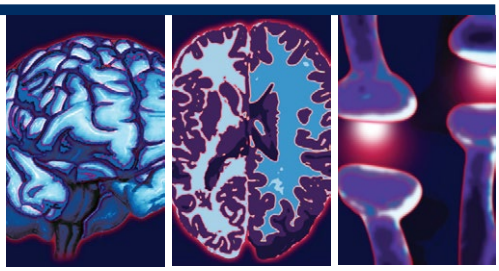

A Sound-based Intervention for Children with Sensory Processing Disorders in Taiwan

En-Chi Chiu[1], Chih-Ping Li[2,†]

Abstract

Sensory processing disorders (SPD), are a group of disorders that involve challenges in modulation, integration, organization, and discrimination of sensory input to the extent that the person does not respond appropriately to the input and experiences disruptions in daily activities and emotional behavioural patterns. Therapeutic listening (TL) is a sound-based intervention, which contains listening to electronically altered music and performing sensory activities to provide sensory stimulations. The purpose of this study aimed to explore the experience of Taiwanese mothers having a child with sensory processing disorder using the TL program. A qualitative ethnographic design was conducted to explore Taiwanese mothers' experiences through semi-structured interviews. We analysed the transcripts and compiled them into themes. A total of three mothers were interviewed. The two themes appeared from the analysis of the transcripts: (a) improvements and changes; and (b) issues of implementing the TL program. These Taiwanese mothers expressed that their children had better control of their behaviours, emotions, and mobility and were involved in daily activities more timely after the TL program. These mothers had better parent-child interactions when mothers joined the TL program. Taiwanese mothers expressed that their children accepted the modulated music and there are benefits of using the TL program. However, absence of rules for performing sensory activities and the appearance, ear cushion material, and size of the headphones may limit the use of the TL program in Taiwan. Therefore in order to better apply and promote the TL program in Taiwan, clinicians and researchers could provide specific rules for performing sensory activities and adjust the headphones.

Keywords

Therapeutic listening, Sensory processing disorder, Ethnographic research

Introduction

Sensory processing disorders (SPD), are a group of disorders that involve challenges in modulation, integration, organization, and discrimination of sensory input to the extent that the person does not respond appropriately to the input and experiences disruptions in daily activities and emotional behavioral patterns [1,2]. Ayres postulated that abnormal inputs sometimes occurred in the sensory nervous system as it progressed through its normal evolution and development. This in turn prevented the development of a healthy and well-organized sensory nervous system [3]. Healthy nervous systems develop by coordinating environmental stimuli from vestibular, auditory and proprioceptive input sources in a coherent and useful way. The brain can then correctly direct its own learning, emotional regulation and motor output functions. Basic research in this

[1]Department of Long-Term Care, National Taipei University of Nursing and Health Sciences, Taipei 112, Taiwan, ROC

[2]Department of Health Industry Management, Kainan University, Taoyuan 338, Taiwan, ROC

[†]Author for correspondence: Chih Ping Li, Assistant Professor at the Department of Health Industry Management, Kainan University, Ph.D. in the Health Information, University of Sheffield, Sheffield, UK, No.1 Kainan Road, Luzhu District, Taoyuan 33857, Taiwan. Tel: +886 (3) 341-2500 ext. 7974, Fax number: +886 (3) 270-5906; email: lichihping@hotmail.com

area of neuroscience has experienced increased activity in recent times [4]. Extreme sensory patterns expressed as either hyposensitivity or hypersensitivity may be really "trait" markers of individuals with major affective disorders given the critical involvement of sensory perception in emotional processes [5,6]. Sensory processing patterns and childhood traumatic experiences may specifically characterize individuals with major affective disorders playing a fundamental role in the prediction of their quality of life [7]. Hubel and Wiesel for example led investigations illustrating how deprivation of visual stimuli adversely affected brain-processing functions [8,9]. Increasing numbers of occupational therapists use SPD to diagnose and treat affected children. A host of other caregivers work in schools, clinics, homes, and community centres and has undergone modification at times by various end users to allow for customized sensory diets and other treatment protocols.

Therapeutic listening (TL) is one of the sound-based intervention programs. The TL program contains a variety of electronically altered music (sound stimulations) and a diversity of sensory activities. The music of the TL program has different musical styles, audio frequencies, wavelengths, quality of sounds and levels of enhancement. The modulated music design is based on concepts and technology of other sound-based interventions (i.e., Tomatis method, Auditory Integration Training, and SAMONAS method) [10-12]. The TL program is an individual listening program. The choice of music and the sensory activities are based on each child's needs and treatment goals.

The sound stimulations and sensory activities used in the TL program are designed to provide sensory stimulations to strengthen the body and nervous system. The sound stimulations provide the auditory input and sensory activities give vestibular, proprioceptive, etc. Combining sound stimulations and sensory activities has been found to decrease the time needed to reach treatment goals in children when compared to only using sensory activities [12,13]. A few studies published have been done on the TL program. Using the TL program on children with SPD, the results showed statistically significant improvements in visual perception and writing lowercase letters and numbers [14]. A study on developmental disabilities displayed changes significantly in visual-motor; fine motor language, and social skills [15]. In addition, the TL program was approved as continuing education by the American Occupational Therapy Association on July, 25, 2003 to be considered as a viable intervention for children, especially children with SPD. The advantage of the TL program is that it is a home-based program compared to other sound-based intervention programs which may need to be undertaken at special facilities (i.e., Tomatis method and Auditory Integration Training). Thus, the TL program can be administered throughout the day by parents and teachers when adhering to the guidance of a trained practitioner [12,13]. Children with SPD living in Taiwan need timely, long-term services from healthcare professionals [16]. A home program (e.g., the TL program) could fit their needs. Therefore, the TL program may be applied to children with SPD living in Taiwan.

Only a few sound-based intervention programs are used in Taiwan. The TL home program was developed in the United States and presumably is best adapted for use in American culture. When the home program is used in other countries such as Taiwan without modification, it may not be as effective as intended due to a lack of acceptance for cultural reasons [17,18]. Therefore, the purpose of this preliminary study was to probe the experiences of Taiwanese mothers using the TL program with a child presenting with SPD for better application of the TL program in Taiwan.

Methods

■ Participants and ethics

Participants of this study were the mothers of children recruited from elementary schools located in Hsinchu County, Taiwan. This study was authorized by Institutional Review Board with the approved number LLUIRB #58337. Our inclusion criteria for the children were as follows: (1) the child had to achieve over a ninety fifth percentile grade on the Taiwan Sensory Integration Function Assessment (TSIFA) [19]; and (2) the age of the child had to be ≥ 7 years old. Children were excluded if the mothers admitted that the child had a diagnosis of a mental disability or autism.

■ Procedures

The first author had been trained and qualified for implementing the TL program. The first author posted flyers in elementary schools and mothers interested contacted the first author. The first author met the mothers at their home

and explained the purpose of the study. After the mothers understood and agreed to be the interviewees and have their child receive the TL program, we asked the mothers to complete the TSIFA. If the recruiting criteria were met, the mother and her child both signed informed consent forms.

The first author met the mothers on another day to complete the Functional Listening Questionnaire (FLQ) [13] in order to design the TL program (i.e., choosing modulated music CDs). In this study, the TL program was a six-week home program **(Table 1).** The music CDs chosen were based on the principals of TL program and were changed every two weeks to ensure that habituation and routinization to the same music did not occur. Each child needed to listen to two music sessions each day for a minimum of 30 minutes per session while wearing a set of headphones. The second daily music session could not be initiated until three hours after the ending of the first listening session. The sensory activities which were individually designed for each family could be easily completed in their home environment with daily routines, such as joint compression therapy, toe walking, push-ups, and blowing and catching bubbles. Each child performed two sensory activities without time and frequency requirements every day. Each child was allowed to perform sensory activities alone or with family. They could listen to the music and perform the sensory activities at the same time or separately.

Each parent had to fill out a parent's record sheet, which recorded when the children listened to music and when they performed sensory activities each day. After the first, third, and fifth weeks of the TL program, the first author used the parent's record sheet to monitor the process and understand the child's difficulties of implementing the TL program. At the third and fifth weeks, the first author chose and changed a music CD on a basis of the TL protocol. The TL protocol contained the applications of each music CD on a child's problems (e.g., attention, emotion, and social connectedness). After completing the six-week home program, the mothers shared their experiences in a semi-structured interview. The interviews were conducted at the participant's home by the first author and lasted approximately 30 minutes. In this study, we did not give children specific rules for sensory activities. We hope that children develop habits for listening music 30 minutes and twice a day.

■ Instrument

The Taiwan Sensory Integration Function Assessment (TSIFA) contains seven domains with 98 items. These seven domains are postural movement, bilateral motor coordination, sensory discrimination, sensory modulation, sensory seeking, attention and hyperactivity, and behavioral and emotional responses. The questionnaire is filled out by a caregiver who is familiar with the child. A total score above the 95% percentile represents the child having SPD. The TSIFA has good internal consistency, test-retest reliability, and construct validity [19].

The Functional Listening Questionnaire (FLQ) is a comprehensive sensorimotor history questionnaire to gain information on the amount of time spent and the strategies used to process sensory information in daily life. For example, some questions are designed to understand a child's response in different acoustic environments, which provide clues of auditory defensiveness [13]. The FLQ is not scored, but it can provide qualitative information for the researcher to understand the child's daily life in order to select more suitable music CDs.

The materials used in the TL program included one set of headphones (HD500A Sennheiser) which were specially designated for the TL program, and CDs with modulated music from Vital Sounds LLC. The music alters in musical styles, audio frequency, and quality of sounds [12]. The music CDs used are shown in **Table 1**.

■ Data analyses

In this study, a qualitative ethnographic design was conducted. We used a semi-structure interview to probe the experiences of Taiwanese mothers with an SPD child undertaking the TL program. An ethnographic method is to probe native points of view in a particular group to understand individual real-life experiences [20]. After the interview, the first author made the verbatim transcripts of the recorded audio tapes debriefing with the mothers and wrote field notes. The data from the interview was individually coded. The first author read the transcripts, concentrated on the units of meaning, produced categories and subcategories, and determined the themes. To refine the themes, the first author discussed with two pediatric experts specializing in qualitative research. Then, we (i.e., the first author and two pediatric experts) compared the themes in the individual interview, detected similarities and differences, and determined

Table 1: A six-week therapeutic listening program.

Time	Music CD used	Home program
1st week	EASe2	The TL program started with the child listening to music twice a day, 30 minutes each time and performing two sensory activities without specific requirements. The child listened to the first music CD chosen by the researcher.
2nd week	EASe2	The researcher used parent's record sheet to follow up the process and understand difficulties in implementing the TL program. The child was administered the TL program.
3rd and 4th week	EASe3, Early Mozart, Peach Jamz	In the 3rd week, the researcher held discussions with the parent and child using the parent's record sheet to understand their routines of performing sensory activities each day. The researcher chose a second music CD for the child. During the 3rd and 4th week, the child was administered the TL program.
5th and 6th week	Razzberry Jamz, Baroque for Modulation, Mozart for Modulation	In the 5th week, the researcher checked the parent's record sheet and chose a third music CD for the child. During the 5th and 6th week, the child was administered the TL program.

Note: TL, therapeutic listening; CD, Compact Disc.

the overall themes which depicted the mothers' experiences with their SPD child when participating in the TL program. Examples of interview questions include: "What did you like most about the TL program?", and "Do you see any differences in your child after implementing the TL program? Please give examples." To assure study reliability, the interviewees were asked the same questions in the same sequence and only one researcher performed the coding work. To ensure study validity, the researcher asked the mothers to confirm whether or not they agreed with the themes and categories.

Results

A total of six parents contacted the researcher. These six parents stated that they had been told that their child may have SPD by school teachers or healthcare professionals. Three of the six children met the criterion of the TSIFA > 95th percentile, which indicated that these children had SPD. Their mothers were recruited for this study. Each child was either eight or nine years of age with diagnosis of attention deficit hyperactivity disorder or developmental delay. Table 2 provides further details of the mothers and their children.

Two themes emerged during the analysis related to mothers' experiences participating in the TL program: (1) improvements and changes; and (2) issues of implementing the TL program.

■ Improvements and changes

The three mothers indicated improvements in four aspects: (1) the child's adaptive emotions; (2) the child's self-control; (3) the child's time management; and (4) parent-child interaction. First, the three mothers stated that their child had better emotional control after implementing the TL program. M1 expressed her son's change, "*He can control his emotions more. When he was in a bad temper, you could talk to him and he would know he was not behaving right. He could better observe others' speech and expressions, which he could not do in the past.*" M2 shared her experience of her son, "*I saw that the frequency of his emotional fluctuations decreased; I feel the number of times he got into a temper are lower.*" M3 explained her son's difference, "*He's changed! He can better control his emotions now.*"

Second, two mothers explained that their child had more self-control of behaviors because of the TL program. M1 stated her son's improvement, "*I feel he has more self-control and displays much less violent behavior.*" M3 stated her son's changed, "*He can control himself in many new areas and recently was much better behaved.*" Other than controlling behaviors, M2 shared that her son's motor control improved, "*In the past, he fell down very often while walking... recently he seems to fall down less at home.*"

Third, two parents shared that their child had learned time management skills after implementing the TL program. M1 explained her son listened to the music while eating breakfast, "*When eating breakfast, I let him listen to music and I felt that he was eating faster…I told him that if he was listening to the end of the music CD, it meant that he was late. So he would pay attention to the time. Before the program started, he had no concept of time.*" M3 stated that her son could listen to music proactively, "*He often knew that it was about time to listen to the music. One day he told me that he would try to manage his time and do everything on schedule.*"

Fourth, two mothers stated that they had improved their parent-child interaction after implementing the TL program. M1 shared her

Table 2: Demographic information of the participants.

Mothers	Age (Child's age)	Mother's Occupation	Mother's Education	Child's Diagnosis	Gender of child	Type of school	Grade level	Receive other interventions
M1[a]	35 (8)	Real estate agent	College	Developmental delay	Male	Public	Third	None
M2[a]	38 (8)	Housewife	College	Developmental delay	Male	Public	Third	None
M3[a]	45 (9)	Housewife	Technical school	Attention deficit hyperactivity disorder	Male	Public	Fourth	None

[a] M = mother

interaction with her son: "*I felt that helping him do the joint compression or therapeutic brushing activities could give me a chance to have more interaction with him. When he listened to something he liked, he would want to share it with me.*" M2 explained the interaction with the whole family, "*His music listening period could be family time. He could sit there listening to music and he could play with us at the same time.*"

■ Issues of implementing the TL program

Two issues appeared for implementing the TL program in Taiwan. The first issue was the requirement of performing the sensory activities. All three mothers commented that they only had the time for listening to music, not for performing the sensory activities in this program. Thus, their child listened to music regularly, but did not perform the sensory activities regularly. One of the mothers suggested not giving the requirement of completing the sensory activities, as her family had activities during the weekend and was unable to perform the sensory activities in other environments. The second issue was related to the headphones, including three aspects. The first aspect was the appearance of wearing a set of headphones. M3 stated that her son did not like to wear the headphones because he felt that he looked different from the other children. The second aspect was sweating while wearing the headphones with fur ear cushions in warm weather. M3 said that her son felt that his ears were too hot due to the warm summer weather. The third aspect was the large size of the headphones. M1 and M2 said the headphones sometimes slipped or fell off while their child was doing sensory activities.

Discussion

All three mothers indicated changes in their child's daily life. Children with SPD have difficulties with integrating sensory information, which results in poor behavioral and emotional control and motor ability [5-7,21,22]. These disabilities influence their social skills, impede their self-esteem, and impair their abilities to complete daily tasks [5-7,23-25]. The results from this study showed that these children may have improvements in controlling their behaviors, emotions, and mobility and engaging in daily activities more timely. Moreover, they could have better parent-child interaction when parents participated in the TL program. Our findings were similar to other studies of the TL program [13-15]. Therefore, the individualized TL home program may be considered for use in Taiwan and provide benefits in children with SPD.

The TL program was accepted into the Taiwanese culture of three families and could become a daily routine. If the intervention program fit into the daily routine of a family, the long term impact could be highly effective [26]. The TL program contained two parts, listening to modulated music and performing sensory activities. Our results revealed that the children could accept listening to modulated music (e.g., mechanic sound and English language music), and even listened to the music proactively. Listening to music could be done throughout the day, which may help establish listening to music as a daily routine.

The researcher designed sensory activities which could be performed in each family's environment for a child to do either alone or with other family members. The mothers participated in the sensory activities, which may have increased the parent-child interaction. However, performing sensory activities did not become a daily routine in our study. Routines may offer children a sense of security and develop self-discipline, which are necessary for implementing a home program [27]. Two possible reasons may explain not building a daily routine for performing sensory activities. First, the researcher gave clear rules (i.e., the duration and the number of administrations) for listening to music, but no specific rules for performing sensory activities. Not having

specific rules may negatively influence the child's likelihood of developing habits. A home program which provides specific rules to be considered as homework can make implementation easier [28]. Second, environmental issues may decrease the child's motivation or ability to perform sensory activities. The children and their mothers may consider the space needed to perform sensory activities and may not like to perform them in different environments. Therefore, clinicians (e.g., nurses and occupational therapists) and researchers should provide activities which could be implemented in a variety of environments [29], and give specific rules [30] for performing sensory activities to better integrate the TL program into daily routines.

According to the Taiwanese mothers' experiences of implementing the TL program, the clinicians needed to consider the issue of headphones while further applying the TL program in Taiwanese culture. For improving Taiwanese children's appearance of wearing a set of headphones, clinicians may suggest the children to decorate the headphones and let them know the advantages of wearing the headphones. Regarding the reducing sweating in warm weather, clinicians could buy ear cushions with plastic material from the Vital Sounds LLC. Moreover, Vital Sounds LLC could provide the choice of wearing ear cushions with fur or plastic material, instead of only sending the fur ear cushions. For the large size of the headphones, the children could wear a sport headband not only to prevent the headphones from falling off, but also to create a more desired look. Our findings could help the clinicians implement the TL program effectively in Taiwan.

Three limitations were noted in this study. First, the small sample size was only recruited from one county, which may limit the generalization of our results. Further studies with larger sample sizes are warranted. Second, the participants were approached through posting flyers in several elementary schools, but only a few participants contacted the researcher. A possible reason is that Taiwanese people may not feel comfortable contacting a researcher whom they are not familiar with. Further studies may consider recruiting participants through referrals from healthcare professionals or school teachers. Third, the headphones were not adjusted in this study. This preliminary study was to explore the Taiwanese mothers' experiences of using the TL program. Further studies could adjust the headphones based on our findings and apply the TL home program to difference populations which have sensory processing issues (e.g., autism) and need intensive program (e.g., early intervention).

Conclusions

Following a six-week experiment using the TL home program, the Taiwanese mothers expressed that their child accepted the modulated music and displayed improvements in behavioral, emotional, and mobility control and time management. Furthermore, these mothers reported that they had improved relationships with their children. However, lack of specific rules for performing sensory activities and the appearance, ear cushion, and size of the headphones may limit the use of the TL program in Taiwan culture. Therefore, healthcare professionals (e.g., nurses and occupational therapists) may consider providing specific rules for performing sensory activities and adjusting the headphones and in order to accommodate to the Taiwanese culture.

Acknowledgements

We deeply appreciate the research assistance of both Dr. Esther Huecker and Dr. Heather Javaherian-Dysinger. This manuscript is part of first author's doctoral studies in the Department of Occupational Therapy at Loma Linda University.

References

1. Miller LJ, Anzalone ME, Lane SJ, *et al.* Concept evolution in sensory integration: A proposed nosology for diagnosis. *Am. J. Occup. Ther* 61(2), 135-140 (2007).
2. Interdisciplinary Council on Developmental and Learning Disorders (ICDL-DMIC) Work Groups. Interdisciplinary Council on Developmental and Learning Disorders Diagnostic manual for infancy and early childhood mental health disorders, developmental disorders, regulatory-sensory processing disorders, language disorders, and learning challenges. Bethesda MA, editor (2005).
3. Ayres AJ, Robbins J. Sensory integration and the child: Understanding hidden sensory challenges: Western Psychological Services (2005).
4. Hubel DH, Wiesel TN. The period of susceptibility to the physiological effects of unilateral eye closure in kittens. *J. Physiol* 206(2), 419-436 (1970).
5. Engel-Yeger B, Muzio C, Rinosi G, *et al.* Extreme sensory processing patterns and their relation with clinical conditions among individuals with major affective disorders. *Psychiatry. Res* 236(1), 112-118 (2016).
6. Engel-Yeger B, Gonda X, Walker M, *et al.* Sensory Hypersensitivity predicts reduced sleeping quality in patients with major affective disorders. *J. Psychiatr. Pract* 23(1),

11-24 (2017).

7. Serafini G, Gonda X, Pompili M, *et al.* The relationship between sensory processing patterns, alexithymia, traumatic childhood experiences, and quality of life among patients with unipolar and bipolar disorders. *Child. Abuse. Neg* 62(1, 39-50 (2016).
8. Wiesel TN, Hubel DH. Extent of recovery from the effects of visual deprivation in kittens. *J. Neurophysiol* 28(6), 1060-1072 (1965).
9. Wiesel TN, Hubel DH. Effects of visual deprivation on morphology and physiology of cells in the cat's lateral geniculate body. *J. Neurophysiol* 26(1), 978-993 (1963).
10. Thompson BM, Andrew SR. An historical commentary on the physiological effects of music: Tomatis, Mozart, and neuropsychology. *Integr. Physiol. Behav. Sci* 35(3), 174-188 (2000).
11. Rimland B, Edelson SM. Brief report: A pilot study of auditory integration training in Autism. *J. Autism. Dev. Disord* 25(1), 61-70 (1995).
12. Frick SM, Hacker C. Listening with the whole body. Madison, WI: Vital Links (2001).
13. Frick SM, Young SR. Listening with the whole body: clinical concepts and treatment guidelines for Therapeutic Listening®. Madison, WI: Vital Links (2009).
14. Hall L, Case-Smith J. The effect of sound-based intervention on children with sensory processing disorders and visual-motor delays. *Am. J. Occup. Ther* 61(2), 209-215 (2007).
15. Bazyk S, Climino J, Hayes K, *et al.* The use of therapeutic listening with preschoolers with developmental disabilities: a look at the outcomes. *J. Occup. Ther. Schools & Early. Intervention* 3(2), 124-138 (2010).
16. Chiu EC. Preliminary study: Taiwanese mothers' experiences of children with sensory processing disorder. *J. Nursing. Res* 21(3), 219-223 (2013).
17. Iwama MK. The Kawa (river) model: Nature, life flow, and the power of culturally relevant occupational therapy. In: Kronenberg F, Algado SS, Pollard N, editors. *Occupational therapy without borders: Learning from the spirit of survivors*. Philadelphia: Elsevier 213-227 (2005).
18. Iwama MK, Thomson NA, Macdonald RM. The Kawa model: The power of culturally responsive occupational therapy. *Disabil. Rehabil* 31(14), 1125-1135 (2009).
19. Lin CK, Lin CH, Lin MH, *et al.* Childhood Sensory Integration Function Assessment Scale. Taipei, Taiwan: *Psychological* (2004).
20. Richards L, Morse JM. Readme first for a user's guide to qualitative methods. 2nd ed. Thousand Oaks, CA: Sage (2007).
21. Miller LJ, Nielsen DM, Schoen SA. Attention deficit hyperactivity disorder and sensory modulation disorder: A comparison of behavior and physiology. *Res. Dev. Disabil* 33(3), 804-818 (2012).
22. Davies PL, Tucker R. Evidence review to investigate the support for subtypes of children with difficulty processing and integrating sensory information. *Am. J. Occup. Ther* 64(3), 391-402 (2010).
23. Parham LD, Mailloux Z. Occupational therapy for children. In: Case-Smith J, editor. Sensory integration. 5th ed. St. Louis, MO: Mosby 356-409 (2005).
24. Schaaf RC, Benevides T, Blanche EI, *et al.* Parasympathetic functions in children with sensory processing disorder. *Front. Integr. Neurosci* 4(1), 1-11 (2010).
25. Doyle BA, Higginson DC. Relationships among self-concept and school achievement, maternal self-esteem and sensory integration abilities for learning disabled children, ages 7 to 12 years. *Percept. Mot. Skills* 58(1), 177-178 (1984).
26. Weisner T, Matheson C, Coots J, *et al.* Sustainability of family rountines as a family outcome. In: Maynard A, Martini M, editors. Learning in cultural contex: Family, peers, and school. New York, NY: Kluwer Academic/ Plenum Publishers 41-73 (2005).
27. Dellisi M. Designed to fail: Self-control and involvement in the criminal justice system. *Am. J. Crim. Justice* 26(1), 131-148 (2001).
28. Novak I. Parent experience of implementing effective home programs. *Phys. Occup. Ther. Pediatr* 31(2), 198-213 (2011).
29. Cosco N, Moore R. Sensory integration and contact with nature: Designing outdoor inclusive environments. *The NAMTA. J* 34(2), 159-177 (2009).
30. Case-Smith J, Nastro MA. The effect of occupational therapy intervention on mothers of children with cerebral palsy. *Am. J. Occup. Ther* 47(9), 811-817 (1993).