

AUDIOLOGY

# Correlation between musical aptitude and learning foreign languages: an epidemiological study in secondary school Italian students

## *Correlazione fra attitudine musicale e apprendimento delle lingue straniere: studio epidemiologico su studenti italiani della scuola media secondaria di primo grado*

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### SUMMARY

The aim of this study was to assess if a correlation exists between language learning skills and musical aptitude through the analysis of scholarly outcomes concerning the study of foreign languages and music. We enrolled 502 students from a secondary Italian school (10-14 years old), attending both traditional courses (2 hours/week of music classes scheduled) and special courses (six hours). For statistical analysis, we considered grades in English, French and Music. Our results showed a significant correlation between grades in the two foreign languages and in music, both in the traditional courses and in special courses, and better results in French than for special courses. These results are discussed and interpreted through the literature about neuroanatomical and physiological mechanisms of foreign language learning and music perception.

KEY WORDS: Musical aptitude • Foreign aptitude • English • French

### RIASSUNTO

*Scopo di questo studio è stato lo studio della relazione fra l'apprendimento delle lingue e le abilità musicali attraverso l'analisi dei risultati scolastici ottenuti da studenti della scuola secondaria nelle materie linguistiche e nello studio della musica. Sono stati inclusi nello studio 502 alunni (età 10-14 anni) di una scuola media secondaria di primo grado, divisi in classi tradizionali (2 ore settimanali di insegnamento della disciplina musicale) e classi "speciali musicali" (6 ore settimanali di insegnamento musicale). Sono stati considerati per l'analisi statistica i voti riportati nelle tre discipline: Inglese, Francese ed Educazione Musicale. I nostri risultati mostrano una correlazione statisticamente significativa fra i voti riportati nelle due lingue straniere e nella disciplina musicale sia nelle classi tradizionali che nelle classi speciali. Inoltre, nel confronto fra classi speciali "musicali" e classi tradizionali l'analisi statistica ha evidenziato una differenza statisticamente significativa per la lingua francese. I risultati vengono discussi ed interpretati sulla base della letteratura riguardante i meccanismi neuroanatomici e fisiologici che sottostanno all'apprendimento delle lingue straniere e della percezione musicale.*

PAROLE CHIAVE: Attitudine musicale • Apprendimento delle lingue straniere • Inglese • Francese

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## Introduction

The present study is based on the hypothesis that there may be a relationship between musical aptitude and language learning ability <sup>1</sup>. Several studies have shown that foreign language learning skills are based on rhythm, singing and musical perception and that musical training enhances the acquisition of phonological skills required for foreign language learning <sup>2-5</sup>. In addition, there are studies on the role of music in specific learning disorders,

especially dyslexia: it seems that patients with learning disabilities, in addition to the well-known deficiencies in visual-spatial skills, present an alteration in the perception of rhythm <sup>6</sup>. In these children, musical training may facilitate the achievement of better results in spelling and phonological segmentation tests <sup>7-9</sup>.

To our knowledge, there is only one published paper concerning foreign languages learning skills and possible related disorders in Italian children. That study focused only on Italian seventh and eighth grade students with

low (LA) or high achievements (HA) in learning English. Foreign language abilities were assessed through an ELT (English Learning task) and a PMA (Primary Mental Aptitude Battery) test previously validated. Students were tested in two different experiments with batteries of tests analysing native language reading skills, comprehension of text, calculation, attention and self-regulation control (from parents and teachers point of view). The results showed that LA students performed poorly in native language reading comprehension tests, and had attentional control problems. The authors hypothesised that students with foreign language learning difficulties were at risk for attention-deficit disorders, but not for learning disorders<sup>10</sup>.

Neurophysiological aspects related to perception of music have been the subject of major studies over the years. Interesting investigations have examined the correlation between linguistic and musical components. According to these studies, music can be considered the equivalent of language, and also consists of discrete elements and specific rules. In fact, it has been shown that language and music share some brain circuits, thus excluding the theory of the two independent areas: the right hemisphere for music and the left for language<sup>11</sup>. Also, the pathological patterns of aphasia and amusia have confirmed these neuro-anatomical and physiological data<sup>12</sup>.

The aim of the present study was to assess if a correlation exists between language learning skills and musical aptitude through the analysis of scholarly outcomes concerning the study of foreign languages and music.

## Materials and methods

After an investigation, and the request to different schools for collaboration in our study, we chose a school for the feasibility of the project, which was related to the adequate number of students, the foreign languages studied (French and English) and the presence of special courses with 6 hours/week of music classes scheduled.

We enrolled all students ( $n = 585$ ) of a secondary school (Italian middle school) for the project. Exclusion criteria were the presence of disabilities related to or directly concerning learning skills (30 children), and the possibility of interference from another language (the same or different than the languages learned at school). We excluded 53 bilingual children resulting from parents with different native language or emigrated to avoid contamination of the results arising from external factors.

We included in the study the remaining 502 students, aged between 10 and 14 years old.

Twelve teachers were involved in the study. Regarding the

methodology of the school program, the school and teachers follow the national guidelines for the curriculum of the secondary school level. It should be noted that the data, obtained directly from the school, with the approval of the Headmaster, were not sensitive data, as the students were listed numerically and the classes encoded with random letters.

The students were divided by school grade (from 6<sup>th</sup> to 8<sup>th</sup>): the first group included 173 students, while the second 159 and the third 170. The weekly timetable concerning foreign languages scheduled 3 hours for English and 2 for French. Foreign language teachers were Italian. The hours for musical discipline are usually two per week in Italian school. 70 of the 502 students belonged to “special courses” with 6 music classes/week. In fact, students have as an optional choice the possibility to attend additional music classes during the afternoon. We considered this as a separate group of students, and we took in account the different grade attended for statistical purposes (6<sup>th</sup> grade 24 students, 7<sup>th</sup> 24 and 8<sup>th</sup> 22).

In order to evaluate learning abilities, we considered the final grade for each discipline considered (English, French and music). In this specific school, grades are given in a standardised way according to parameters established at the beginning of the school year by teachers from different departments. We collected all the final marks for each subject and each student, and we performed statistical analyses to assess whether a correlation existed between language learning abilities and music skills.

The  $\alpha$  level was fixed at 0.05 for all statistical tests. The sample size was computed using the software STATA 10.0, StataCorp LP, TX USA. To detect a difference in the means of 0.3 with a 0.9 power and with a 0.05  $\alpha$  value, we estimated an overall sample size of 468 students (assuming two equally numerous groups). Other statistical analyses were performed using the JMP software, release 7.0.1, from the SAS institute. For comparisons among means (continuous variables) according to categorical variables (independent variable), we performed the analysis of variance using one-way ANOVA, and in case of statistical significance, we compared each pair using a student's T test. We first evaluated the correlations among the numeric variables through a multivariate approach, obtaining scatterplot and covariance matrices, both in the whole population and after stratifying the children according to the type of course attended (nominal variable). When the  $r$  coefficient at scatterplot analysis for a pair of variables was above 0.4, we evaluated the correlation through logistic regression and checked the linear fit through analysis of variance.

**Table I.** Marks in the traditional courses (mean  $\pm$  SD).

	6 <sup>th</sup> grade	7 <sup>th</sup> grade	8 <sup>th</sup> grade
English	7.05 $\pm$ 1.27	6.93 $\pm$ 1.2	6.85 $\pm$ 1.3
French	7.03 $\pm$ 1.12	7.1 $\pm$ 1.28	6.7 $\pm$ 1.1
Music	6.98 $\pm$ 0.91	7 $\pm$ 1.02	6.88 $\pm$ 1.02

**Table II.** Marks in the special courses (mean  $\pm$  SD)

	6 <sup>th</sup> grade	7 <sup>th</sup> grade	8 <sup>th</sup> grade
English	6.79 $\pm$ 0.88	6.66 $\pm$ 1.12	6.63 $\pm$ 0.9
French	7.75 $\pm$ 0.89	7.12 $\pm$ 1.11	7.45 $\pm$ 0.91
Music	7.37 $\pm$ 1.24	6.75 $\pm$ 1.18	7.54 $\pm$ 0.96

## Results

Tables I and II describe mean marks achieved by 6<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> grade students in French and English classes, and are shown separately for students attending traditional and special courses with more music classes scheduled.

Statistical analysis showed that final marks in French classes were significantly different among students attending different grades, and showed a significant (at one-way ANOVA  $p = 0.0166$ ) even if modest decrease along the 3 different grades, being significantly higher (at Student's T test) in the 6<sup>th</sup> than in the 8<sup>th</sup> ( $p = 0.0095$ ) and in the 7<sup>th</sup> than in the 8<sup>th</sup> grade ( $0.0194$ ). Final marks for English and music classes achieved by students attending different grades did not show any significant difference. When evaluating separately traditional vs. special courses, we observed that only traditional classes showed an even more evident decrease in French marks ( $p = 0.0101$  at ANOVA), while in special courses a significant increase of marks in music was observed ( $p = 0.049$ ), with an improvement between the 7<sup>th</sup> and the 8<sup>th</sup> grades ( $p = 0.021$  at student's T test).

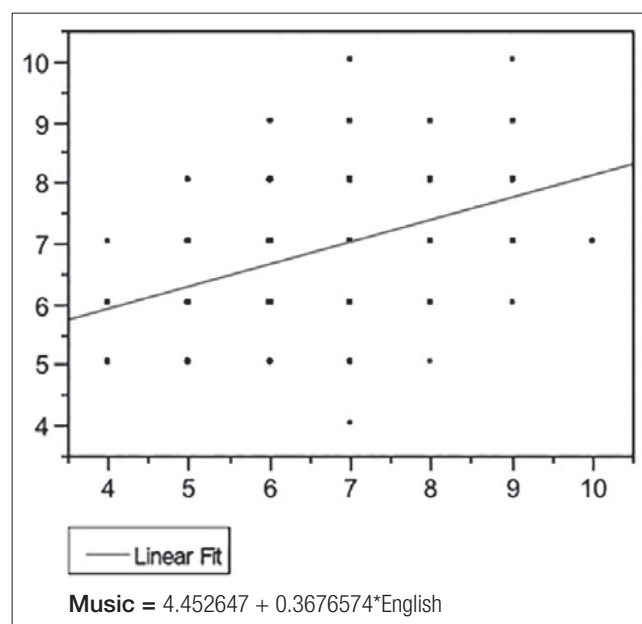
Generally, we observed a significant correlation between the marks in the two different languages ( $r = 0.623$  in scatterplot matrix,  $r = 0.897$  in covariance matrix,  $p < 0.0001$  at analysis of variance for the linear fit), and between the marks in both the languages and in music (English and music:  $r = 0.443$  in scatterplot matrix,  $r = 0.556$  in covariance matrix,  $p < 0.0001$  at analysis of variance for the linear fit; French and music:  $r = 0.488$  in scatterplot matrix,  $r = 0.583$  in covariance matrix,  $p < 0.0001$  at analysis of variance for the linear fit) (Figs. 1, 2). Such correlations were all confirmed even when separately evaluating "special courses" and traditional ones.

Finally, the comparison between special courses and traditional ones showed no statistically significant differences for English and music, while there was a statistically

significant difference for French language ( $p = 0.0003$  at t test) (Fig. 3).

## Discussion

Our results strengthens the hypothesis of a close correlation between language learning skills and musical aptitude. In fact, we demonstrated a significant statistical correlation between the marks obtained by the student in music versus English and French both in traditional and special courses. Moreover, comparison between two groups (traditional and special courses) showed that the agreement is more relevant in special courses: students with musical disposition, or exposed to specific musical



**Fig. 1.** Bivariate Fit of Music (Y) by English (X) shows a statistically significant correlation ( $p < 0.0001$ ).

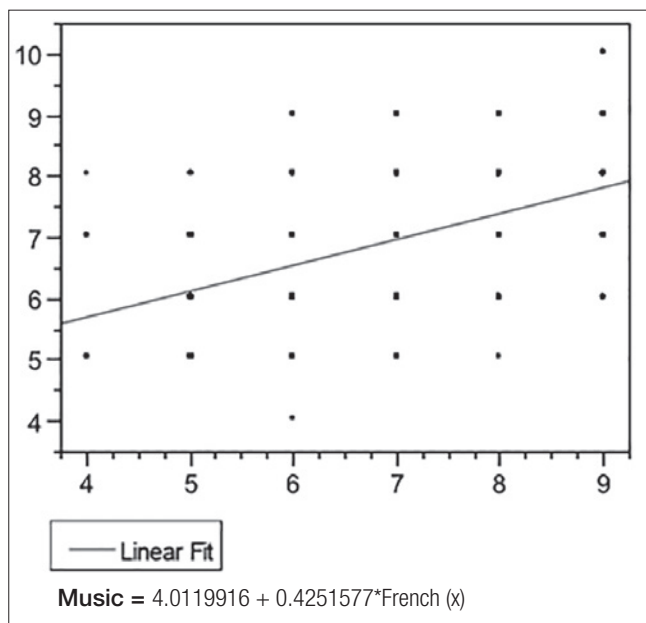


Fig. 2. Bivariate Fit of Music (Y) by French (X) shows a statistically significant correlation ( $p < 0.0001$ ).



Fig. 3. Comparison of the French marks demonstrates significantly better results in special courses than in traditional courses ( $p = 0.0003$ ).

training appear to have a greater success in foreign language learning. Our results are in agreement with Finnish studies by Milovanov et al.<sup>13</sup> about this subject. In a recent review, these authors analysed the neuropsychological and electrophysiological aspects related to music in relation to second language linguistic abilities<sup>14</sup>. They assumed that a better ability to discriminate sounds, typical of individuals with a greater propensity to musicality, predisposition to a better recognition and offering a greater possibility to acquire foreign languages with correct pronunciation. The same authors carried out a study

on students undergoing special musical training that led to a modulation effect in the cerebral organisation of language centre, altering hemispheric functioning with an interesting improvement of foreign language learning<sup>15</sup>. Recently, Christener and Reiterer<sup>2</sup> demonstrated in adults that good singers benefit from vocal and motor flexibility, both productively and cognitively. In particular, motor flexibility and the ability to sing can improve both language and musical function, acting on the memory span of the auditory working memory.

These results could be interpreted as the neuroanatomical and physiological basis of the behind the shared neurological pathways between central auditory processing of musical and linguistic information. Preliminary studies proposed by Mackenzie Beck in 2003<sup>16</sup> showed that musical ability was a useful predictor of general phonetic skills. Afterwards, Dankovicová et al in 2007<sup>17</sup> demonstrated a significant relationship between musical training and intonation task scores, and between music test scores and intonation test scores.

Regarding comprehension of foreign languages, a French study on adult musicians, exposed to sentences spoken in Portuguese, showed that musical expertise increases discrimination of pitch, facilitating the processing of pitch variations not only in music but also in language<sup>18</sup>.

To our knowledge, the present study is the first of this type conducted in the Italian school system. Our results show that students attending traditional courses tend to achieve lower marks in French classes during subsequent grades. This finding is in contradiction with an apparent easiness of the French language learning, due to the common Latin origin. Anyway, the difficulty could be related to grammatical and syntactical aspects of the French language rather than phonological and lexical ones.

On the other hand, students attending special courses showed better French learning skills: we suppose that better results could be justified by the greater musicality of French than English, resulting in better learning of French by students with a more marked musical aptitude.

This retrospective study has some limitations: marks, even if assigned according to standardised parameters, cannot be considered objective, if not for the presence of multiple evaluators. Moreover, the analysis of data from more schools would have been much more representative, but would have brought even more confounding factors, including different programs, a wider range of textbooks and probably different standards for marks. Of course, this should be considered just the first step towards more ambitious study designs. It would be very interesting, for example, to carry out a more detailed examination of foreign language learning skills evaluating separately writ-

ing skills, conversation and pronunciation, as well the knowledge of musical theory and ability in music practice. We believe that our findings, reflecting the impact of the discussed neurophysiological theories on real life, will give some momentum to this interesting research field.

## Conclusions

In conclusion, our results are interesting under multiple points of view. First of all, even if not conclusive and with the discussed points of weakness, they do reflect the potential impact of the neurophysiological theories connecting music and language processing pathways. If confirmed by further studies, these findings will prove useful both in the research field and as actual teaching tools. In a clinical setting, assessing the role of musical aptitude in learning disabilities involving foreign language studies may offer us both a testing tool and a therapeutic aid<sup>19 20</sup>. However, before any actual application, more data and more evidence, possibly interpreted by interdisciplinary teams constituted by musicians, hearing and speech therapists, psychologists and physicians will be needed to improve our understanding of the relations between both comprehension and production of written and spoken foreign languages and the study and practice of music. We hope that this initial retrospective work will be a prompt both for our and other research groups to further explore this field, possibly through electrophysiological analysis and specific phoniatric tests.

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