Occupational Therapy Techniques, Over Time, on Children with Developmental Delays

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ABSTRACT

OCCUPATIONAL THERAPY TECHNIQUES, OVER TIME, ON CHILDREN WITH DEVELOPMENTAL DELAYS:

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Two therapies that have been identified to target sensory modulation needs associated with developmental delay are the Wilbarger Deep Pressure Proprioceptive Technique (Wilbarger Protocol) and Therapeutic Listening. This study examined several patients from an outpatient pediatric occupational therapy facility. These patients have some sort of developmental delay and need intervention to help them modulate their sensory input, so that their lack of appropriate sensory modulation will not interfere with their delay occupations. This study looked at the effects of the Wilbarger Protocol and Therapeutic Listening over multiple sessions to determine how those techniques affected four overall themes to which research has demonstrated a correlation: modulation, calmness, level of communication, and challenging behaviors. Both treatments demonstrated weak correlations, with the Wilbarger Protocol being a negative correlation (-0.26) and Therapeutic Listening being a positive correlation (0.55). Therefore, the hypotheses that the Wilbarger Protocol and Therapeutic Listening would positively affect the four overall themes were rejected. It appears that the effect is more influenced by patient-dependent variables than by temporal markers. It is also likely that the limited number of subjects (n=7) and changes in the treatment protocols, over time, led to the results being inconclusive.

Introduction

Developmental delay manifests as a substantial delay in the developmental process of children. Developmental delay is more than a transient delay in development, because children experience a late attainment of typical milestones of development. Typically, this is disadvantageous for the children's educational performances and social skills. Developmental delays that extend beyond the age of eight usually have additional diagnoses. Children with developmental delays are more likely to experience obstacles impeding their education and social skills that can stagnate their growth including specific skill delays such as "delays in language, perception, metacognition, and social, emotional and/or motor development" (Government of Newfoundland and Labrador, 2015).

A child who has a developmental delay is also more likely to experience challenges in sensory integration. Sensory integration is "the way in which the nervous system communicates with the senses, translating these messages into motor and behavioral responses that are more appropriate" (Sensory Processing Disorder Foundation [SPD Foundation], 2016). Sensory integration was also defined by Jane Ayres (1989), the pioneer of sensory integration research, as

> The neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment. The spatial and temporal aspects of inputs from different sensory modalities are interpreted, associated, and unified (p. 11).

Some children who have sensory integration challenges may be *hyperresponsive,* meaning they might over-respond to sensation, finding certain sensations to be intolerable. Other children may be *hyporesponsive,* meaning they display little to no response to sensation (SPD Foundation, 2016).

When a child does not have an appropriate level of sensory integration, his or her daily occupations, such as playing, learning and socializing, are stifled. It is imperative that the child masters sensory modulation. Sensory modulation is defined as the way in which an individual can be trained to recognize and process certain stimulations from various senses in order to display appropriate behaviors and responses to these stimuli (Pollock, 2009). Sensory modulation was also originally defined by Jane Ayres (1979) as "the nervous system's process of self-organization" produced by "the combination of facilitatory and inhibitory messages" (44-45). Ayers went on to suggest that, "Modulation is the process of increasing or reducing neural activity to keep that activity in harmony with all the other functions of the nervous system" (p. 70). It is normally quite evident when there are complications in the nervous system's ability to process and modulate this sensory information as motor delays, tactile defensiveness, learning disorders, social and or emotional difficulties, deficits in speech and language and attention disorders can arise (Marks, n.d.). This symptomology is usually identified as developmental delay.

Occupational therapy services that focus on sensory integration have shown to be effective in increasing a child's ability to modulate his or her senses in order to display proper responses to sensory input (Pollock, 2009). Occupational therapists work with children and their families to help them succeed in their daily occupations, including playing, learning, and socializing (American Occupational Therapy Association [AOTA], 2016). Because developmental delay can cause issues in each of these areas, due to challenges with sensory integration, occupational therapists commonly provide intervention for developmental delay.

Two therapies/techniques that have been identified to target this sensory need and allow children to modulate appropriately are the Wilbarger Brushing Deep Pressure Proprioceptive Technique (Wilbarger Protocol) and Therapeutic Listening. This study examined several patients

from an outpatient pediatric occupational therapy facility. These patients have developmental delays and need interventions to help them modulate their sensory inputs, so that their lack of appropriate sensory modulation will not interfere with their daily occupations. To be most effective, therapeutic activities need to be implemented with an at-home treatment plan, also referred to as a "sensory diet" (SPD Foundation, 2016). This study looked at the effects of the Wilbarger Protocol and Therapeutic Listening over multiple sessions to determine how those techniques affected four overall themes to which research has demonstrated a correlation: modulation, calmness, level of communication, and challenging behaviors.

The purpose of this study was to compare the effects of various occupational therapies on the symptomology of developmental delays in children.

Review of Literature

Wilbarger Brushing Deep Pressure Proprioceptive Technique

The Wilbarger Protocol was developed by occupational therapist and psychologist, Patricia Wilbarger to help the body organize its incoming sensory information (Therapeutic Brushing Techniques, 2015). A therapist, parent, caregiver and sometimes the patient his or herself must be certified in order to perform this technique, as it involves a specific amount of pressure, brushing pattern, knowledge of appropriate locations for brushing and frequency of brushing. The brushing regimen is typically followed by joint compressions at each joint in the body. The Wilbarger Protocol involves therapeutic brushing of the patient's arms, back, and legs (National Autism Resources [NAR], n.d.). It is also imperative for the therapist, parent, caregiver or patient to avoid brushing the face, chest and abdomen area (NSA, n.d.), as these areas are extremely sensitive and can incite adverse effects such as urinating or vomiting (Champagne, 2016).

Brushing begins with the arms and back and then moves towards the feet. The brush used should be a soft, plastic surgical brush, with no exceptions (Champagne, 2016). According to an article on this technique, "This brush is believed to be the most effective for the delivery of the specific type of stimulation to the nerve endings of the skin that is required by this protocol" (Champagne, 2016). The pressure applied during the brushing should involve long strokes and be firm. Pressure should be a balance between a tactile sensation and a proprioceptive (deep pressure) input as these can be aversive for *hyper*- and *hyporesponsive* patients (Marks, n.d.). The brushing regimen is intended to be implemented every two hours for at least two weeks and could be continued for a longer period of time per the discretion of the occupational therapist (Champagne, 2016). The Wilbarger Protocol should take 2-3 minutes to administer each time (NAR, n.d.). Brushing can provoke aversive reactions from patients as the treatment process begins but will eventually become more accepted and sometimes enjoyable (Champagne, 2016).

The joint compression component follows the brushing process. These are gentle compressions completed with the administrator's hands on either side of a joint. Soft but firm pressure is applied for ten counts each at the shoulders, elbows, wrists, fingers, hips, knees, and ankles (NAR, n.d.). Pushing against the wall, doing jumping-jacks, push-ups, or jumping on a trampoline can be used for self-administration of the protocol (NAR, n.d.).

According to the National Autism Resources (n.d.), there has not been extensive research done on the Wilbarger Protocol. As aforementioned, this protocol is centered on a deep touch pressure of brushing followed by joint compressions – another type of deep touch pressure. Although there has not been extensive research on the Wilbarger Protocol, there has been research done on the principles (deep touch pressure) through which it was developed.

Application of Wilbarger Protocol

Benefits of the Wilbarger Protocol may include greater ability to transition from daily activities, increased attention span, less discomfort or apprehension of the sense of touch, greater coordination and better self-modulation (NAR, n.d.). In a study conducted by Bhopti and Brown (2013), four out of five parents that implemented an at-home treatment plan focusing on the Wilbarger Protocol with their children, reported that the intervention proved effective for their child.

Modulation and the Wilbarger Protocol

Of the body's sensory organs, skin is by far the largest one. Skin is controlled by the brain and is fully connected to the nervous system. The brain receives information from sensory receptors connected to the skin and neural impulses that are stimulated by the environment. The brain organizes and registers this information, and this information is sent "back through the nervous system for use as understanding, adaptation, learning, and skill development" (Marks, n.d.). This process is the neurological function of sensory modulation. This process of modulation develops necessary motor, language skills, and social and emotional behaviors. As aforementioned, these are deficit areas for children with developmental delay. The nervous system's course of processing and internalizing sensory information is vital in order for a person to interact appropriately and efficiently with their environment. This is evident in reports of decreases in *hyperresposiveness* (NAR, n.d.).

Level of Calmness and the Wilbarger Protocol

Deep touch pressure, akin to what is used in the Wilbarger Protocol, can bring about a calming effect. "Deep pressure touch is demonstrated to have a beneficial effect… including lowering increased heart rate and respiration." (Blairs, Slater, & Hare, 2007). Blairs and associates continued by suggesting that personal restraint has shown to calm the persons with

sensory abnormalities associated with learning disabilities. This is linked to reducing agitation and anxiety, thus decreasing challenging and dysfunctional behaviors (Blairs et al., 2007). In this situation, personal restraint is equivalent to deep pressure. With people who have sensory abnormalities, though also pertinent to other diagnoses, there have been specific documented interventions involving deep pressure touch as a clinical and therapeutic intervention. As Blair et al. (2007) cited:

> What is termed deep touch pressure (Tagaki & Kobagasi, 1956) i.e. forms of touch involving hugging, stroking the skin or swaddling can be distinguished from light touch pressure i.e. superficial stimulation involving tickling or stroking of body hair, the latter is arousing of the sympathetic nervous system leading to increased pulse rate and respiration, whereas the deep pressure touch is calming and leads to reduction in pulse rate and respiration.

There have been other cases where deep touch pressure has evoked a feeling of relaxation. Animal Scientist, Dr. Temple Grandin, who has been diagnosed with Autism Spectrum Disorder, constructed her own deep pressure device called a "squeeze-machine" (Blairs et al., 2007). Grandin reported that her "squeeze-machine" has brought about a decrease in *hyperresponsiveness* and that 60% of participants who also used the "squeeze-machine" reported feeling more relaxed (Blairs et al., 2007). Blairs et al. (2007) went on to conduct their own study where a deep touch pressure program was implemented on a client who had multiple diagnoses involving sensory abnormalities. The authors reported that deep pressure was implemented as part of the structured program for the patient, however, it was "neither practical nor ethical to attempt to isolate the specific effects of deep touch pressure" (Blairs et al., 2007, p. 218). The study furthered this statement by reiterating that due to difficulty of implementing certain intrapersonal aspects of the program, support lends to the idea that deep touch pressure was the

critical component of structured program. It was also found that blood pressure, pulse rate, respiration rate and body temperature after the intervention were at lower, more relaxed levels than they were before the intervention (Blairs et al., 2007). These body markers indicate that the person may be more easily able to behave in a calm manner.

Communication and the Wilbarger Protocol

The central nervous system uses information from the peripheral nervous system. The Wilbarger Protocol may increase the ability of the central nervous system to effectively use the information received from the peripheral nervous system (Champagne, 2016). When these two systems communicate effectively, it will result in enhanced communication as well as movement coordination, sensory modulation and "hence, self-regulation" (Champagne, 2016).

Challenging Behaviors and the Wilbarger Protocol

Deficits in sensory modulation may contribute to observable challenging behaviors. Such behaviors can be caused by several underlying problems; however, "it is the unique notion that an individual's sensory 'threshold' (e.g. tendency to be hyper- or hyposensitive to 'normal' amounts of sensation) drives a continuum of behavioral responses that sets this framework apart from other interpretations of behavior" (O'Malley, 2007). Further, O'Malley listed sensory modulation behavioral symptoms as inattention/distractibility, hyperactivity, emotional dysregulation or lability, clumsiness, and behavioral and motoric disorganization. Emotional dysregulation can manifest as maladaptive behaviors including emotional reactivity, aggression, and behaviors that are disorganized, withdrawn, and avoidant. The Wilbarger Protocol has been reported to precede observable "significant behavioral changes" in many clients as reported by members of a parent support group for children with sensory processing challenges (Baker, n.d.).

Therapeutic Listening

Another occupational therapy technique that targets sensory modulation is Therapeutic Listening. This technique approaches sensory modulation through a different sensation than the Wilbarger Protocol. Therapeutic Listening is an auditory intervention in the form of a gated music program designed for individuals who display difficulties with sensory processing dysfunction, listening, attention, and communication (Vital Links, 2016). Users have also reported improvements in "communication, ability to tolerate transitions, enhanced safety awareness, ability to function in noisy environments, and advanced fine- and gross-motor skills" (Frick, & Young, 2009). The patients can use this program in clinic or through an at-home "sensory diet' as prescribed by an occupational therapist. Therapists can meet the needs of each unique client with a wide selection of 45 RPM albums of specifically enhanced music, spanning five different series of music.

Application of Therapeutic Listening

Sound has an immediate, pervasive impact on the nervous system because of the structure of the auditory system. The auditory system is interconnected with several parts of the brain, making it easy for sound to infiltrate various levels of the brain. The Therapeutic Listening program is made up of albums that give the "listener unique and precisely controlled sensory information" (Vital Links, 2016). Therapeutic Listening tracks have been modified to prompt attention and incite body movement from the listener by activating certain corresponding parts of the sound spectrum. This program is also capable of initiating a self-organizing response in the listener by use of the "organized rhythmical sound patterns inherent in music" (Vital Links, 2016).

According to an experiment conducted by Hall and Case-Smith (2007), parents reported improved transitions, improved communication, and greater regularity when following

directions, among other positive behaviors. In combination with occupational therapy as a sensory integration tool, Therapeutic Listening, as an intervention, was supported (Hall & Case-Smith, 2007). Bazyk, Cimino, Hayers, Goodman, and Farrell (2010) conducted a study which focused specifically on children who have developmental disabilities as well as displayed sensory processing difficulties. These students participated in Therapeutic Listening one to two times a day, for five days a week, for twenty to thirty minutes. Participants demonstrated significant changes in language, non-verbal and social skills after the course of the implemented program. Teachers and parents also reported improvements in group activity participation, overall attention and processing, increased verbalizations, more positive social interactions and an increase in ability to complete direction (Bazyk et al., 2010). Other studies supported increased sensory modulation and self-regulation as a part of a plan of various sensory integrative techniques combined (Frick et al., 2009).

Modulation and Therapeutic Listening

In various cases, Therapeutic Listening has shown an improvement in overall modulation. Some patients have shown significant improvements on the Sensory Profile (Frick, Young, & Huecker, 2007) whereas others, specifically about developmental disabilities, have shown no significant improvements on the Sensory Profile. There have not been studies done on multiple clients with developmental delays over time. A case study of a four and one-half year-old girl showed improvements in modulation as she was more "frequently engaged in a quiet alert state" and had noticeably better attention and visual-spatial skills as reported by her teachers (Frick et al., 2007). These small improvements are evidence that the patient was much more able to navigate her environment. Additional studies have indicated that patients have been able to better self-regulate (Cipriani, 2010; Hall & Case-Smith, 2007; Frick et al., 2009; Over, 2011).

However, there is a lack of research specifically on multiple children with developmental delays over time.

Level of Calmness and Therapeutic Listening

It is widely accepted that music alone can produce a calming effect. As aforementioned, Therapeutic Listening has been reported to precede a child's "quiet alert state" (Frick et al., 2007). In a pilot study that documented participants with varying degrees of motor, visual, and sensory modulation impairments, changes were noted after just two weeks (Cipriani, 2010). The results of the pilot study also suggested that parents of these patients reported their children were less frustrated and less anxious. Five of six parents in a third study reported that their child was calmer following an intervention involving Therapeutic Listening (Hall & Case-Smith, 2007).

Communication and Therapeutic Listening

Therapeutic Listening has been reported to improve interaction with peers and more directly, communication in general (Hall & Case-Smith, 2007; Frick et al., 2009). Another study noted that verbalizations increased and social interactions took place more often and were more positive (Bazyk et al., 2010).

Challenging Behaviors and Therapeutic Listening

Therapeutic Listening has also shown to be effective in decreasing challenging behaviors. Four patients in a study by Hall & Case-Smith, (2007) initially reported having weekly to daily tantrums noted a change in these behaviors. Some of the patients' tantrums stopped completely and others had tantrums less frequently, were able to gather themselves in less time, and overall displayed tantrums with less intensity. Another study noted an increase in emotional flexibility that could easily translate into a child's ability to more appropriately respond when they might normally respond with aggression or a tantrum (Cipriani, 2010).

Methods

Participants

Participants were selected for this study by occupational therapists at Therapy Playground in Fayetteville, North Carolina, based on patient diagnosis (developmental delay) and method of treatment (Wilbarger Protocol and/or Therapeutic Listening). These participants were minors as the facility is specifically a pediatric clinic. Patients in the facility are referred for therapy by outside physicians and clinicians.

Materials

These patients' daily session notes, progress notes, intake notes and discharge notes including information on the Wilbarger Protocol and/or Therapeutic Listening were selected and printed. The lead occupational therapist, at this facility, redacted identifying information from each note. Literature about the Wilbarger Protocol and Therapeutic Listening was reviewed and the following themes were identified: modulation, calmness, level of communication and challenging behaviors.

Procedures

The Wilbarger Protocol and Therapeutic Listening both provide the practitioner with qualitative data that demonstrates the effectiveness of the therapy protocol over time. For this study, the principal investigator (PI) obtained redacted therapy session summaries for seven pediatric patients of a local occupational therapy group who had been identified as having a developmental delay. It was individually hypothesized that the effects of the Wilbarger Protocol and Therapeutic Listening techniques would positively affect the four overall themes to which research has demonstrated a correlation: modulation, calmness, level of communication, and challenging behaviors, when implemented over a period of time.

The PI and faculty mentor assessed the summaries and independently coded the data by themes attributed to the therapies. The separate coding data was then evaluated to determine inter-rater reliability which was a 96%.

The data was evaluated for positive, neutral, or negative outcomes for each session recorded. A positive session required a positive balance of coded themes, whereas a negative session required a negative balance of coded themes. Neutral sessions were those sessions in which the positive themes and negative themes were equally represented. When sessions merely involved the educating of parents regarding protocol, those sessions were also considered neutral. The data was then analyzed using a Pearson Correlation, comparing the positivity of the outcomes to the number of treatments.

Results

The inter-rater reliability for the two investigators was 96%. Additionally, both treatments demonstrated weak correlations, with the Wilbarger Protocol being a negative correlation (-0.26) and Therapeutic Listening being a positive correlation (0.55). Therefore, the hypotheses that the Wilbarger Protocol and Therapeutic Listening would positively affect the four overall themes were rejected.

Discussion

Five of the seven total participants had the Wilbarger Protocol administered to them and it was to be administered as an ongoing at-home treatment. Though insignificant, the negative correlation infers that not only was the correlation with treatment over time not positive, it could have a negative effect on the patient. With the same pattern, a larger pool of participants could have created a more significant negative correlation. This could mean that the Wilbarger Protocol actually had adverse effects if their sessions were given an overall negative grade even after several sessions. It is possible that the Wilbarger Protocol can elicit negative responses in

the first treatments as Therapeutic Listening has been reported to do this as the children learn what to do with the new sensory information (The Anonymous OT, 2013).

A review of the raw data demonstrated positive responses to the Wilbarger Protocol for subjects D, E, and F, but those responses were independent of the number of sessions provided. Each of those three subjects demonstrated consistently positive effects early on in the treatment process and the effects remained positive throughout the treatment. Subject G displayed either positive or no changes within the four themes though not negative changes. It is likely that the small sample of participants and varying amounts of treatment per participant skewed the representation of the protocol.

Three participants had Therapeutic Listening integrated into their at-home therapy treatments. Two of the three participants showed better communication at least once in the treatment. Because this study looked at previously recorded session notes, from occupational therapists who were not aware of the study at the time, useful details and information could have been excluded from the notes. Future studies should involve patient observation in real-time over the course of the treatments. Parents could be instructed to log certain changes in behavior at home. This might be more beneficial because they would be sure to document changes that occur daily related to the individual treatment that might not be otherwise pertinent to the session notes, written by the assigned occupational therapist once a week.

Though the themes were not positively affected, the PI did find that the frequency of themes affected were comparable between the Wilbarger Protocol and Therapeutic Listening. The number of times that modulation seemed to be affected by the Wilbarger Protocol was 15 times, challenging behaviors were affected 9 times, level of calmness was affected 8 times, and communication was affected 1 time. The frequency of themes affected by Therapeutic Listening were affected in the same order. Specifically, the level of modulation was affected 5 times,

challenging behaviors were affected 4 times, level of calmness was affected 3 times, and communication was affected 1 time. The expected outcome of these therapies is increased modulation which was supported by the works of Champagne (2016) and Frick et al., (2007). From the frequency of themes affected, it should be noted that modulation, though not entirely positive, is being affected and it was the most frequently affected theme overall.

Conclusion

It appears that the effect is more influenced by patient-dependent variables (e.g. parental involvement, degree of developmental delay, age, etc.) than by temporal markers. It is also likely that the limited number of subjects (n=7) and changes in the treatment protocols, over time, led to the results being inconclusive. Future studies should look at more homogenous samples. Furthermore, future studies should include a more longitudinal review of the data for an improved interpretation of temporal effect. Future studies could also focus on the specific themes of modulation, calmness, level of communication, and challenging behaviors. Further studies on frequencies of themes effected could be carried out to see if these themes were again effected in the same order and could address why this may happen.

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