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Evaluation of a Group Music Intervention to Support School-Readiness Skills in Preschool Children with Hearing Loss

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Abstract

Although children with hearing loss are now often integrated into mainstream classrooms, many do not begin school with age-appropriate school-readiness skills. Traditional therapies in early listening and spoken language programs may not focus on developing the social skills, executive functions, and motor abilities needed for the typical classroom environment of friends, academics, and play. This study was developed to better understand how to incorporate group activities into traditional therapies to build skills in these areas, and whether or not the use of music and its social aspects could support this. A quasi-randomized, group, facilitated, music intervention was conducted to help support school readiness skill development in preschool-aged children with hearing loss. Standardized testing was used to measure outcomes, and although improvement in skills was observed during the intervention, all test results were nonsignificant. Families reported overall improvement in skills and enjoyment of the intervention. Questions arise regarding the limits of standardized measures and the possibility of adding observational assessments for studies measuring function in social settings to better capture change.

Keywords: school readiness, hearing loss, formalized assessment, music and movement, integration

Acronyms: ASI = auditory skills intervention; AVT = Auditory-Verbal Therapy; CB = craft-based; EF = executive functions; HL = hearing loss; IHP = Infant Hearing Program; M&M = music and movement

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Since 2001, the Infant Hearing Program (IHP) has provided newborn hearing screening and audiology assessments for families in Ontario. Using the "1-3-6 plan" outlined in the Canadian Infant Task force position paper (Canadian Hearing Task Force, 2016), the goal is for children to be screened by one month, receive a diagnostic audiological evaluation if they did not pass their newborn hearing screen by three months and begin early intervention by six months. This plan has enabled early diagnosis identification and greater support for families with children with hearing loss. Early identification and therapy intervention have been shown to improve outcomes in this group of children (Ching, 2015; Sahli & Belgin, 2011).

Hearing technology has improved over the years and is now more sophisticated, giving greater access to spoken language. For families who choose a listening and spoken language program, the two auditory oral therapies offered are Auditory-Verbal Therapy (AVT) which involves certification, or auditory skills intervention (ASI) which follows the same philosophies however is non-certified. The same strategies are used by both therapies during weekly sessions, with a focus on listening and spoken language skills (A.G. Bell, 2011). Parents are coached to be communication partners with their child using various techniques and strategies which are then used at home during typical daily routines. Strategies are built on a language development hierarchy and sessions are structured with the child, the parent, and the therapist participating. Speech and language are typically tested every six months using standardized tests and outcomes are assessed based on developmental trajectories in those areas.

Advances in technology have supported children with hearing loss (HL) as they are often integrated into regular classrooms. However, hearing technology has limitations and the children using it must be accommodated—especially in noisy environments such as a classroom. Although various technological supports have been developed which assist with access, challenges persist and children do not have the same ability to experience incidental language learning through overhearing conversations or comments.

Although auditory-oral therapies have had good success with language outcomes (Fairgay et al., 2010; Fulcher et al., 2015), other studies report continued delays (Meinzen-Derr et al., 2018) with approximately 50% of children having language levels below those of their typically hearing peers at school entry (Geers et al., 2015; Niparko et al., 2010; Wei, 2010). Other developmental areas related to literacy, social, and executive functions may not typically be included in auditory oral therapy and may also be impacted. These all depend, at least in some part, upon age-appropriate language including vocabulary for their continued development. Also, due to the nature of hearing loss and its association with the vestibular system, balance is a challenge for many children with HL (Cushing et al., 2008; Livingstone & McPhillips, 2011) and can be an impediment to social games and play.

For all children, the cascading influence of various areas of development on overall success is important to understand and is a good starting point to address some of the challenges children with a hearing loss face. A lag in any area of skill may influence development in others (Hoffman et al., 2014).

Areas of Challenge for Children with Hearing Loss

Language

Language outcomes of children with HL continue to be a challenge as the population is varied and consistent access to speech and language is a key factor. The reason for and degree of hearing loss, presence of residual hearing (Niparko et al., 2010), age at diagnosis, technology support (Stika et al., 2015), type of therapy (Dettman et al., 2013), and other diagnoses all contribute to the overall outcomes of children with hearing loss. Combined, this diversity greatly impacts outcomes, and reporting on children with hearing loss as a group may not accurately reflect all areas needing support.

Listening and spoken language therapies focus on language development using a one-on-one, structured hierarchy of strategies and parental coaching to enable parents to use these strategies during all daily activities (A.G. Bell, 2011). Therapists model and coach as the child, the parent, and the therapist interact through listening and language-based activities. Although reports cite positive outcomes for listening and spoken language therapies, children can continue to have language delays by school entry (Wei, 2010). Data from some studies predict that these children may not catch up to their peers until 8 years of age or later (Leigh et al., 2013). As language proficiency impacts other areas of development (Rinaldi et al., 2013), it is imperative that these gaps are closed as quickly as possible.

Literacy

The ability to decode written language plays a large part in the school curriculum. From early on, children are expected to be able to move through the steps needed to attain this milestone. Mastering literacy skill is paramount to ultimate success in school as all subsequent learning depends on the ability to read and understand written material.

Preliteracy skills including phonological awareness impact the development of skills needed for reading (von Muenster & Baker, 2014). These involve the ability to rhyme, segment sentences and words into syllables, and later, delete and blend sounds. Delays in this area for children with hearing loss are related to ongoing challenges with speech perception and language skills (Ching et al., 2014). Children with hearing loss often do not perform at the same level as their peers with typical hearing in pre-literacy skills and there can be a significant lag in their development (Goldberg & Lederberg, 2015; Harris et al., 2017; Nittrouer et al., 2012; Webb & Lederberg, 2014). Test scores of children with HL continue to be one standard deviation below their peers who have typical hearing (Ambrose et al., 2012; Ching et al., 2014; Goldberg & Lederberg, 2015) and these scores correlate with receptive and expressive language as well as speech perception scores (Ambrose et al., 2012).

Social Skills

Skills related to social interactions with both peers and others is another very important aspect of development. Social skills incorporate all abilities to communicate, negotiate, and participate successfully in the activities of the day. Consequently, language also plays a large part in the development of social skills. Although children with HL initiate interactions as often as children with typical hearing, they may not be as readily accepted into the play group (DeLuzio & Girolametto, 2011). This may be due to challenges with language; either issues with intelligibility or lack of age-appropriate vocabulary, a possible result of the inability to overhear peer interactions (DeLuzio & Girolametto, 2011). Related challenges have also been seen in the delayed development of pragmatics (Rinaldi et al., 2013), emotional perception and production in speech (Chatterjee et al., 2019; Van De Velde et al., 2019), and overall emotional understanding (Wiefferink et al., 2013). Some have emphasized that a focus on language development along with social skills should be stressed when developing strategies for supporting children with hearing loss (Hoffman et al., 2014; Wong et al., 2017), along with the suggestion of developing a truly inclusive environment in the classroom where children are part of the classroom community and not just present in the class (Xie et al., 2014).

Children with hearing loss are also at a greater risk of having mental health issues related to loneliness (Most et al., 2011), and depression (Brown & Cornes, 2015; Idstad et al., 2019; Jiang et al., 2020; Theunissen et al., 2014). Interviews and surveys have concluded that issues around making friends and challenges understanding nuanced communication add to the hurdles faced by children with HL (Punch & Hyde, 2011). These all illustrate the importance of early supports for social skill development in children with HL in order to have continued success and happiness.

Executive Functions

Another aspect of development influenced by language is executive functions (EF). These play an important role in behaviors such as inhibition, flexibility, problem solving, planning, focus, and working memory. As a whole, EF may be influenced or their development interrupted by challenges such as a language delay (Beer et al., 2014; Kaushanskaya et al., 2017). Some question whether it is the executive functions that contribute to the language delay or the language delay that impedes the development of executive functions (Beer et al., 2014). Children with hearing loss tend to score significantly lower on EF skills related to inhibition, concentration, and working memory (Beer et al., 2014; Kronenberger et al., 2013). Children with lower language abilities tend to also have more EF difficulties (Hintermair, 2013). Some posit that in order to best support development in the area of executive functions, one must take a holistic view of the child and activities should include aspects of social, emotional, and physical development (Diamond & Lee, 2011).

Balance

The ability to interact and play with peers in a competent, confident manner is paramount to success, both in the classroom and on the playground. For children with hearing loss this is a two-fold challenge as both language delays and balance play a role. Due to the anatomy of the inner ear, the cochlea has two related but separate functional areas, the auditory and the vestibular systems. Hearing loss can have a great impact on the vestibular system due to its close proximity and often overlapping structural or functional issues (Cushing, Chia, et al., 2008; Cushing, Papsin, et al., 2008; Livingstone & McPhillips, 2011).

Twenty to seventy percent of children with hearing loss have vestibular deficits (Cushing, Chia, et al., 2008) that can impact other multisensory processing systems (i.e., tactile and motor function also involved in play; Bharadwaj et al., 2012; Fellinger et al., 2015) further affecting engagement with peers. Children with HL would also benefit by making motor skills an aspect of habilitation.

The Role of Music

Several areas in development are dependent on the ability to perceive sounds in the environment accurately and in a timely fashion to maintain context and synchrony with others. Many have reviewed the literature and commented on the use of music to assist in the development of processing, audition, and language (Brandt et al., 2012; Francois et al., 2015; Shahin, 2011). Evidence has supported the use of musical experience to scaffold development in these areas in children with typical hearing. The rhythmical quality of both music and language, demonstrated in children's nursery rhymes, engages children in a number of ways: emotionally through the enjoyment of the sounds, neurologically through entrainment to the beat, and socially through aspects of language use and sharing of the activity. Preliteracy skills may be built on the ability to entrain (or engage both the auditory and motor neural pathways) to a rhythm as this allows for the development of segmentation of both sentences and words, tasks necessary ultimately for reading (Degé & Schwarzer, 2011). Music experience can support social skills as it is often enjoyed in a group setting. Children's music groups from early on have demonstrated the ability to support positive social engagement behaviors described as prosocial (Cirelli et al., 2014; Gerry et al., 2012). During these social interactions, other aspects of development can also be supported and practiced.

Music and children with HL

The use of music and movement for children with hearing loss comes from a logic based on evidence that increasing the complexity of listening exercises can build auditory skills. This then may influence all other skills dependent on the ability to access and process auditory input accurately and finely. The ability of music and movement to scaffold these skills has been demonstrated in numerous outcomes related to speech perception, language, social skills, and executive functions (Gfeller, 2016). Although the limitations of hearing technology are well known regarding certain aspects of music (Hsiao & Gfeller, 2012; See et al., 2013), the question arises as to whether or not early training and experience may be able to fine-tune the auditory pathways and support skill development. Understanding the areas of strength both in the technology and neural pathways, makes the use of music and movement in the early years a possible strategy for skill development in preschool children with hearing loss.

Research Questions

This study used a twelve-week, group music intervention to investigate two questions.

1. Will the outcomes in areas of school-readiness skills (language, literacy, social competence, executive functions, and balance) be significantly improved in the intervention group compared to the control group?
2. Will the outcomes between the music and movement and craft-based groups be significantly different?

Method

Study Design

A quasi-randomized music intervention was conducted with 12 weekly, facilitated, group sessions. Each child had one parent participate with them during the intervention.

Participants and Recruitment

Children with bilateral, permanent, sensorineural hearing loss, using hearing technology consistently, and in an English listening and spoken language program, were recruited for this study. School boards, listening and spoken language practitioners, and community support groups were all approached to identify potential participants. All children were between the ages of 3 and 5 years and were screened using the Nipissing District Developmental Screen (NDDS, 2011) to exclude any

children who might have developmental conditions that would preclude their participation in the intervention programs, including those with auditory neuropathy spectrum disorder.

If the child met the inclusion criteria, parents signed a participation consent form and completed a demographic questionnaire containing information regarding general developmental milestone attainment, hearing tests and technology, and any previous involvement in music lessons. Families were subsequently put into one of three groups: music and movement (M&M), craft-based (CB), or control. The control group was offered a series of twelve 45-minute music and movement sessions after their post testing with the understanding that they would act as *late entry* participants and would be tested a third time. The children were quasi-randomized for age and sex only with each group having both sexes and different ages represented whenever possible. Each child participated with a parent/caregiver in twelve 45-minute, weekly sessions. Two sites for the intervention were selected to support attendance of all interested families. A total of 15 children were recruited for the interventions: eight for M&M (two late-entries) and seven for CB (two late-entries).

Intervention

Each intervention curriculum was developed based on activities to support school-readiness skills including language, listening, phonological awareness, social skills, executive functions, and balance. Using aspects of entrainment theory and a focus on school-readiness skills, the goal was to support development in these important areas and better prepare children with hearing loss for an integrated classroom setting. Twelve sessions were organized with a weekly theme (e.g., transportation, under the sea, superheroes), a book, and activities to reinforce the theme (see Tables 1 and 2). Groups consisted of between two and five children with one accompanying parent/caregiver who also participated in the activities. All intervention groups were facilitated by a speech-language pathologist specializing in HL who had had no previous interactions with the participating families. The two groups were chosen to attempt to distinguish between group effect and music effect as both could contribute to overall outcomes.

All music used for the sessions was made available to the families for use at home during practice time through a link to a YouTube channel that was sent to each family after the first two classes. The same pieces of music were used in both intervention groups and consisted of a selection of both classical and children's music. None of the music used had lyrics. The M&M sessions had activities facilitating movement to the music whereas the CB sessions had the music playing in the background while crafts were being completed.

Attendance was taken each week and a portable sound field amplification system was used by the facilitator at each session to ensure optimal auditory access for all participants (a sound field amplification system is made up of a microphone worn by the facilitator, an amplifier, and a built-in speaker which makes the facilitator's voice more intense than the ambient noise in the room).

Homework practice sheets were sent home with families each week, with the expectation that activities similar to those introduced during the sessions would be practiced twice between sessions. For example, in the M&M group this might include singing songs used in the warm-up and for the CB group craft-related activities consisting of

Table 1
Sample Curriculum for Music and Movement

Activity	Goals
1. Warm up: Done in a circle and will include various stretches of the legs, arms, and torso. Each stretch will have a set song/rhyme to accompany it.	self-regulation, listening, vocabulary, rhyming, active use of language, cooperation, singing, memory
2. Follow the leader: Children form a line, remain in that line for the completion of the song and move to the beat of the music in one of three ways (march, gallop, or tip toe). The music will be chosen based on its rhythm and tempo.	self-regulation, cooperation, listening and moving to the beat, motor coordination and balance
3. Sleeping game: Children sleep while they listen to the rhyme that tells them what they will be when they wake up. Various props are utilized in this activity (e.g., scarves, bean bags, bells).	pretend play and imagination, self-regulation, vocabulary, rhyming, language use, negotiation
4. Story time: A different nursery rhyme is read each session and the children are encouraged to act out the story with scaffolding by the instructor.	self-regulation, cooperation, imagination and pretend play, vocabulary, language use, rhyming
5. Stop and go: Various types of music will be played with differing aspects such as rhythm (gallop, march, skip, bounce, skate/slide), high/low, fast/slow, quiet/loud, happy/sad. Children will interpret the music freely but will need to listen for when it starts and stops to regulate their own dancing. Reminders will be given before the activity starts regarding when to stop and when to go.	listening, self-regulation, cooperation, focus
6. Bird on a wire: This activity requires the children to form a line side by side to watch a demonstration of steps as well as say thank you and curtsey/bow. It is begun with a request for bird on a wire and a countdown is done from 3 to 1.	listening, self-regulation, cooperation, focus, memory

Table 2
Sample Curriculum for Craft-Based Group

Activity	Goals
1. Warm up: Introduce the theme of the class by reading a story and discussing content and vocabulary.	self-regulation, listening, vocabulary, active use of language, cooperation, memory
2. Follow the directions of the facilitator in making the craft by using various fine motor skills related to cutting, pasting, crayons, stickers, and lacing.	self-regulation, cooperation, listening, motor skill
3. The children will interact using their completed craft in show and tell and nursery rhyme activities.	pretend play and imagination, self-regulation, vocabulary, language use
4. Clean-up Routine: Craft area will be tidied and cleaned up as a group.	listening, self-regulation, cooperation, focus

coloring or cutting and pasting. Parents were also asked to keep track of any other behaviors from the sessions that were initiated by their child. Again, this might be songs/movements from class, rereading the book, or doing a craft. These sheets were collected each week.

Data Collection

All assessments used in this study were selected as they each reported both reliability and validity. Each test provided either a Standard Score or a *T* score and had been normed on a population of typically developing children. All pre-testing was done within one month prior to the beginning of the intervention. Testing consisted of the Preschool Language Scale 4th edition (PLS-4; Zimmerman et al., 2002), the Phonological Awareness Test 2nd edition (PAT-2; Robertson & Salter, 1997), the Peabody Developmental Motor Scales (PDMS; Folio & Fewell, 2000), the Social Skills Rating Scale Parent and Teacher (SSRS; Gresham & Elliot, 1990), and the Behavioural Rating Inventory of Executive Function Preschool Version (BRIEF-P; Gioia et al., 2002). Two subtests of the PAT-2 (Rhyming Discrimination and Production, and Segmentation for Words and Sentences) and the PDMS (Stationary and Locomotion) were used.

Testing took approximately one hour for each child. A speech-language pathologist with more than 10 years of experience working with children with hearing loss was hired by the researcher and completed all testing for this study. Each child was tested using the PLS-4, the PAT, and the PDMS and one parent completed the SSRS (parent version) and the BRIEF-P. The two tests for teachers, SSRS teacher and the BRIEF-P were given to the parent for their child's teacher along with an envelope and directions regarding how the teacher was to return the completed forms to the researcher. Participants then attended twelve 45-minute, weekly sessions of either M&M or CB or waited the 12 weeks if in the control group. Post-testing was completed within one month of the final intervention class or after the 12-week waiting period. All post-testing was completed by the same speech-language pathologist in the same location as for pre-testing. Parents and teachers (when possible) also completed the same tests post intervention (SSRS, BRIEF-P). The speech-language pathologist completing the testing was not aware of the intervention group to which each child had been assigned. Families in the control group completed testing at baseline and then three months later using the same protocol as the intervention groups.

Parents in the intervention group also participated in a semi-structured interview with the researcher during post-testing that explored the experience of the sessions by both the parent and the child, specific behaviors during and between sessions related to intervention activities, and any final comments. Results of this qualitative analysis are presented elsewhere (DuBois et al., 2020).

The facilitator was videotaped during sessions to assess her consistent interaction and engagement with the children between the M&M and CB interventions to avoid possible bias in facilitation. The storybook reading section of each video was selected, cut, and randomly assigned to a folder. Eight folders with three videotaped sections were created to ensure that each video clip would be evaluated a minimum of four times. Eight students from the Department of Speech-Language Pathology were recruited and assigned one folder each to watch and evaluate the videos using a Likert Scale based on agreement (*strongly disagree* to *strongly agree*).

Data Analysis Plan

Assessment outcome values were calculated into Standard Scores for each individual test. Standard Scores were then changed to categorical outcomes based on whether scores increased or decreased for each participant post-intervention or post 12 week waiting period for the control group.

Ethical Considerations

Ethics approval was obtained from the University of Toronto and all school boards involved in recruitment for the study.

Results

Five children were lost to the interventions due to family circumstances (4 CB and 1 M&M), however three of these families agreed to be controls only (1 CB and 2 of the late-entry CB), and two were lost completely (1 CB and 1 M&M); therefore, the final data set was comprised of ten participants in the intervention data group (8 direct entry and 2 late entry) and five in the control data group (3 controls and 2 late-entry; Table 3). All children had their hearing loss identified during the newborn screening period except one whose hearing loss was not identified until two years of age. Eight mothers and two fathers participated. All families attended a minimum of 9 sessions during the intervention, with one family attending 9 of 12 sessions and 9 families attending 10, 11, or 12 of 12

sessions. Homework sheets were collected from nine of the 10 families during the intervention. All families recorded that they had practiced activities from the group intervention twice during the week between sessions as requested by the facilitator. Families also listed instances when their child initiated activities spontaneously and what these activities were. Overall, all participants initiated activities on their own a minimum of one to two more times during the week. No post-intervention test results were available from the teachers as the interventions ran through the summer term.

Table 3
Participant Characteristics

Parent	Child age (years at recruitment)	Child Sex	Child hearing device technology[a]	Group (M&M/CB)[b]
1. parent	5	female	CIs	M&M
2. parent	5	male	HAs	M&M
3. parent	5	female	HAs	M&M
4. parent	5	male	CIs	M&M
5. parent	5	female	HAs	M&M
6. parent	3	female	CIs	M&M (late entry)
7. parent	3	female	HAs	M&M (late entry)
8. parent	5	male	HAs	CB
9. parent	5	male	HAs	CB
10. parent	3	male	HAs	CB
11. parent	4	female	CIs	Control
12. parent	3	female	CIs	Control
13. parent	3	male	HAs	Control

[a]CI = Cochlear Implants; HA = Hearing Aids
[b]Groups were divided into Movement & Music (M&M), Craft-based (CB), and Control

Data Analysis

All children were post tested within one month of completing the intervention sessions. The formalized tests were scored according to their respective manual protocols and standard scores were collected in preparation for analysis. All standard scores were evaluated based on whether the score had increased or decreased post intervention and these values were used in a 2x2 chi square (intervention X control and decrease X increase) to assess change between the intervention and control groups. As the chi square assumptions were not met due to the small number of participants, a Fischer's Exact test was used to correct for this. Results for all assessments were nonsignificant using a two-sided test and a significance level of .05 (range 0.075–1.00).

These same parameters were then used to compare the intervention groups and the controls in a descriptive manner comparing increases in standard scores. More children in the music and movement group improved post intervention in preliteracy (Table 4). Although both intervention groups had the same rhyming books read to them each week, the warmup for the M&M group involved rhymes with finger play or actions. Added to this, their activities involved moving to music throughout the sessions, whereas the craft-based group had only music playing in the background during their craft activities. The influence of moving to the rhymes influenced the impact of the rhythms as they became a whole-body experience rather than being solely auditory. Also of note are the scores of the intervention groups when compared to those of the control group. Overall, 90% of the intervention participants improved in their rhyming scores compared with 40% of the controls.

Table 4
Preliteracy: Phonological Awareness Test (PAT-2) Rhyming (Discrimination &/or Production subtests)

Group	Percentage of participants with increased standard scores post test
Music and Movement	100%
Craft Based	66%
Controls	40%

The social skills scores demonstrated an increase in pro-social behaviors in the intervention group, but not in the controls (Table 5). This adds support to the idea that being in group activities with peers allows for opportunities to practice peer-to-peer interactions in natural, but supportive conditions. In the case of this intervention, a facilitator and a parent were able to both model and scaffold appropriate behaviors in a multitude of situations during the intervention making it a rich environment for watching, learning, and practicing.

Table 5
Social Skills: Social Skills Rating Scale (SSRS)

Group	Percentage of participants with increased standard scores post test
Music and Movement	71%
Craft Based	66%
Controls	0%

Language outcomes improved for all groups with the intervention groups having a higher percentage of participants with increased standard scores (Table 6).

Table 6
Language: Preschool Language Scale (PLS-4)

Group	Percentage of participants with increased standard scores post test
Music and Movement	43%
Craft Based	33%
Controls	20%

Balance scores increased for both intervention groups only (Table 7); however as discussed, balance is variable in children with hearing loss making these outcomes difficult to measure and comment on with any certainty. Executive function scores improved more for the control group than for the intervention groups (decreased standard scores for the combined intervention groups was 40%, Table 8).

Table 7
Balance: Peabody Developmental Motor Scales (PDMS-2) Locomotion and Stationary

Group	Percentage of participants with increased standard scores post test
Music and Movement	71%
Craft Based	66%
Controls	0%

Table 8
Executive Functions: Behaviour Rating Inventory of Executive Function-Preschool (BRIEF-P)

Group	Percentage of participants with increased standard scores post test[a]
Music and Movement	57%
Craft Based	0%
Controls	60%

[a]Decreased scores for the BRIEF-P demonstrate improved outcomes and are therefore listed for this scale.

Although outcomes were not statistically significant, these data support the idea that the addition of group activities is promising and may help to demonstrate a positive trend in outcomes for preliteracy, social skills, language, and possibly balance.

Intervention Video Evaluations

The videotapes of the sessions were initially recorded to measure consistent facilitation between the intervention groups. As the intervention outcome scores were grouped together, the variable of possible bias in facilitation was no longer relevant. Consequently, results from the student-evaluated Likert scales is not reported here as they do not add pertinent information.

Discussion

Many studies have demonstrated benefits when music and movement are used in areas of school readiness skills such as: language (Chobert et al., 2014), preliteracy (Degé & Schwarzer, 2011), social (Kokal et al., 2011), executive function (Zachariou & Whitebread, 2015), and balance (Fernandes et al., 2015). Surprisingly, this study did not demonstrate significant outcomes in any of the areas of interest during the standardized testing, despite evidence of improvements in all areas during the intervention observed by both parents and the facilitator.

Limitations of this study that affected these overall outcomes statistically may have been the small intervention group (10 children), which resulted in very little power, and the length of the overall intervention (12 weeks) as compared to previous studies. Many of the music interventions previously cited included sessions over an entire school year rather than the 3 months used in this study.

A larger component of the outcome results may have been the scope of the tests used. Although all were chosen due to their reported validity and reliability in the individual specialties, their sensitivity to real life situations and function may not have been adequate for this study. Balance was one such area. Although testing did not demonstrate a significant change in balance, observations during the intervention belied the scores. As it was an easily observed change in skill during the intervention sessions, the test scores were surprising. The children walked a tape line a number of times each week in the session room, competing against both themselves and one another. By the end of the sessions, each child was able to walk the line much more easily and often very accurately to the end of the tape. They did, however, need a few practice runs to allow for precision. The test for balance did not allow for any practice and therefore did not truly represent the balance capability of each child. As balance in play, sports, or physical education has many opportunities for practice, improvements are more obvious as more practice occurs. Also, as children become more adept at these skills, practice is more satisfying. As was observed in the sessions; when each child saw improvement in their skill on the tape line, they tried harder to be better—success drove the practice, in turn supporting the use of activities to build confidence and skills in this area.

The same occurred in the area of language as test scores did not show any significant changes in language development, but there was observable change during the sessions. As the test used a particular selection of vocabulary and language skills for each age group, there was no opportunity to expand on any of the areas during testing. During the sessions, children were exposed to many new vocabulary words. Each book brought a new set of words but also different situations for language use and form (polite forms, tenses, descriptives, poetry), expansion of known vocabulary (unusual farm animals, sea creatures, baby animals), and scaffolding for skills such as how to ask a question, how to kindly help a peer, or how to ask for help

giving clear information. The children demonstrated both vocabulary and language use gains during the sessions which are both very important language skills. Both skills, however, can be difficult to capture during a standardized test.

Another area that showed promise during sessions was that of preliteracy. Although children did not demonstrate significant improvements in rhyming ability on the test, during the intervention many of the children had great fun trying to make up words that rhymed. They would bounce ideas off one another and compete to see who could make up the most words. As all of the warm-up songs/rhymes and many of the books read in the intervention had rhyming components, the children had ample opportunity to play with rhyming. Parents reported that their children spent time both in the car ride home and with siblings playing rhyming games. This use of rhyming as a game allowed the children to expand their skill and build confidence in an area of literacy preparation. Again, although the test had sections for both discriminating whether or not two words rhymed and producing a word that rhymed with the one given by the tester, it had a set list of words to be tested and no room for expansion, thereby limiting the child's opportunities. Word and sentence segmentation added another unforeseen challenge for the children. Children with coordination challenges were not able to demonstrate their abilities well because this test relied on clapping or tapping to demonstrate the various segments of a sentence or word. As has been discussed, children with HL often have motor challenges (Livingstone & McPhillips, 2011) which take some time to mature possibly making their test results under representative of ability.

Social skills were also difficult to test. A number of challenges arose; (a) the test was a parent questionnaire possibly adding bias to the answers given, (b) a second bias related to exposure to a group, and (c) despite the test including a Teacher Questionnaire component, teacher evaluation was not able to be accessed due to timing of the intervention. The value of teacher input may also not have been representative of the child's social skills, however, since the difficulties of assessing one child's peer-to-peer interactions in a busy classroom or playground setting would be challenging. Parents completed the questionnaire before the intervention began and based their answers on observed behaviors of their child at home. It was later divulged to the facilitator that many of the parents had never seen their child interact with peers, only siblings. Consequently, many of the participating children scored lower in social skills after the interventions possibly based on parents' perception of their child's behaviors when compared to that of their group mates'. Once again, many improvements in social skill development were observed during the sessions. The facilitator used scaffolding to help children during interactions intrinsic to the activities (sharing, taking turns, requesting), and in peer-to-peer discussions during story time or joining and leaving the group. As the sessions progressed, the children were able to consistently use the skills practiced with their peers, helping to build confidence for further practice and use in the classroom. The two children whose scores decreased the most in the post test according to their parents, actually improved the most during the sessions with evidence of greater consideration of their peers. Unfortunately, this was not demonstrated in their post intervention scores.

The final area of challenge for testing was executive functions (EF). Although other more objective tests have been used in research (e.g., Go-No Go, Dimensional Change Card Sort, Marshmallow Test) they do not test function in real life situations. Therefore, like social skills, EF was tested using a parent questionnaire. This questionnaire had the same possible biases as social skills test; it too depended on parent judgement of the child before and after participation in the intervention. Once again, the input from the teacher component was not accessible due to timing. The teacher's evaluation of peer-to-peer use of EF may not have been representative in this case. Focus, memory, and flexibility in the classroom, however, may have shed some light on academic areas of development. During the intervention, many instances of improvement were observed. Children were often corrected by their peers if they were being disruptive. This resulted in an immediate change in behavior, supporting the idea that children are often able to support and model appropriate behaviors with their peers. Each group demonstrated this with different children being the model or enforcer at different points in the intervention. It was also observed that children reacted very differently when a peer gave the correction as compared to when the parent gave it. The children seemed to understand that it was important to behave in a particular manner to be part of the group. This ability to self-regulate for inclusion is important in the classroom and the children were able to watch and learn as well as practice strategies during the group sessions.

As skill development was observed during sessions, it was surprising when test results did not reflect this. Most were not measurable in testing as there was no method to observe how skills were used in context during the standardized tests. Parents also commented that the sessions provided a safe environment for their children and might have supported growth as they all understood that they had HL and felt part of a common group. The children helping each other was also observed in multiple instances during the intervention sessions (e.g., initial sound in words, getting a friend's attention, supporting successes, competing on the taped line). It is clear therefore that it is important to gain a more complete picture of the child; within their own *world* of family, school, and other activities; when deciding how best to support development.

Parent involvement in sessions is also important to consider. Parents have reported a need for more information and ongoing support for their children (Jackson, 2019). Adapting the modeling, strategies, and advocacy (for self and teaching modelling for child) to real life situations helps both parents and children use the demonstrated skills on a daily basis. Because there is typically no way of measuring what is practiced and reinforced day-to-day, the homework sheets used in this study demonstrated

that children practiced skills from sessions at home, both alone and with family members, each week. Hopefully parents saw the benefits of joint participation and continued to encourage and support these activities at home by participating with their child even after the sessions were completed.

Conclusion

As this study demonstrated, being able to measure abilities in functional settings is paramount to ultimate success for this population. Using purely formalized testing did not show improvement even though observations during intervention sessions showed a few examples or at times multiple instances of skill development. One suggestion of how to glean a clearer view of the child in his or her world would be to use behavioral observations along with formalized testing. This would allow for a more complete evaluation of the child and his or her challenges, thereby allowing for a more appropriate and individual set of goals. In the case of this study, outcome measures would have benefitted from an observer scoring a set of criteria related to social skills and executive functions as well as balance that could have supplemented what was seen in the standardized testing. Observations in areas such as peer-to-peer interactions (initiation, sharing, vocabulary and language use, empathy, self-regulation, listening strategies, and advocacy) would have given a more complete idea of areas for future support and scaffolding for each child. This would, in turn, allow for the creation of goals related to areas needing support which could then be incorporated into real life activities with opportunities for practice.

Behaviors are complex and dynamic, making it imperative that their assessments reflect this. Helping children with HL to catch up to their peers and continue to build school-readiness skills needs accurate observation and continued evaluation so that skills can move on the same trajectory as classmates. Although standardized tests accurately assess the child's ability with regards to the specific test and in those particular circumstances, they may not access the child's full potential or flag challenges not addressed by the assessment tool. Those working with this population and assessing their progress would have a more comprehensive view of outcomes if functional measures of skill were assessed. This would then ensure that outcomes were not solely based on test scores, but rather on a more complete picture of the child in a functional role. Consideration of the child as a member of society trying to learn how to function and be successful in all aspects of life (i.e., family, academics, social, and self-regulation abilities) must be the goal. Representative outcomes guiding functional habilitation is the means to the attainment of ultimate success both in the classroom and beyond.

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