Effects of Musical Training and Listening to Mozart on Preschool Children’s Verbal Reasoning and Numerical Memory

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Objective: This research is aimed at comparing the effects of musical training and listening to Mozart on both male and female Kerman City preschool children’s verbal reasoning and numerical memory in 2012-13 educational year.

Method: An experimental-intermediary study was carried out based on pre-test and post-test research design with control group, this research included 52 preschool male and female children, who were selected randomly in two groups of musical training and listening to Mozart. Musical activities were completed in 20 sessions of 75 minutes each allocated to training and rehearsal in the Orff Approach at the test group, and 20 sessions of 75 minutes each allocated to listening to Mozart’s D major key at the control group. Wechsler test was conducted on both groups before and after the interventions. Data analysis was carried out by one-way covariance statistical method.

Findings: Results showed that the children attended at musical training sessions have significantly gained higher scores (p<0.001) than those listening to Mozart in terms of verbal reasoning and numerical memory.

Conclusions: This is concluded that attendance in group-based musical training sessions is effective on preschool children’s verbal reasoning and numerical memory.

KEY WORDS: musical training; Mozart music; verbal reasoning; numerical memory; preschool children

INTRODUCTION

Non-musical effects of musical training are examined and the results show that they are mostly alluded to the childhood. Education in primary phases of childhood is of paramount importance in terms of sensitivity and receptivity of children from educational environments and sustainability of learning. Primary leaning is an appropriate context for children’s upcoming transactions; in fact, what are learnt in the childhood are more enduring and difficult to forget (Ghasem Tabar et al., 2011). In the recent decades, musical learning has been taken into account as an effectual strategy to increase communicational, cognitive, and emotional capabilities of the children. Most trainers and experts believe that musical responses of children are the most natural reactions which play important roles in various learning respects (Noor Mohammadi, 2004).

In the recent years, there has been different scientific research (Bilhartz, Bruhn, and Olson, 2000) whose main common point has been the result that musical training is effective on cognitive growth and abstract thought. Gardner addresses music as an organizer of children’s cognitive processes (cited by Ruscher and Zupan, 200). Research indicates that musical lessons have positive relationship with performance in verbal abilities (Marques, Moreno, Castro, and Besson, 2007; Moreno et al., 2008; Patel and Iversen, 2007; Shelenberg, 2005), phonology awareness (Shelenberg, 2008), spatial reasoning (Hetlind, 2000), mathematics (Vaughn, 2000), memory (as inJakobson, Lewycky, Kilgour & Stoesz, 2008; Lee, Lu &Ko, 2007; Stoesz et al., 2007; Ruscher et al., 1997), and IQ (Shelenberg, 2004).

In describing the fact that musical capabilities and spatial reasoning abilities are related, Leng and Shaw (1991) put forward the “trion model of the cortex,” based on which certain neuron activity patterns that are arranged in vast areas of the cortex for mental spatial-time processes are used for both spatial reasoning and musical activities. EEG-aided studies support Trion model of the cortex. Leng and Shaw’s model, together with theory of children’s early sensitivity to music(Krumhansl and Jusczyk, 1990; Olsho, Schoon, Sakai, Turpin, and Sperduto, 1982), proposes the theory that musical training causes an improvement and evolution of neural paths involved in environment-dependent cognitive processes including spatial abilities. According to Hebb learning principles, making reparative use of this neural network through musical learning can make it more capable to complete other abilities (Le Fransoa, 2000: 171). Based on above-mentioned studies and aligned with them, this research is aimed at investigating the effects of musical training on children’s spatial-time abilities. There is overlapping between areas related to cortex’s verbal abilities (BA22 and Wernicke's area) and areas of temporal stratum which is engaged for professional musical activities (Lots, 2003). Since, according to conducted studies (Amirian, 2001; Mirbaha, 2005; Herrara, 2011; Bulduc, 2009; Hyward, 2009; Jausovec, 2006; Gromko, 2005; SchmitHorres, 2004; Rauscher, 2003; Ho, 2003; Gromko, 1998; Rauscher, 1997; Eugenia, 1999), musical training grows verbal abilities such as phonological awareness, verbal reasoning, and verbal memory, this research intends to discover the relationship between musical training and verbal abilities.
According to Schlenberg (2011a), 144 preschool children were divided into two groups, one of which was trained for 36 weeks and the other left untrained. Wechsler intelligence scale was used. Post-test showed that test group had significantly better scores in intelligence test as compared to control group.

Schlenberg (2011c) investigated the relationship between musical lessons and intelligence in 106 male and female children of 9 to 12 years using Wechsler intelligence scale. 50 children were trained music for averagely 2 to 3 years and 56 children were left untrained. One-way variance analysis indicated that trained group had significantly higher IQ rates than their untrained counterparts (P<0.001, F=17.72).

Franklin, Rattray, Moore, Moher, Yip, and Jonides (2008) in their research in the University of Michigan examined the impact of musical practices on verbal memory of 20 musicians of 10 years of experience using Reiven test and verbal memory. T-test showed that musicians gained significantly higher scores in verbal memory (P<0.004, F=3.17).

In this study, Schlenberg (2006) investigated the relationship between musical training and IQ in Toronto, Canada, in 147 children of 6 to 11 years of age including 72 boys and 75 girls who had experienced musical training sessions for 23 months using Wechsler intelligence scale. Results of correlation test demonstrated that there is a positive and significant relationship between musical training and verbal IQ (p<0.001, r=0.54). He conducted the same study on 150 students of 16 to 25 years of age including 112 females and 38 males to examine the correlation between cognitive abilities in adulthood and musical training in childhood in those who have experienced musical training sessions for an average of 3.7 years. Results showed that subjection to music in childhood has a positive relationship with IQ and educational performance (p<0.01, r=0.23 and p<0.05, r=0.21).

Since the conducted research affirms the effectiveness of musical training, this study aims to examine the impact of musical training on verbal reasoning and numerical memory as compared to listening to Mozart in both male and female Kerman’s preschool children in 2012-13 educational year.

Following questions are put forward:
1. Does musical training of preschool children cause an improvement of their verbal reasoning as compared to those who have listened to Mozart?
2. Does musical training of preschool children cause an improvement of their numerical memory as compared to those who have listened to Mozart?

**METHODOLOGY**

This research is a practical study in its objective, for which a pseudo-tentative methodology together with pretest and post-test states is used. 52 children were randomly selected and divided into training group and Mozart group, the members of the former of which were trained for 20 weeks (one session of 75 minutes per week) and the member of the latter were exposed to Mozart’s D major key for 20 weeks (one session of 75 minutes per week). After termination of the sessions, post-tests were conducted on both test and control groups. Statistical analysis of the results was carried out by covariance analysis where all its suppositions were taken into account: normal distribution, linearity, reliability of covariant variable, homogeneity of variances, and reliability of regression gradient. Diagrams of normal distribution and linearity suggested non-violence, just as homogeneity of variances and reliability of regression gradient did, as shown in the Table 2.

| Table 1: homogeneity of variances |
|-----------------------------|--------------|--------------|--------------|
| Variables                   | F            | First intergroup degree of freedom (df1) | Second intergroup degree of freedom (df2) | Level of significance |
| Verbal reasoning            | 3.02         | 1            | 50           | 0.088         |
| Numerical memory            | 0.19         | 1            | 50           | 0.66          |

| Table 2: homogeneity of regression gradient |
|---------------------------------------------|--------------|--------------|
| Variables                   | Sum of squares | F            | Level of significance |
| Verbal reasoning            | 21.00         | 3.26         | 0.07           |
| Numerical memory            | 23.00         | 2.8          | 1              |

**Statistical Community, Samples, and Sampling**

Statistical community of this research includes all Kerman’s preschool children in 2012-13 educational year. One preschool center was randomly selected and sampled by cluster random sampling method. In this research, from among all preschool centers from Kerman Province, one center was firstly selected. Then, 26 students were randomly selected for test group and the same number of students for the control group.

**Instruments of the Research**

*Wechsler intelligence scale for children*(1974) was utilized for measuring verbal reasoning and numerical memory of children between 5 to 15 years of age. It consists of measurement of verbal and nonverbal abilities in 12 equally divided subtests (Ganji, 2007: 385). Overall, ten tests are carried out to calculate IQ (Ganji, 2007: 182). Reliability coefficient of all
subtests and three verbal, nonverbal, and total scales were calculated for 7.5, 10.5, and 13.5 years in even-odd manner (ibid, 2007: 385). Reliability coefficient of Cronbach’s alpha was calculated to be 0.72.

### Table 3: A summary of musical training package in Orff Approach

<table>
<thead>
<tr>
<th>Sessions</th>
<th>Training axes</th>
<th>Sessions</th>
<th>Training axes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before the program</td>
<td>Pre-test</td>
<td>5th session</td>
<td>Teaching notes’ traction and their written form</td>
</tr>
<tr>
<td>1st session</td>
<td>Acquaintance and communication Familiarity with sound characteristics</td>
<td>6th session</td>
<td>Rehearsing notes’ traction on a new piece</td>
</tr>
<tr>
<td>2nd session</td>
<td>Teaching notes’ sequence and their names Teaching thrumming Rehearing concentration Musical games to improve audition and mental accuracy</td>
<td>7th session</td>
<td>Familiarity with silence in music</td>
</tr>
<tr>
<td>3rd session</td>
<td>Teaching de major key Teaching notes on five carrier lines Improvement of pitches recognition and quality of sounds</td>
<td>8th session</td>
<td>Teaching new music</td>
</tr>
<tr>
<td>4th session</td>
<td>Teaching a short lyrics-included piece Developing musical skills, body coordination, rhythm recognition, and motional precision</td>
<td>9th session</td>
<td>Group rehearsals for more coordination</td>
</tr>
<tr>
<td>5th session</td>
<td>Rehearsing notes’ traction on a new piece</td>
<td>10th session</td>
<td>Performing a demo concert for parents</td>
</tr>
<tr>
<td>6th session</td>
<td>Developing rhythm recognition as well as emotional and motional precision</td>
<td>After the program</td>
<td>Post-test</td>
</tr>
</tbody>
</table>

### Findings

Descriptive findings are demonstrated in Table 4. Scores averages of training group and Mozart group in verbal reasoning and numerical memory have no significant difference in pretest; however, musical training group could gain higher scores in both verbal reasoning and numerical memory compared to Mozart group.

Preliminary investigations to assure non-violence of assumptions’ normality, linearity, homogeneity of variances, homogeneity of regression gradients, and reliability of covariance variables were also carried out (Tables 1 and 2). As seen in Table 5, effects of verbal reasoning pretest (p<0.001, F=31.82) and numerical memory (p<0.05, F=0.70) have been statistically effective. In other words, pretest score has had an effect in posttest, and some of variance of posttest scores has been impacted by pretest. Afterwards, to examine intermediary effect on the dependent variable, pretest effect was omitted as covariate variable. After pretest scores were adjusted, a significant difference between two test and control groups in score average of verbal reasoning (p<0.001, F(49.1)-96.84,Eta-square-0.664) and numerical memory (p<0.001, F(49.1)-65.34,Eta-square-0.571) was obtained.

### Table 4: Average of subjects’ scores in pre- and post-tests

<table>
<thead>
<tr>
<th>Tests</th>
<th>Training group</th>
<th>Mozart group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>SD</td>
</tr>
<tr>
<td>Verbal reasoning</td>
<td>Pretest</td>
<td>6.69</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>14.61</td>
</tr>
<tr>
<td>Numerical memory</td>
<td>Pretest</td>
<td>3.76</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>12.80</td>
</tr>
</tbody>
</table>

### Table 5: Covariance analysis of research variable

<table>
<thead>
<tr>
<th>Tests</th>
<th>Sum of squares</th>
<th>Mean of squares</th>
<th>F</th>
<th>Level of significance</th>
<th>Eta-square</th>
<th>Average adjusted Mozart</th>
<th>Average training Mozart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal reasoning</td>
<td>Pretest</td>
<td>215.05</td>
<td>215.0</td>
<td>31.82</td>
<td>0.001</td>
<td>0.394</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>654.38</td>
<td>654.38</td>
<td>96.84</td>
<td>0.001**</td>
<td>0.664</td>
<td>7.28</td>
</tr>
<tr>
<td>Numerical memory</td>
<td>Pretest</td>
<td>31.46</td>
<td>37.46</td>
<td>3.70</td>
<td>0.05</td>
<td>0.07</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>557.36</td>
<td>557.36</td>
<td>65.34</td>
<td>0.001**</td>
<td>0.571</td>
<td>6.5</td>
</tr>
</tbody>
</table>

**p<0.001

According to the average adjusted scores of music group, i.e., 14.48, as compared to that of Mozart group, i.e., 7.28, Eta-square obtained for each variable indicates that IQ test of musical training caused an increase in verbal reasoning scores in training group. Effect/difference amount is equal to 0.664 and 66.4 percent of total variance of verbal reasoning scores verifies musical training. Therefore, the answer to the first research question “Does musical training of preschool children cause an improvement of their verbal reasoning as compared to those who have listened to Mozart?” is positive. Effect of musical training, in fact, is the reason for average differences of posttests as to pretests.

Numerical memory indicates eta square equal to 0.571, which, according to average adjusted scores of verbal reasoning of music group (12.72) as to that of Mozart group (6.5), is 57.1 percent of personal differences in numerical memory post-test scores, is associated with musical training. Therefore, the answer to “Does musical training of preschool
children cause an improvement of their numerical memory as compared to those who have listened to Mozart?" is positive. Effect of musical training is, in reality, the reason for average differences of posttests as to pretests.

**DISCUSSION AND CONCLUSIONS**

The chief purpose of this research was to investigate the relationship between musical training and listening to Mozart, on the one hand, and verbal reasoning and numerical memory of Kerman’s preschool children, on the other. With regard to negating effects of pretest, this can be stated that musical training (Orff, in this research) has been effective in increasing children’s verbal reasoning and also in numerical memory of training group compared to those who had listened to Mozart. This is aligned with results of Hererra et al. (2011) and Gromko (2004), who concluded that musical training leaves a positive impact on verbal reasoning. One-way covariance analysis as used to obtain the answer to the second question.

After pretest effects were negated, a significant difference was observed between scores of the subjects in Mozart group in numerical memory (training group average=12.72, Mozart group average=6.5) in F=65.34 in the level of p<0.001. In other words, scores of test group in numerical memory were higher than Mozart group as a result of musical training. Examination of averages in two groups indicates that posttest score of training group is increased as compared to that of Mozart group.

This is, therefore, safe to assert that musical training provokes increased numerical memory in the group subject to musical training. Consequently, the answer to the research question “Does musical training of preschool children cause an improvement of their numerical memory as compared to those who have listened to Mozart?” is positive. This in line with Mirbaha (2003), Amirian (2011), Khalaf Beigi, Bayan Zadeh, Zadeh Mohammadi, and Shafaroudi (2006) as well as Bulduk (2009), who studied the effect of musical training on short-term memory, phonological memory, auditory memory, and attention. To delineate this finding, this is to note that musical training calls for broad utilization of memory.

Also, some games focus on strengthening the human memory. According to Hebbian learning principles, making reparative use of certain brain sections strengthens used paths and their performance, making them more active (Le Fransoa, 2000: 165). In Javsovec et al. (2006), EEG indicated that Mozart music activates the sections involved in memory-related tasks. According to this research, musical training has significant impact on verbal reasoning and numerical memory of preschool children.

Importance of education and training in preschool periods is presently taken into more account than before (Yazd Khasti, 1998). Nasri (2000) indicated that the students who have passed the preschool period in relevant educational centers are equipped with more social compatibility than those who have not passed the same. Moreover, passing preschool period stimulates learning (Mohammadi, 1995), and educational progress and social development (Sahebi, 2000). Education before elementary school through environmental enrichment enables children to achieve new perceptive and mental experiences which are impossible to be gained in general familial atmospheres. Therefore, education before formal schools has found vital importance and many countries have focused their attention thereon.

Since children are in constant give-and-takes with the environment, the more enriched and user-friendly the environment, the higher the impression of the children from the environment. The interval from three to six years of age is the span in which the personality shapes. In addition, the prominent function of the education in preschool years is making children acquainted with social life. Among other objectives of education are physical-motional growth, language and discourse development, cognitive growth, and creative evolution (Yazd Khasti, 1998).

Since musical training is effective on cognitive and social development of children especially in preschool periods, it can be taken advantage of in assisting children to grow socially and cognitively parallel with other preschool training courses.

**PERSIAN RESOURCES**

Amirian, Kamran (2011). “Impact of Musical Training on Intelligence Abilities of Kermanshah’s Youngsters,” article collection in the third cross-country art therapy congress in Iran


ENGLISH RESOURCES


