Mediated Music Lessons and Language Proficiency in Children of Migrant Workers[1]

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This study evaluates the impact of music classes conducted as *Mediated Learning* environments on the musical aptitude, executive functions, and language proficiency of a select group of kindergarten children of migrant workers. *Mediated Learning* is a didactic approach intended to nurture quality and synchronized teacher-child interactions while specifically focusing on enhancing general learning skills (see Appendix 1). Extensive research has confirmed positive interactions between music education and general learning skills, specifically language skills (Hallam 2010, 2015), as well as between *Mediated Learning* and general learning skills (Feuerstein 1980, 2006; Klein 1987). This study coordinates between the benefits of *Mediated Learning* experiences and Music Education, and adds to our understanding of the potential contribution of *Mediated Music* education to the general attainment and linguistic development of at-risk populations.

The participants included 63 kindergarten children of migrant workers growing up in an urban area of Tel Aviv, Israel. The children studied in two classes at two schools, which were assigned randomly to control and experimental groups. Children in the experimental group (n=31) studied music for two hours a week for a period of four months with a certified music teacher who was also a trained mediator. Children in the control group (n=32) studied music for the same period with a certified music teacher who was not a trained mediator. Pre- and post-assessments evaluated the development of musical aptitude (Gordon 1979), executive functions (working memory, self-inhibition, cognitive flexibility, Davidson et al. 2006), and language proficiency (Gorelnik 1982). The findings indicate significant improvements for the research group in central aspects of the musical aptitude, executive functions, and language proficiency assessments. These findings, while limited in scope, are meaningful in that they suggest that mediated music environments foster improved executive functions and language proficiency, and that skills acquired in music lessons transfer to other contexts in a relatively short period.

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Overview

This study focuses on the contribution of Mediated Music Lessons to the improvement of key learning skills—working memory, self-inhibition, and mental flexibility—termed "executive functions" (Davidson et al. 2006). Working memory involves holding or maintaining information in your mind's eye while mentally working with or manipulating that information. Inhibitory control refers to the ability to resist a strong inclination to do one thing in order to do what is most appropriate or needed. Mental flexibility enables one to adjust nimbly to changed demands or priorities, and to think "outside the box" (Diamond et al. 2007). Research studies suggest that executive functions (EF) serve as prerequisites to all learning, may predict scholastic achievement in language acquisition and math, and constitute a particularly important component in determining readiness for first grade (Duncan et al. 2007; Best et al. 2011). Indeed, Duckworth and Seligman (2005) concluded: "Discipline influences achievement more than talent does" (p. 944), and Nicholson (2011) contended: "… a focus on the content, without a focus on the skills required to use that content, will end up with children being left behind." Moreover, ongoing research suggests that intellectual development is associated with improved executive functions. Kindergarten children at risk because of economic disadvantage are disproportionately behind in EFs in comparison with children from middle-income homes. Hence, improving EFs is particularly urgent for at-risk children (Diamond et al. 2007; Diamond, 2010).

Mounting evidence worldwide confirms positive interactions between music education and language development (Hallam 2010, 2015; Catterall 2002, 2009; Cohen et al. 2011). Studies show that repeated exposure to sounds, including non-verbal sounds (e.g. music), contribute positively to the development of neural auditory skills (Putkinen et al. 2014), including an ability to make stronger distinctions between speech syllables (Kraus & Nicol 2014; Parberry-Clark et al. 2012; Strait & Kraus 2014; and Zuk et al. 2013). More specifically, children with musical training have been found to outperform those with no training in music and language tasks (Magne et al. 2006), and that music training positively influences the development of executive functions related to language proficiency (Zuk et al. 2014; Moreno et al. 2011a, 2011b; Winsler et al. 2011), including enhanced comprehension of complicated text passages (Thompson et al. 2012). Moreover, linguistic difficulties often arise from problems related to auditory working memory (including verbal and non-verbal sounds) and these difficulties can be addressed through music training (Shelter 1990; Ho et al. 2003, Degé et al. 2011; Strait et al. 2012). Recent brain research suggests explanations for these findings by demonstrating that language and music data processing occur in the same region of the brain (Hallam 2015).

It has often been found that positive extra-musical outcomes depend, as mentioned above, on the quality of the teachers and good teaching practices (Hallam, 2010; Deane et al. 2011). Mediated Learning Environments constitute a particularly effective pedagogical approach, conducive to the development of executive functions (Feuerstein 2006; Klein 1993, 1996; Diamond 2007). Interconnecting content and approach, this research proposes to study whether and how Mediated Music Lessons may create a learning environment particularly conducive to the development of

executive functions and language proficiency among a select group of kindergarten-age children of foreign workers growing up in Tel Aviv, Israel.

Method

Participants

Israel, an immigrant-absorbing state, serves as home to many children of migrant workers. Most of these children do not speak Hebrew fluently and have never acquired a single standard language. Their inability to communicate effectively often results in learning deficiencies and prevents them from successfully integrating into Israeli society. Moreover, national reports reveal severe behavior and disciplinary problems among children of migrant workers.[3]

For the purposes of this study, two kindergarten classes from two schools that serve immigrant populations in urban Tel Aviv were chosen for evaluation. One of the schools was randomly chosen as home for the experimental group (n=31 children), while the other accommodated the control group (n=32 children).

Research Tools

All assessments were conducted anonymously, using the following assessment tools:

Musical Aptitude: *Gordon Primary Measure of Music Audiation*, suitable for children K-3 (1979), was used to determine musical aptitude, and compare individual aptitudes with the aptitudes of other children of similar ages. The test consists of forty pairs of short musical phrases played consecutively on a computer. Administered individually, each child is asked to determine whether the phrases in each of the pairs are the same or different. The scoring accounts for the number of correct answers and the relative position of the child in comparison with other children. The scores subdivide into three groups: low, average, and high. High includes children who answered between 31-40 questions correctly, and rank among 91-99 percent of the population. Average includes children who answered 21-30 answers correctly, and rank among 23-89 percent. Low includes children who answered 15-20 answers correctly, and rank among 1-17 percent.

Executive Functions: To assess the effect of the intervention on the children's working memory and inhibition, the children were tested with the *Hearts and Flowers* and *Flanker Fish* tests, administered individually using computer software and recorded responses (Davidson et al. 2006; Diamond et al. 2007, 2010). During both tests, the participants hold a button box in both hands and use their thumbs to press one of two response buttons. Each test includes three conditions, arranged progressively according to difficulty. The *Hearts and Flowers* Test includes congruent, incongruent, and mixed conditions. In the congruent condition, the children view a Heart and are asked to press the button on the same side as the Heart. In the

[3] Thus, the State Auditor's report (Report 58B, issued in May 2008), stated that the Ministry of Education had failed to deal with violence in this population from late 1999 to late 2006.

incongruent condition, the children view a Flower and are asked to press the button on the side opposite the Flower. In the Mixed condition, Hearts and Flowers are randomly intermixed (Figure 1).

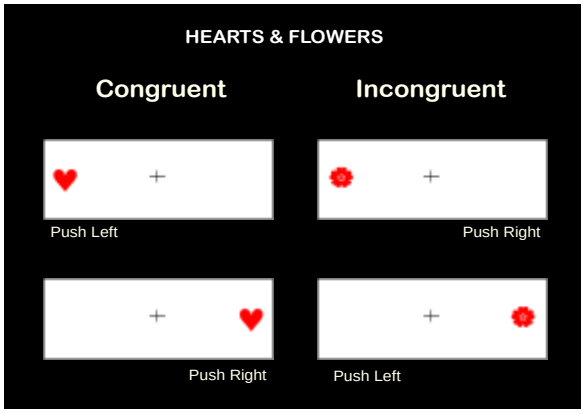

Figure 1 **http://www.devcogneuro.com/eftasks.html**

The *Flanker Fish* test also features three progressively more difficult tests. In the first test featuring Blue Fish, the participant is asked to relate to the direction in which the central Blue fish is swimming and *ignore* the flanking stimuli on either side (Figure 2a). In the second test featuring Pink Fish, the participant is asked to relate to the direction in which the flanking stimuli are swimming, and to ignore the central fish (Figure 2b). In the third Mixed test, the participants view Blue and Pink fish intermixed randomly. Scores document the percentage of correct answers obtained, the reaction time, and standard of deviation (www.devcogneuro.com/EFTasks/FlankerInfo.ppt).

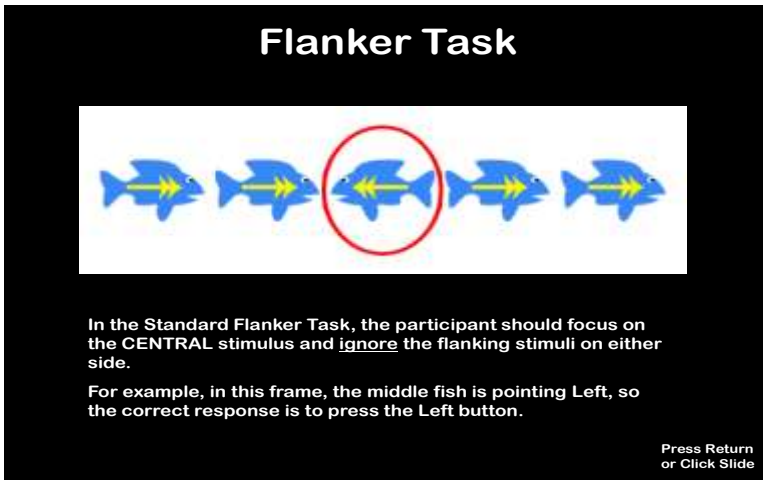

Figure 2a Flanker Task

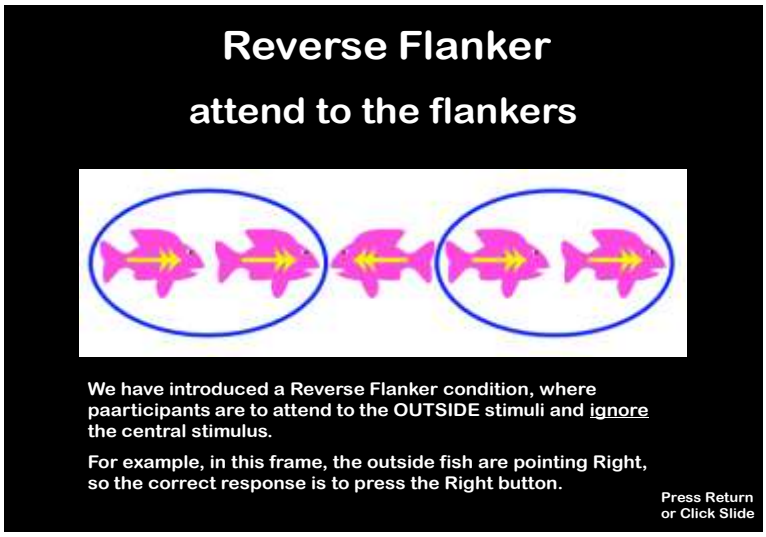

Fig. 2b Reverse Flanker

Language Assessment: Language proficiency was assessed using the Gorelnik language test, suitable for children aged two to six years (Gorelnik 2005). The test subdivides into six sections (vocabulary, pronunciation, comprehension, imitation, expression, and storytelling), each scored separately. Professionally trained speech therapists administer the tests.

Procedures

Hypothesis

Children participating in the Mediated Music Lessons will do significantly better in music aptitude tests than children in the control group (test 1);
Children participating in the Mediated Music Lessons will do significantly better in executive functions tests than children in the control group (test 2);
Children participating in the Mediated Music Lessons will do significantly better in the language proficiency test than children in the control group (test 3).

Pre-tests

All of the participants were assessed for musical aptitude, executive functions, and language proficiency. No significant baseline differences were found between the scores of the children in the experimental and control groups.

Intervention

An intervention of six months included the following activities:

Professional training sessions: A supervisor attended and filmed the music lessons bi-weekly, focusing particularly on the teacher-child interaction. The supervisor and music teacher then analyzed the films according to the criteria of *Mediated Learning* (see Appendix 1). Specifically, the supervisor worked with the teacher in creating a teaching profile, determined by positive affect, eye contact, and implementation of the three basic criteria for mediated teaching. These include: *Focusing and Reciprocity*, *Meaning*, and *Expansion*. Thus, for example, the teacher might ask the children to *focus* on individual musical elements (sounds, rhythms, melodies), and then to re-create them in different modalities (performing on musical instruments, movements, drawings). The teacher designed *meaningful* experiences by selecting activities that were relevant to the children's world, and by maintaining an enthusiastic attitude during the classes. Singing activities included text analysis, thereby helping the children to develop a richer Hebrew vocabulary and become better acquainted with Israeli culture. Finally, *expanding beyond the immediate*, the teacher demonstrated how concepts relevant to a specific piece might transfer to additional contexts, and encouraged the children to express their musical understanding in a variety of modalities (movement, drawing, mirrors). These activities provided opportunities to make connections and think flexibly about materials studied in class.

The mediated music classroom serves as a context in which the children think, question, and reflect on their feelings and ideas. Different aspects of performance are particularly important in developing a working memory. Thus, for example, children practice recalling sequences of progressively more complicated rhythmic progressions, memorizing texts, and matching kinesthetic gestures to musical events. In addition, while performing and composing short musical pieces in groups, the children become aware of features that define opening, continuing, and closing functions as well as other compositional techniques, such as repetition and variation. Rotating performance parts enhance mental flexibility. Moreover, following and creating graphic representations assist them in developing a sequential and holistic understanding of a musical piece.

While engaged in the above activities, the children practice waiting, thinking, choosing, reflecting, and taking turns. This process helps them to overcome impulsive behavior.

LINK TO VIDEO: Demonstrating a Mediated Music Classroom. We would like to thank Ronit Buaron, our dedicated music teacher who appears in the video, and who designed the music activities.

Post-tests

Following the intervention, children in the experimental and control groups were reassessed with a repeat of the musical aptitude, executive functions, and language proficiency tests.

Findings

The children's musical aptitude was measured by applying Gordon's *Primary Measures of Music Audiation* tonal test pre- and post-intervention. Our research hypothesis suggests that children in the experimental group show greater improvement on the results of their evaluations than the children in the control group. The initial results indicated a very wide standard of deviation. To overcome this problem, the tests of children who scored above 95 percent were removed from the sample. Thereafter, a uni-variant analysis was conducted. The pre-intervention measurements showed no significant differences between the two groups: $F(1,51)=.62$, $p>0.05$.

The ANOVA 2x2 analysis was conducted to evaluate the research hypothesis (Group x Time) with repeated measurements concerning Time. The analysis showed a significant difference between the measurement of pre- and post-intervention of the experimental and control groups, $F(1,48)=9.50$, $p<0.01$, $Eta^2=.17$, and a significant interaction effect of Group x Time, $F(1,48)=4.33$, $p<0.05$, $Eta^2=0.08$. Table 1 demonstrates the changes that occurred in the number of correct answers obtained in the two groups, pre-post intervention, and the relationship between the children's score and the norm of other children their age.

Table 1 Gordon's *Primary Measures of Music Audiation* (K-3)

PMMA		**Research Group**			**Control Group**	
		Pre	**Post**		**Pre**	**Post**
Score	Mean	24.13	27.57		23.41	24.07
	SD	3.91	4.82		3.14	4.61
Percentage	Mean	49.48	68.83		44.7	46.00
	SD	29.053	27.72		24.07	28.30

Hearts and Flowers and *Flanker's Fish* assessments for the evaluation of executive functions: The pre-intervention measurements showed no significant differences between the two groups: $F(2,54) = 1.54$, $P<0.5$.

Analysis of the pre-post intervention scores did not indicate significant differences between the groups in the *Hearts and Flowers* tests and the *Flanker Fish* Blue and Pink tests. However, an almost significant difference ($p=<0.7$) was found between the groups in the *Flankers Fish* mixed tasks, as the percentage of correct answers in the experimental group improved from 67 percent to 79 percent, while that of the control group improved from 74 percent to 78 percent.

As noted above (Tools), MIXFF are the most difficult tasks in the assessment, as the child must refrain from impulsive behavior, recall multiple rules, and match the appropriate rule with the specific task at hand.

Evaluating Language Acquisition: In the post-intervention assessments, a significant interaction (Group × Gorelnic Story Telling) was found in the storytelling component of the test, $F(1, 47) = 22.243$, $p < .001$, $Eta^2 = .321$ (see Table 2). The storytelling subsection is the last and most difficult subsection in the test. It contains two parts. In the first part, the tester and the child look at a picture book that tells a story about a family. They look only at the pictures, and sometimes the tester points at the main figures in the story. In the second part, the child recounts the story while looking at each of the pictures. The pictures contain a large number of details, requiring the child to focus on the most important events in each picture and interconnect them with the previous and future events of the story. The national norm for this subsection among children of comparable age, irrespective of socioeconomic conditions, stands at 21.20, SD 4.96. Our findings indicate that the children in the experimental group significantly closed the gap in relation to their peers, while those in the control group did not.

Table2 The Averages (Mean) and Standard Deviation (SD) Measurements Pre- and Post-interventions for Experiment and Control groups in the Storytelling Subsection of the Gorelnik Assessment for Evaluating Language Acquisition

Gorelnik-Story	**Mean**		**SD**	
Group	**Experiment**	**Control**	**Experiment**	**Control**
Pre	12.75	13.56	6.14	5.13
Post	17.04	10.52	7.23	5.90

Discussion

This study attempts to assess the impact of Mediated Music Lessons on the musical understanding, executive functions, and linguistic skills of a select group of kindergarten-age children of migrant workers. The study is part of a series of research projects designed to explore and deepen our understanding of interconnections between music education and general learning skills, especially among at-risk children. Based on the positive results obtained from previous studies (Portowitz & Klein 2007; Portowitz et al. 2009; Portowitz 2010), this study addresses the question of whether skills developed within Mediated Music Lessons might transfer to other domains as well.

We initially feared that several of the working conditions of the study might obscure the implications of the results. Thus, for example, both groups studied with highly competent, certified music teachers, and the period of the intervention was relatively short. In the end, however, these factors underscored the significance of the findings. Most importantly, this study supports the understanding that even highly

qualified and successful teachers will upgrade the quality of their teaching when they adopt a mediated learning pedagogical approach, an approach that is particularly relevant for at-risk children. In addition, the impact of these lessons will become evident in a relatively short time (Kraus et al. 2014).

The research tools used in this study addressed difficulties frequently encountered when evaluating executive functions. Such tools often rely on caretakers (teachers, parents) to complete questionnaires that relay their impressions of the children's learning skills. The tools that are used here differ, in that they afford objective, neurocognitive measurements, obtained directly from the participants' performance.

Moreover, while the tests differed in their focus, success in completing them depended on the application of similar learning strategies. Thus, *Gordon's Music Aptitude* test depended on a child's ability to concentrate, focus, recall, and compare as prerequisites to being able to differentiate among musical sounds. Similarly, the *Flanker Fish Mix* tasks required that the participant exercise self-inhibition of an attentional tendency, as the children were required to recall and apply the appropriate rule based on alternating stimuli. Finally, the storytelling task called for the child to construct a coherent story by focusing, selecting, and highlighting the central characters and issues.

The limitations of the study, particularly the relatively small sample of participants and the short span of the intervention, require us to exercise caution in assessing its results. However, the findings seem to warrant further research, exploring the benefits of Mediated Music Lessons as a context in which at-risk kindergarten children may close achievement gaps and be better prepared to enter first grade.

Appendix 1

Mediated Learning Experiences provide contexts that are designed specifically for the development of cognitive functions. Criteria for mediated learning experiences, applied within a music classroom, include:

Focusing and Reciprocity—promoting student engagement as the teacher focuses the child's attention while encouraging him/her to respond actively, verbally or non-verbally. Listening to music is a particularly potent means of fastening a child's attention, as it fosters a need to concentrate on auditory input and "make sense" of it.

Expanding enables students to think beyond the immediate. When discussing the structural organization of a piece of music, for example, or defining musical patterns, teachers may expand the specific context to show how similar structures and procedures occur in other contexts. Expanding also facilitates connecting concepts and principles shared by different disciplines, such as rhythmic notation and concepts of fractions in mathematics.

Mediation of Meaning and Excitement: Such mediation includes, for example, defining terms, conveying respect and enthusiasm for unfamiliar practices and traditions, and explaining the value of things that may seem irrelevant. Defining and giving meaning to musical concepts also enriches language and communication skills.
For a full discussion of mediated learning within a music context, see Portowitz & Klein 2007, Portowitz et al. 2009, and Portowitz 2010.

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