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### Critically Appraised Topic

*Title: There is limited evidence to support the use of the Therapeutic Listening Program, in addition to traditional therapy, for reducing negative behaviors and improving sensory processing skills in children 3-7 years old diagnosed with autism spectrum disorder (ASD), pervasive developmental disorders not otherwise specified (PDD-NOS), or other developmental disabilities.*

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Prepared by: Samantha Chaneske ([chaneske.sama@uwlax.edu](mailto:chaneske.sama@uwlax.edu)), Lyddia Petrofsky ([petrofsky.lyd@uwlax.edu](mailto:petrofsky.lyd@uwlax.edu)), Brittany Seneczko ([seneczko.brit@uwlax.edu](mailto:seneczko.brit@uwlax.edu))

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#### CLINICAL SCENARIO:

- Client population: Children ages 3-7 years old (n=17) with developmental disabilities, pervasive developmental disorders not otherwise specified (PDD-NOS), autism spectrum disorder (ASD) and sensory processing problems.
- Treatment context: Participants received treatment at home, outpatient clinics or in classroom setting.
- Problem/condition this intervention is used for: Problem addressed by the Therapeutic Listening Program varied from child to child. The primary conditions highlighted in the current research included a variety of developmental disorders, sensory processing difficulties, and autism spectrum disorder (ASD). One participant with moderate ASD exhibited sensory over-responsiveness to auditory stimuli to the point it was interrupting daily routines or roles. Behavioural disturbances associated with sensory processing can be a problem for children with ASD (Gee, Thompson, St. John, 2014). Another participant with pervasive developmental disorders not otherwise specified (PDD-NOS) displayed problems with aggressive behaviour, inattentiveness, sensory processing skills, and impulsivity. Deficits in attention, language, classroom participation and sensory processing were addressed in the children with developmental disabilities.
- Intervention: Therapeutic Listening Program (TLP) is a form of sound-based intervention that uses modified music with different frequencies and pitches listened to through a set of Sennhieser headphones that theoretically can impact functional capabilities. The therapeutic listening program is completed 1-2x day, each session lasting 15 minutes. There needs to be at least three hours between sessions. The program lasts a total of 20 weeks. A child may participate in a co-occurring activity as long there is no competing sound and the activity does not require a lot of focus. (Vital Links, 2014)
- Science behind intervention: There is no physiological explanation in research to support the mechanism of therapeutic listening. There are several theories suggesting that listening to modified music exercises the muscles of the inner ear to better modulate auditory input. (Therapeutic Listening, n.d.)
- Why is this intervention appropriate for occupational therapy? Poor sensory regulation can negatively impact occupations including play, social and classroom participation, and activities of daily living. Therapeutic Listening is believed to impact sensory integration, behavioural challenges related to poor sensory processing, language, executive functioning, play, and learning which can influence balance, muscle tone, coordination, and body awareness. This intervention can be used as a preparatory method to promote development of skills at home and in school. (Bazyk, 2010)
- ICF level: Body function and structures

**FOCUSED CLINICAL QUESTION:** Will the Therapeutic Listening Program be effective at reducing negative behaviours, and improving sensory processing skills in children 3-7 years old diagnosed with autism spectrum disorder (ASD), pervasive developmental disorders not otherwise specified (PDD-NOS), or other developmental disabilities?

**SUMMARY:**

- Clinical Question: Will the Therapeutic Listening Program be effective at reducing negative behaviours, and improving sensory processing skills in children 3-7 years old diagnosed with autism spectrum disorder (ASD), pervasive developmental disorders not otherwise specified (PDD-NOS), or other developmental disabilities?
- Search
  - Number of data bases searched: 2 (Health Professions Database, EBSCOhost)
  - Total number of relevant articles located: 5
  - Number/strength of articles critiqued: 2 Level IIIb articles, 3 Level V articles
  - Rationale for selection of articles to critique: The articles were chosen because the similar interventions and protocol followed. The articles also demonstrated the strongest study designs.
- Clinical Bottom Line: Limited evidence supports the use of the Therapeutic Listening Program, in addition to traditional therapy, for reducing negative behaviors and improving sensory processing skills in children 3-7 years old diagnosed with autism spectrum disorder (ASD), pervasive developmental disorders not otherwise specified (PDD-NOS), or other developmental disabilities.

**CLINICAL BOTTOM LINE:** *Limited evidence supports the use of the Therapeutic Listening Program, in addition to traditional therapy, for reducing negative behaviors and improving sensory processing skills in children 3-7 years old diagnosed with autism spectrum disorder (ASD), pervasive developmental disorders not otherwise specified (PDD-NOS), or other developmental disabilities.*

**Limitation of this CAT:** This critically appraised paper (or topic) has been reviewed by occupational therapy graduate students and the course instructor.

**SEARCH STRATEGY:**

**Table 1: Search Strategy**

Databases Searched	Search Terms	Limits used	Inclusion and Exclusion Criteria
EBSCOhost Health Professions Database	-Therapeutic listening & pediatric occupational therapy -Listening Program & pediatric occupational therapy -Autism & Listening Program -Therapeutic listening and pediatric -Listening program and pediatric occupational therapy		Exclusion Criteria: Articles older than 2000

## RESULTS OF SEARCH

Table 2: Summary of Study Designs of Articles Retrieved

Level	Study Design/ Methodology of Articles Retrieved	Total Number Located	Data Base Source	Citation (Name, Year)
Level 1a	Systematic Reviews or Metanalysis of Randomized Control Trials	0		
Level 1b	Individualized Randomized Control Trials	0		
Level 2a	Systematic reviews of cohort studies	0		
Level 2b	Individualized cohort studies and low quality RCT's (PEDro < 6)	0		
Level 3a	Systematic review of case-control studies	0		
Level 3b	Case-control studies and non-randomized controlled trials	3	EBSCOhost Health Professions Database	-Bazyk, S., Cimino, J., Hayes, K., Goodman, G., & Farrell, P. (2010) -Hall, L. & Case-Smith, J. (2007) -Fancis, H., & Banai, K. (2011)
Level 4	Case-series and poor quality cohort and case-control studies	0		
Level 5	Expert Opinion	2	EBSCOhost Health Professions Database	-Nwora, A., & Gee, B., (2009) -Gee, B., Thompson, K., St. John, H. (2014)

## STUDIES INCLUDED

Table 3: Summary of Included Studies

	Study 1 (Bazyk et al., 2010)	Study 2 (Gee et al., 2014)	Study 3 (Nwora et al., 2009)
<b>Design</b>	Quasi Experimental	Case Study	Case Study
<b>Level of Evidence</b>	3b	5	5
<b>PEDro score</b>	n/a	n/a	n/a
<b>Population</b>	15 preschoolers (10 male, 5 female) ages 3-6 Diagnosed with 1+ of the following: Autism (4) Down Syndrome (3) Prematurity (3) Cerebral Palsy (2) Fetal Alcohol Syndrome (1) Developmental Delay (4) Brachycephaly (1) Hydrocephaly (10) Mobius Syndrome (1)	7 yr old female Diagnosis: moderate ASD Inclusion Criteria: -Exhibited sensory over-responsiveness to auditory stimuli to the point it was interrupting daily routines or roles -Tolerated wearing headphones minimum of 15 mins, 2x/day -Between 5-10 years of age	5 yr old male Diagnosis: PDD-NOS -Intolerance to sensory input -Aggressive tendency towards others
<b>Intervention Investigated</b>	Therapeutic Listening Program Classroom Setting- during math, gym, lunch, or rest Intervention ranged 6-20 weeks, depending on child 1-2x per day for 30 mins	Therapeutic Listening Program Outpatient Clinic Intervention 10 weeks  A1: At clinic. 4 weeks, 1day/week for 20 minutes. Caregiver completed SPM and examiner assessed child using SensOR Scales, in separate room  B: At home. Therapeutic Listening Intervention Began. 10 weeks, 2x/day (5days/week) for 15 minute listening sessions  A2: At clinic. Discontinued therapeutic listening program.	Therapeutic Listening Program Home Based Program Intervention 20 weeks 2x per day for 15min sessions/day

		Observation sessions and data collection for 4 consecutive weeks.	
<b>Comparison Intervention</b>	n/a	n/a	n/a
<b>Dependent Variables</b>	-Fine-motor skills -Visual motor skills -Social skills -Language -Nonverbal intelligence -Sensory processing	-Negative behaviors: covering ears, rotating head away from stimulus, startling to or eliminating the stimulus, physically negative response to the stimulus, and verbalizing negative perception of stimulus. -Positive behavior: tolerating and accepting auditory stimulus	-Behaviors associated with Autism (diminished social interaction, self stimulating behavior, distractibility, inattention) -Listening -Language -Sensory processing
<b>Outcome Measures</b>	-PDMS-2 (Peabody developmental motor skills, only assessed fine motor section) -VMI (Visual Motor integration test) -DAP (Draw-A-Person) -SSRS (Social Skills Rating System) -Sensory Profile Caregiver questionnaire -PLS-3 (Preschool language scale) -Written Records from teachers, parents and therapists (Treatment notes, semester progress notes, classroom observations that were documented)	-SensOR Scale (examiner based observation measure, only assessed auditory domain) -SPM (caregiver questionnaire, home form, only hearing (HEA) and overall total sensory processing (TOT) score were tracked) -Observations of self stimulating behaviors, # of times and duration of behavior	- Video footage of school music program (observations) -Listening Checklist -Sensory Profile Caregiver Questionnaire
<b>Results</b>	Statistically significant improvements ( $p < 0.05$ ) from pre-post test seen in.... DAP standard: $p=0.008$ DAP total score: $p=.002$ SSRS social skills standard score: $p=.015$ VMI composite standard score: $p=.014$	SensOR Scales: A1 → B → A2 upward trend for positive behaviors, downward trend for negative behaviors  SPM: t scores downward trend for negative behaviors,	-Video footage showed child tolerating multi stimuli (auditory, touch and visual) with music program. Sign, prop interaction, and participate in dancing to songs. Increased eye contact. Improved interactions with peers. Improved (bilateral)

	PDMS-2: composite standard score p=.003	upward trend for positive behaviors  Self stimulating behaviors: downward trend A1 → B. Increase in behaviors during A2 (removal of TLP)	coordination, sequencings & timing. -Listening Checklist: improved in every receptive area of previous deficit. Improved posture, handwriting, tolerance, and expressive language. -Sensory Profile: improvements in touch processing and multisensory processing
<b>Effect Size</b>	DAP self standard score: extremely large, d= 3.69 DAP total standard score: extremely large, d= 4.48 SSRS: extremely large, d=2.47 VMI: extremely large, d=3.3 PMDS-2: extremely large, d=2.2	n/a	n/a
<b>Conclusion</b>	Therapeutic listening increased fine motor, visual motor, non-verbal intelligence, language and social skills for kids with a variety of developmental disabilities, when used in conjunction with regular therapy.	Therapeutic listening, used in conjunction with current therapy, was effective at increasing positive behaviors, decreasing negative behaviors in response to an auditory stimulus, as well as improved auditory sensory processing and overall sensory processing skills, for this child.	For this child, therapeutic listening, when used in conjunction with current therapy, had a positive effect on sensory processing which led to improvements in sensory stimuli tolerance, expressive/receptive listening and language skills, motor skills, and behavioral/social skills.

## IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH

- Clinical Question: Will the Therapeutic Listening Program be effective at reducing negative behaviours, and improving sensory processing skills in children 3-7 years old diagnosed with autism spectrum disorder (ASD), pervasive developmental disorders not otherwise specified (PDD-NOS), or other developmental disabilities?
- General Answer: There is limited evidence to support the use of the Therapeutic Listening Program, in addition to traditional therapy, for reducing negative behaviors and improving sensory processing skills in children 3-7 years old diagnosed with autism spectrum disorder (ASD), pervasive developmental disorders not otherwise specified (PDD-NOS), or other developmental disabilities.
- Description of Dependent Variables
  - Reducing Negative Behaviors: covering ears, rotating head away from stimulus, startling to or eliminating the stimulus, physically negative response to the stimulus, verbalizing negative perception of stimulus and self stimulating behaviors
  - Improving Sensory Processing: ability to process sensory input (auditory, visual, vestibular, tactile, oral), and multisensory processing
- Results organized by variables:
  - **Reducing Negative Behaviors:**
    - (Gee et al., 2014): A downward trend in negative behavior (covering ears, turning head away from stimulus, and startling reaction) was reported on the SensOR Scales and the caregiver questionnaire (SPM). As reported by caregiver and test administrators (who were not specifically identified) there was decrease in the self-stimulatory behavior of the participant, which is a variable that frequently disrupted her participation in meaningful occupations.
    - (Nwora et al., 2009): As reported by caregiver questionnaire (Listening Checklist) participant no longer demonstrated low frustration tolerance or the inability to acclimate to new situations with appropriate response.
    - Overall similarities: The studies indicated mixed results for reducing negative behaviors. Two articles demonstrated a decrease in negative behaviors as reported by caregiver questionnaires and observations. One study did not measure negative behaviors.
  - **Improving Sensory Processing:**
    - (Bazyk et al., 2010): Written record from occupational therapists reported changes noticed in sensory processing; however, no significant changes were noted as measured by the Sensory Profile.
    - (Gee et al., 2014): Overall the Therapeutic Listening Program intervention appeared to improve sensory processing skills based on parent report and administrator (who was not specifically identified) observation.
    - (Nwora et al., 2009): Participant demonstrated improvement of one level of function in multiple sensory processing categories; moving towards a more typical pattern of function as compared to previous dysfunction.
    - Overall similarities: All three studies showed improvements in sensory processing as measured by caregiver questionnaires (2 articles) and observations (2 articles).

- **Additional Variables:**
  - (Bazyk et al., 2010): Improved performance in the classroom with changes in attention and processing, increasing fine motor skills, visual motor, non-verbal intelligence, language and social skills for kids were made through observation by the teachers.
  - (Nwora et al., 2009): As measured by the Listening Checklist there were improvements in every receptive area of previous deficit: improved posture, handwriting, tolerance, and expressive language.
  - Overall similarities: Improvements were seen in social skills (2 articles), language (2 articles), decrease in self-stimulating behaviors (1 article), fine motor skills (1 article) and visual motor skills (1 article).
- Difference between studies: Possible explanations for the difference in results can be attributed to several factors. The population varied from having a single diagnosis (2 articles) and having unspecified co-morbidity of diagnosis (1 study). Treatment settings also varied: home based programs (1 study), outpatient clinic (1 article), and in classroom setting (1 article). Total treatment time ranged from 6 weeks - 20 weeks. Treatment time was variable based on each child's individual needs and tolerance for intervention. Individual sessions varied between two 15 minute sessions or one 30 minute session per day. Further, children continued to receive other treatments, including occupational therapy (3 articles), speech therapy (1 article), applied behavioral analysis (1 article) and special education (1 article) and what occurred in these therapy sessions was not specified. Additionally, children receiving treatment closer to 20 weeks may have seen results due to natural development.
- Statistical analysis described accurately: One article (Bazyk et al., 2010) with 17 participants used statistical analysis on data. There were statistical significant improvements ( $p < 0.05$ ) in additional variables (fine motor skills, visual-motor skills, nonverbal skills, language and social skills). All of these areas had extremely large effect sizes. No statistical significance in sensory processing.

**Clinical Bottom Line:** There is limited evidence to support the use of the Therapeutic Listening Program, in addition to traditional therapy, for reducing negative behaviors and improving sensory processing skills in children 3-7 years old diagnosed with autism spectrum disorder (ASD), pervasive developmental disorders not otherwise specified (PDD-NOS), or other developmental disabilities. Current research shows evidence of Level IIIb, grade B (one article) and Level V, grade D (two articles). Weak evidence may be the result of poorly designed studies characterized by small sample size, no control group, case study designs, limited use of formal assessments, variability of treatment time, the lack of thorough data reports, and methodological problems.

- Boundaries: A total of 17 participants between the ages of 3-7 years old participated in the three studies. Diagnoses included autism spectrum, PDD-NOS, and other developmental disabilities. All children demonstrated sensory processing problems that interrupted their daily routine. In addition to receiving the Therapeutic Listening Program intervention, all children continued receiving their other therapy during the intervention (including special education, occupational therapy, and speech therapy).
- Implications for practice: Careful consideration regarding the use of Therapeutic Listening Program is necessary due to the limitations of the current evidence. Additionally, target population and total treatment time for use of Therapeutic Listening Program for most effective results has not yet been determined. Also adequate explanation of the science behind Therapeutic Listening Program is not readily available. While encouraging results have been reported from single case studies, more



rigorous research studies involving a larger population to determine the effectiveness of Therapeutic Listening Program as an intervention method have not yet been conducted.

## References

Bazyk, S., Cimino, J., Hayes, K., Goodman, G., & Farrell, P. (2010). The use of therapeutic listening with preschoolers with developmental disabilities: a look at the outcomes. *Journal of Occupational Therapy, Schools & Early Intervention*, 3(2), 124-138. doi:10.1080/19411243.2010.491013

Gee, B. M., Thompson, K., & St. John, H. (2014). Efficacy of a sound-based intervention with a child with an autism spectrum disorder and auditory sensory over-responsivity. *Occupational Therapy International*, 21(1), 12-20. doi: 10.1002/oti.1359

Nwora, A., J. & Bryan, G. (2009). A case study of a five-year-old child with pervasive developmental disorder-not otherwise specified using sound-based interventions. *Occupational Therapy International*, 16(1), 25-43. doi: 10.1002/oti.263

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Vital Links. (2014). *Frequently asked questions about therapeutic listening*. Retrieved from <http://www.vitallinks.net/pages/Frequently-Asked-Questions.php>

## Related Articles (not individually appraised)

Fancis, H., & Banai, K. (2011). Effects of 'the listening program' on children with profound and multiple learning difficulties. *International Journal of Therapy & Rehabilitation*, 18(11), 611-621.

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