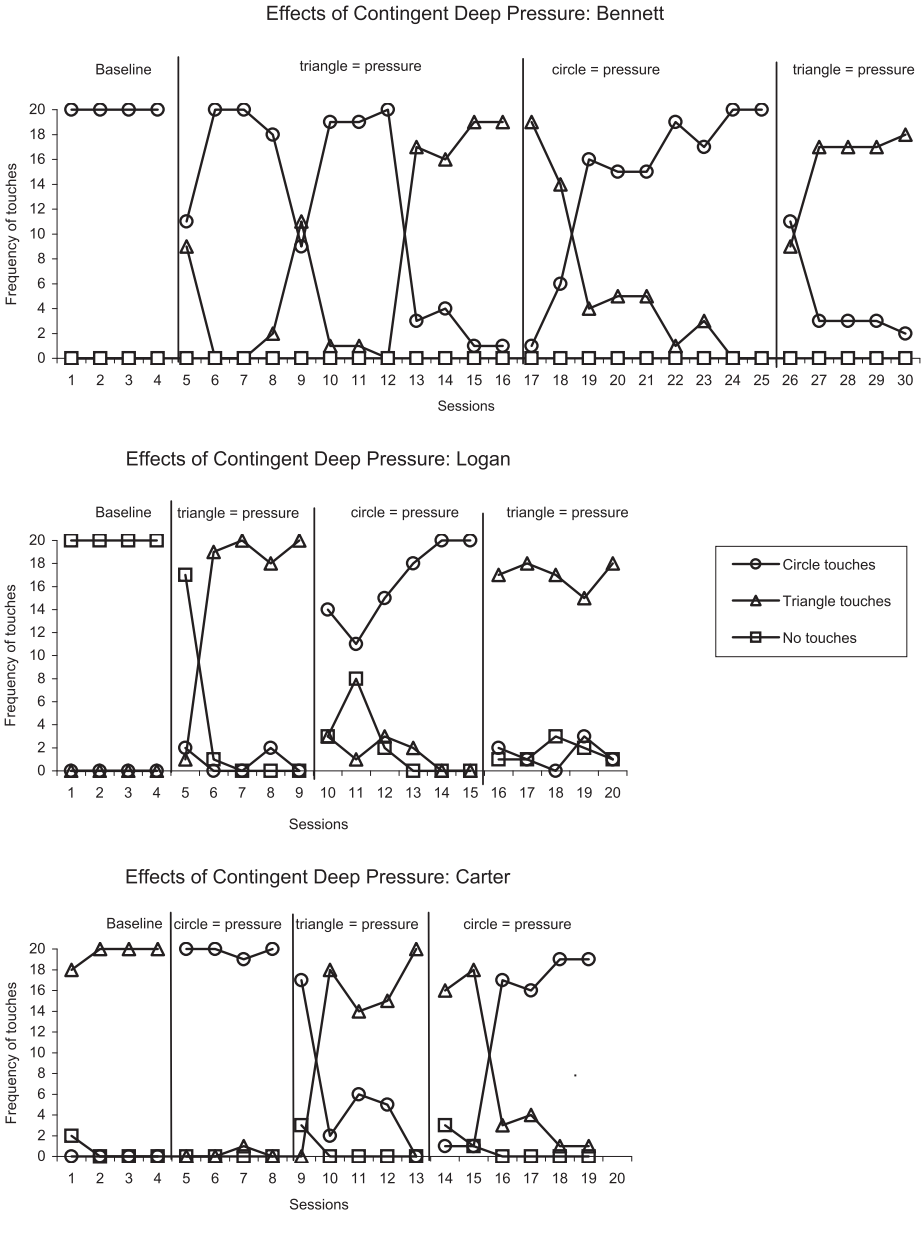

Figure 1. Effects of contingent deep pressure.

when planning and implementing behavioral protocols. Activities associated with deep pressure may be an advantageous reinforcer for several reasons. The materials involved, such as blankets, therapy mats, or cushions, are typically a one-time,

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low-cost investment. These materials are easily accessible in many home and community settings. These types of activities may also be a healthy alternative to edible reinforcers and a socially acceptable option for clients whose reinforcers are restricted to items that are not age-appropriate.

If a functional analysis suggests that a particular problem behavior is maintained by sensory reinforcement, behavior analysts should consider if activities associated with deep pressure function as the maintaining variable. In these cases, the behavior analyst or occupational therapist should consider teaching acceptable ways for the individual to access this stimulation, such as mand training (Carr & Durand, 1985; Sweeney-Kerwin, Carbone, O'Brien, Zecchin & Janecky, 2007). Some socially acceptable forms of this type of stimulation might include lying under a heavy blanket or receiving a hug from another person. Additionally, if deep pressure is indeed a reinforcer for an individual's behavior, it would be advisable to avoid the use of physical restraints, as past studies have shown that physical restraints may function as positive reinforcers (Favell, McGimsey & Jones, 1978; Favell, McGimsey, Jones & Cannon, 1981).

Occupational therapists who design 'sensory diets' (Nackley, 2001) of scheduled sensory activities should be made aware of the potential reinforcing effects that deep pressure activities may have upon the behavior it follows. Clinicians should be careful that deep pressure activities are not provided contingent upon problem behavior. In addition, parents and clinicians may need to refrain from using activities such as hugging or swaddling to calm or re-direct an individual who is engaging in problem behavior. Activities like those used in this study may have an immediate abative effect, but in the future, the individual might be more likely to engage in the same problem behavior.

An additional implication of this study is that some occupational therapy treatments may affect behavior, but not in the way that has been proposed (Ayres, 1979; Mason & Iwata, 1990). Prior to this study, there was no literature showing the reinforcing effects of the procedures associated with deep pressure that are commonly applied in pediatric occupational therapy practice, both within educational and medical settings. Although there is very limited research to support the use of sensory integration approaches (Vargas & Camilli, 1999), this does not mean that these approaches are behaviorally inert, and their application should be monitored for possible reinforcing effects on the very behaviors they are meant to decrease.

This study did possess several limitations. The study was limited to three children with autistic spectrum disorders, who were receiving intensive behavioral intervention services. Additionally, there is a possible selection bias in that all of the children who were invited to participate in the study had previously displayed favorable responses, such as smiling, when deep pressure had been provided in

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various forms, per parental report. It is indeed possible that deep pressure activities might function as a form of punishment for other participants, and this possibility should be studied in future research.

Finally, occupational therapy interventions that emphasize sensory integration are frequent elements in the treatment plans of individuals with autism and other developmental disabilities (American Occupational Therapy Association, 2005; Case-Smith & Arbesman, 2008; Roley, Bissell & Clark, 2009). Given this fact, there is a pressing need for research regarding the behavioral effects of various activities used by occupational therapy practitioners. Future studies should investigate the potential reinforcing, and punishing, effects of activities associated with vestibular, proprioceptive, tactile, visual, and auditory stimulation.

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DOI: 10.1002/bin