

Links between Musical Learning and Reading for First to Third Grade Students: A Literature Review

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Abstract

An increasing amount of studies has put forward the various links between musical learning and other non-musical learning domains. Music also appears to be an effective way to improve reading abilities of children at the onset of the elementary level. This literature review presents results from seventeen studies investigating the link between musical learning and reading among first to third graders. Three correlational and fourteen quasi-experimental studies are presented. Results from these studies indicate an undeniable link between musical learning and reading. However, the nature of the link between these two variables is not clearly defined given the varying results of the quasi-experimental studies. This disparity also makes it impossible to establish a strong causal relationship between music training and reading.

Keywords: musical learning, reading instruction, primary grades

1. Introduction

Numerous approaches have been implemented to facilitate the development of reading abilities through teaching. One of those is the eclectic approach, which combines the global and synthetic approaches (Allington, 2002; Armand et al., 2004; Giasson, 2003; Golder & Gaonac'h, 2004). Despite their pertinence and validity, complementary approaches have been put forward to limit the recurring difficulties students encounter at the onset of the elementary level. Among these, several authors place a particular emphasis on the world of sounds (Hurteau & Bonin, 2007; Jeannot, 1977; Rivais, 1997; Thompson, 2008). Recent researches demonstrate the beneficial role of musical education on the development of the written language through, among other things, the activation of mirror neurons (Bialystok & DePape, 2009; Fadiga, Craighero & d'Ausilio, 2009; Limb, 2006; Milovanov, Pietilä, Tervaniemi & Esquef, 2010; Tallal & Gaab, 2006). Musical learning also stimulates auditory perception, verbal memory and metacognitive abilities (Chan, Ho & Cheung, 1998; Deutsch, Dolson & Henthorn, 2004; Gómez-Gama, Ávila-Corona, Gómez-Gama, Puente & Ojeda-Morales, 2004; Ho, Cheung & Chan, 2003; Register, 2001; Selway, 2003). In this perspective, we present a literature review of studies documenting the possible effects of musical learning on the learning of reading of children from first to third grade.

2. Procedures and criteria of the review

This review was conducted using different databases (Education Full Text, Sage Education, Educator's Reference Complete, Eric, Francis, Proquest Theses and Dissertations, LLBA, PsycINFO, IIMP, Érudit, Repère). The following terms were used in French and English: first grade or second grade or third grade, musical learning, reading. We also consulted two meta-analyses (Butzlaff, 2000; Standley, 2008). Our criteria to select studies were as follows: 1) Studies published between 1995 and 2009; 2) Studies conducted with first to third grade students; 3) Studies investigating the possible link between musical learning and the learning of reading: it excludes studies where music is only used passively or when its rhythmic and melodic components are not exploited; 4) Studies whose design is either correlational or quasi-experimental.

The latter criterion excludes, for example, case studies. A total of seventeen studies met these criteria and are presented below.

3. Correlational studies

Among the studies on the relationship between musical learning and the learning of reading of students in early grades, we selected three correlational studies (Chamberlain, 2003; Hester, 2005; Southgate & Roscino, 2009). The first one was conducted with students from the third and fifth grade ($n=76$, 31 boys, 45 girls) in four natural classes (pre-existing) of a public school in North Carolina (Chamberlain, 2003). Aged eight to ten years old, the subjects were predominantly Caucasian (72%). Other subjects (28%) were not described with precision in regard to their ethnicity. To test their reading abilities, the STAR Reading test (Advantage Learning Systems', 1996) was performed on computers with the school's informatics teacher. Students answered to vocabulary items put in context (e.g. choosing the correct word in a list to complete a sentence) and read excerpts of authentic texts. They were also submitted to the Beat Competence Analysis Test (BCAT) of Weikart (1987), which was adapted by the researcher. It consisted of hand clapping or walking to the tempo of a musical piece at two different speeds. For each of the four musical tasks, students received a score ranging from 1 (very accurate) to 5 (low) up to a maximum of 20 points. The score was assigned by three different judges (interjudge analysis).

Moreover, a pilot study tested the application of the adapted BCAT test beforehand ($n=28$). Spearman's rank correlation and multiple linear regression with variables selection analyses were used in the main study. Results display a significant, moderate and negative correlation between the results obtained in the adapted BCAT and those obtained in the STAR Reading (-0.27 , $p=0.02$). Specifically, a significant relationship was observed between reading abilities and the capacity of hand clapping the musical tempo. Reading abilities were also correlated with the capacity to walk to the tempo of the music. However, these results should be treated with caution. Firstly, the relationship established was moderate. Moreover, a larger sampling would be needed to generalize these results to a larger population. The second study (Hester, 2005) was conducted among 200 subjects from first to third grade (32% Afro-American, 35% Hispanic and 33% Caucasian) of a multiethnic school in an underprivileged neighborhood of North Carolina (104 boys, 96 girls). This doctoral thesis aimed to describe the relationships between the level, gender, ethnicity, rhythmical abilities and the reading abilities in English of early grade students.

As in the previous study, the STAR Reading test (1996) was used with students, according to their level, to assess their reading abilities. The test was performed individually on computers in the presence of their respective teacher during the month of April 2005. Musical abilities were tested in groups, during music classes, using the Primary Measures of Music Audiation (PMMA) of Gordon (1986). Only the rhythmic part of the test was used in this study. Students had to listen to two pieces of music and circle an image (two similar figures if the pieces were the same or two different figures if the pieces were different). The Pearson correlation coefficient established a moderate, positive and significant relationship between the STAR and PMMA test results of all students ($r = 0.437$, $p < 0.01$). However, this link was weak and not significant for first graders ($r = 0.197$; $p > 0.5$). In second and third grade, a moderate, positive and significant relationship was observed between the two variables (2nd grade : $r = 0.382$; $p < 0.01$; 3rd grade : $r = 0.401$; $p < 0.01$). Moreover, multiple regression analyses established that the level and results obtained with the rhythmic test can predict the reading abilities of students ($p= 0.001$), which is not the case for gender and ethnicity. It is important to keep in mind that in order to generalize these results, the tests should be conducted on a larger group of students originating from various schools.

The third correlational study was conducted using data from approximately 20 000 students (specific number of boys and girls was not mentioned) in kindergarten in 1998-1999 (Southgate & Roscino, 2009). They originated from over 1000 schools in the United States. Researchers used databases constructed from two studies conducted on a large scale by the United States department of education. In this case, we are particularly interested in data relative to elementary students, thus the ECLS-K (Early Childhood Longitudinal Study). This study used varied and standardized measures of academic achievement in different subjects. It also described the general characteristics of children (socioeconomic status, ethnicity, etc.). With the help of logistic regression, it was noted that involvement in music at school positively predicts student results in reading among young children while parental implication in music does not. However, it should be noted that music is usually a compulsory subject at the elementary level. Thus, music can only partially explain student's academic success. In fact, even if music seems to have a clear and significant influence on success in other subjects (with a robust correlation with reading abilities), the addition of musical indicators to the other indicators in the equation only weakly influences the variance explaining this situation.

Overall, this study suggests that music does not act as a predictor, but rather as a mediator of the student status by influencing the provisions or habits of the mind. However, there are some limitations to this study. Participation in music was not measured with great precision as no data was present on the quality or duration of the musical involvement of students. Despite that fact, the sample size ($n=20\,000$) gives a relevant overview on the possible link between music and reading. We would like to point out a common limit to studies using a correlational design: under no circumstances they enable the establishment of causal relationships between the variables studied (Cohen, Manion & Morrison, 2000; Gauthier, 2004; Mertens, 2005). However, they are still of great interest to investigate the existence of a link between musical and reading learning. In the three studies mentioned above, we can establish that these two variables are linked. These results corroborate those obtained by Butzlaff (2000), who conducted a meta-analysis of 24 correlational studies that linked musical experience with reading among a heterogeneous population (children, adolescents and adults). The measure of effect size displayed a great variability across studies (the coefficient was either weak, average or high). It also indicated a strong and reliable association between musical learning and performance in standardized reading tests.

4. Quasi-experimental studies

In order to establish some causal relationship between musical learning and the learning of reading, quasi-experimental studies have been conducted by several researchers from 1995 to 2009. When studies evaluated more than one ability of the children, we chose to present results pertaining uniquely to reading. Throughout our search, we found seven published studies and seven theses. Eleven studies were conducted with less than 100 subjects and three were conducted with more than 100 subjects. The first study is a doctoral thesis conducted with 53 students (specific number of boys and girls is not mentioned) of two French immersion classes of second grade in New-Brunswick (Lowe, 1995). The study aimed to assess the effects of a music-language program on the learning of a second language. After a pilot study conducted with 23 students of second grade, subjects of the main study passed a pretest in December evaluating their pronunciation, oral grammar, vocabulary, reading comprehension as well as rhythmic patterns, melodic patterns and forms comprehension (describe, perform and create with music). All tests were developed by the researcher and were criterion-referenced. They were based on specific objectives within the experimental program and covered the variable related to language or music mentioned above.

The experimental group ($n=27$, number of girls and boys in the class not specified), received 15 minutes of the music-language program daily during eight weeks. The lessons focused on the development of rhythmic and melodic concepts and the establishment of links with the various structures of the second language (pronunciation, oral grammar, vocabulary and comprehension). Meanwhile, the control group (the other class of 2nd grade, $n=26$) performed their usual activities such as learning by repetition. The posttest was conducted in March and April and its results analyzed using ANOVAs and ANCOVAs. Results obtained at the pretest showed that the control group had a significantly greater reading comprehension level than the experimental group. However, the experimental group displayed a higher reading comprehension level at the posttest than the control group, although the difference was not deemed statistically significant. Thus, it is interesting to observe that the experimental group reading comprehension level improved to a greater extent than the control group. However, these results should be treated with caution. Firstly, the reading pretest turned out to be very difficult for most students. Moreover, behavioral differences were also observed between the two classes and variables pertaining to teachers, their personality and their interventions were not controlled. Finally, there is also the possibility of a Hawthorne effect. These limits may prevent the generalization of these results to other populations.

With similar objectives than his doctoral thesis, Lowe (1998) conducted a second study with Anglophone second grade students in French immersion (New-Brunswick). The music-language program previously conceived (Lowe, 1995) was reused, putting the emphasis once again on the learning of rhythmic and melodic patterns. These patterns were similar to those observed in oral and written French comprehension and production. This program still consisted of eight units of five lessons per week, but this time, daily lessons lasted 20 minutes instead of 15. It was integrated as part of the French as a second language curriculum of the three natural classes of the experimental group ($n=63$). It was taught by the teachers present in class. It is important to note that the teacher did not receive any particular musical formation before teaching this program. The control group (three classes, $n=64$) were taught the French classes of the regular program without additional intervention. The study gathered 127 subjects (number of girls and boys not specified). MANOVA and MANCOVA conducted using the pretests and posttests reading comprehension scores (which consisted of excerpts reading followed by questions answering) showed that students from the experimental group performed better at the reading comprehension and production tests than the control group.

However, these results should be analyzed with caution as no statistical difference was observed between the two groups. According to the author, it is possible that the test used was too easy, unlike the 1995 study, leading to a ceiling effect. However, these two studies still indicate that the teaching and learning strategies put forward in this model can enhance the learning of French as a second language. The third study (Gardiner, Fox, Knowles & Jeffrey, 1996) was conducted with eight first grade classes (n=96, 5 to 7 years old). Half of the classes (four natural classes) participated in a program combining visual arts and music focusing on the sequential development of abilities (Kodály). The Kodály approach uses a sequential curriculum that includes folkloric songs and authentic singing games to teach melody, rhythm, harmony, dynamics and timbre as well as singing, movement, listening, musical notation reading and musical analysis abilities. The control group (four classes) received the standard course curriculum of visual arts and music. After seven months, subjects passed standardized tests (reading, mathematics) for the first grade. For 83% of students, these results were compared with those obtained in kindergarten with chi-square tests.

While the art classes started at a lower level than the control group, the two groups were equal in reading scores at the end of the seven month experiment. Standardized tests were also passed the following year (end of second grade) and again, both groups were equal in reading scores. Thus, the gain in reading obtained by the experimental group (between kindergarten and the end of first grade) was superior to the control group. It is important to mention that the pretests data was only available for 83% of the students, bringing the number of subjects at 80 instead of 96. Moreover, it is difficult to criticize the methodology of this study considering that the program and tests employed were poorly detailed in the article. It is important to note that the observed effects could result not only from the « music » part of the program but also from its « visual arts » aspect. The fourth study (Kingsriter, 1998) was conducted with students (n=30, 11 boys, 19 girls) of two second grade classes of a public school, randomly divided into two groups (control and experimental). The study aimed to assess the student's attitude towards reading in light of activities including music. The control group participated in literacy activities using giant books and audio material. Among others, they read aloud and in unison, they discussed in group, answered the teacher questions and worked some rhymes.

The experimental groups used the same material, but the students also sang the text with musical accompaniment (drums, xylophones, rhythmic pulsations). Both groups followed three lessons of 30 minutes per week, for eight weeks. Using the Elementary Reading Attitude Survey developed by McKenna and Kear, the students answered 20 questions assessing their appreciation level (scale imaged from 1 to 4) before and after the intervention. The t-tests for independent samples (Mann-Whitney) did not establish significant differences in attitudes towards reading of the two groups, despite the positive observations of the teachers in the experimental group. These results must be treated with caution considering the small number of study subjects, the fact that they all came from the same school and that only one tool was used to measure attitude towards reading. One of the objectives of the fifth study (Overy, 2000) was to measure the effects of the participation of dyslexic children in musical activities on their performance in language and literacy tests. Subjects (n=28, number of boys and girls not specified) came from a first grade class and were aged 6.8 years old on average. Their teacher was following a course on musical teaching in class as well as being guided by the Voice Foundation. Students were tested for dyslexia (Dyslexia Screening Test, Fawcett and Nicolson, 1996) using tasks in non verbal reasoning, verbal comprehension, perceptual speed, phonological processing, recognition and understanding of words and recognition of letters and words segmentation. They were also tested in reading, writing (WORD, Rust et al., 1993) and music (Musical Aptitude Profile, Gordon, 1965).

Following the end of the school year, children were post-tested using the same tests as before and their results compared with national standards rather than a control group considered equivalent. Overy (2000) reported that the ANOVAs displayed no significant improvements in reading for all subjects, dyslexic or not. This quasi-experimental design, which does not use a control group, is considered less powerful than studies comparing the subjects to other persons sharing common characteristics (Shadish & Luellen, 2006). Moreover, results cannot be generalized since this study was only preliminary. The sixth study (Olson, 2000) is a master's thesis that aimed to evaluate the effects of supplemental musical instruction using the Kodály approach on the performance in music, reading and mathematics of first grade students. Subjects (n=41, number of boys and girls not specified) came from four natural classes of a public school located in an underprivileged and multiethnic neighborhood. One class (n=12), forming the control group, received 55 minutes of music teaching using the Kodály approach each week. As mentioned earlier, this approach uses folkloric songs, authentic singing games and movement to develop musical abilities such as musical notation reading, listening and musical analysis.

Three classes (n=29) formed the experimental group. They followed the same lessons as the control group, in addition to receive another lesson of 30 minutes of Kodály approach each week, during twenty weeks. They did more singing, rhymes and rhythm games. They also had additional activities to be conducted during their regular classes. Students took a pretest and a posttest to assess, among other things, their level in music (*Saunders's model*, 1997), in reading (*Metropolitan Achievement Test*, Psychological Corporation, 1993) and in commitment (questionnaire). Results analysis displayed a significant improvement of the experimental group in melodic and rhythmic abilities. However, chi-square and Spearman's rank correlation tests failed to establish a significant link between musical abilities and reading success. The latter was correlated with the level of commitment of the group. The additional lessons of music did not seem to have an effect on reading abilities. One major limitation of this study is the non-randomly distribution of the experimental or control condition: the three experimental classes were the only ones where the teachers had volunteered for this condition. The small sample size also makes generalization of these results to a larger population difficult. However, the same person taught music to the two groups, enabling a better control of an experimental bias (« teacher » variable).

Pursuing in the same vein, Olson (2003) collected data of first graders (n=35, 20 girls, 15 boys), second graders (n=33, 15 girls, 18 boys) and third graders (n=27, 15 girls, 12 boys) of a Montessori type public school (n=96) from his doctoral thesis. Each group (control and experimental) consisted of three multiage natural classes that received 55 minutes of music per week, during 29 weeks (26 and a half hours total). While the control classes followed the regular music curriculum of the Kodály approach (see the detailed description above), the lessons in the experimental classrooms reused mathematical and reading concepts through music. For example, students had to sing while counting two by two, while reading the lyrics, etc. Students were pretested and post-tested, among other things, for reading (Iowa Tests of Basic Skills, Hoover et al., 2003; Riverside Publishing Company, 1993; Northwest Achievement Level Tests, MPS, 2002) and music (PMMA of Gordon (1979); melodic and rhythmic test developed by Olson). A series of ANOVAs and ANCOVAs displayed no significant difference between the groups, by grade, in their reading performance. However, boys from the first and second grade of the experimental group obtained significantly higher scores in reading than boys from the same grade in the control group.

Furthermore, as no significant difference is observed between groups for musical performance (either by level or by gender), the Kodály musical curriculum could constitute a promising intervention avenue to improve reading abilities of boys without compromising their musical knowledge. However, the generalization of these results can only be applied to a population similar to the urban Montessori school chosen for this study. The eight study (Fisher, 2001) was conducted over two years with four natural classes of 20 Hispanic students (n=80, number of boys and girls not specified) who were in a bilingual school (Spanish and English) from kindergarten to first grade. The subjects were assigned randomly to one of the four teachers who taught them during the study. While two teachers used music frequently in their class (experimental group), the other two did not (control group). Beside this difference, the four teachers planned their lessons together in order to teach the same topic at the same time. They remained with their students for two years, from kindergarten to first grade. The students were pretested in kindergarten and nineteen months later (end of first grade) were post-tested on their reading abilities using SOLOM tests (California Department of Education, 1981), *Yopp-Singer Test of Phoneme Segmentation* (Yopp, 1995) and *Developmental Reading Assessment* (Beaver, 1997).

Observations made in class were also part of the data. T-tests and chi-squares analyses demonstrated that classes with music had a higher score in reading (13.2) than classes which did not (8.4). Moreover, ten students who benefited from musical interventions reached the reading level of their grade, against only one in classes without music. The findings of this study indicate that music can be used to promote language and literacy development. Despite the consistency of several variables during the duration of the study, the personality of the teachers, their experience and how they interact with their students were not controlled, which may have influenced the results. The ninth study (Bowles, 2003) is a doctoral study which is considered «experimental» by the author since the entire population studied is limited to all the students from kindergarten to third grade (n=66, 31 girls, 35 boys) of a single art-based public school. Subjects were assigned randomly to experimental (n=25) or control conditions (n=31). However, if we considered that students originated from a larger population, the design employed here possesses one of the characteristics of quasi-experimentation, according to Boudreault (2004). We decided to include it to this review, while recognizing that it could be considered an experimental, and not a quasi-experimental, study by many authors. This study aimed to evaluate the effects of a special program of music taught by a quintet of the region. While the control group did routine tasks (nature of the tasks not specified) with the teacher, the experimental group received two music lessons of 30 minutes each week, for twelve weeks.

This special program contained demonstrations, musical writing, auditory training, composition and performance. Musical component teaching also included analogies with other school subjects. Fifteen students from kindergarten (9 boys, 6 girls), 22 of first grade (12 boys, 10 girls), 15 of second grade (10 boys, 5 girls) and 14 of third grade (4 boys, 10 girls) were pretested in August and post-tested in December for their reading abilities (Woodcock Johnson III: words and letters identification, fluidity, comprehension, 2001) and their phonological conscience (Phonemic Awareness PAR of Wood, 2002). ANCOVAs (2x4) showed that the special music curriculum did not seem to influence student's scores in reading (the data excluded students from kindergarten because of their non-parametric distribution). The author argues that the results can be explained by the low statistical power and that with more subjects, they could be different. Furthermore, the fact that the school is centered on arts and the possibility of a Halo effect may have influenced the motivation and the participation of the students, thus impacting the results.

The tenth study is a doctoral thesis (Cardarelli, 2003) which aimed to determine whether musical training can improve scores of third grade students in reading at the different tasks of the *Florida Comprehensive Achievement Test* (FCAT). Subjects were third grade students coming from two public schools in underprivileged neighborhoods of Florida. The control group (n=51) received the school usual weekly class of music, including singing activities, rhythm and Orff instruments games as well as games based on various musical subjects. The experimental group (n=75) received two weekly lessons of 30 minutes, from September to February, of A Gift for Music curriculum. This program, created by the researcher, aimed to develop, among other things, reading and comprehension abilities. It mostly consisted of instrumental violin classes and rhythmic reading routines. FCAT scores (reading and mathematics tests using a scale from 1 to 5) were provided by the two schools used for the study at the end of the program. The researcher then compared students belonging to each category (1 to 5) in each group using t-tests for independent samples. Results shows that the scores obtained by the experimental group in reading were significantly higher than the control group ($t = 2.10$; $p = 0.03$).

The author suggests that these positive results could promote the inclusion of music among populations at risk. One major limitation of this study is the absence of a pretest, which refers to a quasi-experimental design with nonequivalent comparison group without pretest. This design is considered less powerful than others (Shadish & Luellen, 2006). Moreover, groups were not formed based on student's ability but rather on the availability and schedule of the classes. These space and resource constraints also limited the number of students who could participate in the experimental condition. Finally, the Halo effect and the activities performed in class by the teachers to improve reading abilities were not monitored, which may have influenced the results. The eleventh study (Kennedy, 2007) is a master's thesis which aimed to assess the effects of a short-term participation in an Orff experiment on the reading fluidity and comprehension of second grade students (n=20, number of boys and girls not specified). The Orff approach is an active way of learning music through singing, movement and dance. In this approach, rhythm and language are considered two essential elements of music. This approach also emphasizes improvisation, composition and play (Comeau, 1995). Originating from the same class, students were assigned randomly to group A (n=8) or B (n=12). In the first phase, group B acted as control while group A received 16 Orff learning lessons (twice a week) in the morning before classes began.

Among other things, students took part in rhythmic activities using language, songs, musical listening, movements and body percussions. During the second phase of the study, the roles were reversed. Group B received the 16 Orff lessons while group A served as control. Students were tested before, midway (between the two phases) and after all the lessons on their reading speed, number of errors, fluidity and comprehension¹. The conducted ANOVAs indicate no significant difference between the groups for all of the aspects evaluated at each section of the test. Before we can generalize these results, we must mention the many limitations of this study. Firstly, the sample size was quite small (n=20) and the rate of absenteeism to the morning Orff lessons was high. Moreover, several students could not participate in the activities due to their behavior making the disciplinary management an obstacle to the lessons. We also note that standard errors were very wide for a majority of the tests, indicating large differences between individuals. Moreover, most parametric ANOVAs require a normal distribution of the data (Howell, 1998), which was not the case here. For these reasons, the statistic validity of this research is compromised in various ways (Vellutino & Schatschneider, 2004). The twelfth study (Register, Darrow, Standley & Swedberg, 2007) served as a pilot study for the five studies presented in the next paragraph.

¹ In the copy of the thesis of Kennedy (2007) we were able to obtain, pages 24 to 29 inclusively were missing, which correspond to the « methodology » of the study. We have no precise information about the tests used.

This study focused on the effect of a curriculum centered on music and reading (knowledge of words, decoding and comprehension) on regular second grade students (n=33, number of boys and girls in the two classes not specified) and second grade students with difficulties in reading (n=8). While all of the students in difficulty participated to the music/reading curriculum, the two second grade natural classes were assigned randomly to the control (n=16) or experimental conditions (n=17). The control group received regular reading lessons while the experimental group received twelve extra lessons (three times a week for four weeks). The extra lessons used a book per week, active and passive music, selected vocabulary from evaluating material, varied visual supports, games and cards to put in the correct order to reconstruct a story. Three subtests of the Gates-MacGinitie Reading Tests (Riverside Publishing Company, fourth edition, 2000) were used in pretest and posttest (items on vocabulary terms to recognize, on the selection of the right picture to describe a short written excerpt, on questions regarding reading and decoding).

Wilcoxon rank test for dependant samples determined that students in difficulty (n=8) improved significantly between the two tests. In the regular classes, t-tests indicated that the two groups significantly improved in decoding and words knowledge (as well as in the three subtests put together) but not in reading comprehension. The ANCOVAs also indicated that the experimental group made more progress than the control group in the three subtests, but that this difference was statistically significant only for words knowledge. It should be noted that the class for students in difficulty was much smaller, enabling a better participation of each student. Moreover, their difficulties were greater at the beginning of the study than students from the regular classes, which may have contributed to the significant improvement observed with them. The authors also suggest that the reading improvement could have been greater if the program had last more than four weeks, leaving more time for students to master the different strategies employed. They also pointed out the higher pretests results of the experimental group, which could potentially lead to a ceiling effect, limiting the observable improvements. The large standard errors also suggest that learning was not uniform among all participants. Finally, a high rate of absenteeism was observed during the curriculum lessons which may have influenced the learning of the students.

Pursuing in the same vein as Register & al. (2007), Darrow et al. (2009) conducted five studies in different settings to evaluate the effects of a short-term and intensive musical curriculum created to improve the reading abilities of second graders. Overall, approximately 460 students from five different sites in the United States were divided in experimental and control groups. Despite many variations from one study to another, the five sites used the same music/reading curriculum, consisting of eighteen lessons of thirty minutes. Each lesson included activities aiming to develop literacy abilities (rhymes, letters sounds, vocabulary, sound decoding accompanied by singing or a song) and used books (read, sung or accompanied by musical instruments when children recognized a previously identified word). They also used parts of books (use of pictures to retell the story in their own words or to reconstruct it) and included musical listening, singing and movement as part of their lessons.

In each of the five studies, students were tested before and after the program application using three subtests of the Gates-MacGinitie Reading Test (2000). Using the forms S and T, they tested word decoding (43 items evaluating the ability to recognize words), words knowledge (43 items assessing the beginner's reading vocabulary) and comprehension (39 items verifying the ability to understand passages read). After the completion of the pilot study described above (Register et al., 2007), the five subsequent studies were conducted with similarities and differences in the implementation of the curriculum developed by the researchers. The time allotted for the music/reading curriculum usually replaced the time allotted to teach reading. It was taught over a period varying from six to nine weeks at a frequency ranging from two to three times per week on average. According to the study, the control group conditions varied from having regular musical education, musical activities or teaching reading in class. All teachers did not share the same work experience.

Results show that for four out of five studies, progress in reading abilities between the pretest and the posttest was greater in the experimental group than the control group, albeit not significantly. In the study where this observation was not made, results were similar between the two groups. Nevertheless, in all of the studies, children and teachers were enthusiastic about the music/reading curriculum. Overall, this project displayed the benefits related to the musical curriculum, which may be a viable and effective method to teach reading while generating enthusiasm to learn this school subject. In the fourteenth study conducted by Moreno et al. (2009), the two main goals were 1) to determine if functional differences between children partaking in music-related activities and children that do not reflect a predisposition for music or if they are related to their musical training and 2) determine if musical training improves the non-musical functions of the brain such as reading and linguistic pitch processing.

To achieve these goals, a longitudinal study was conducted over a period of nine months. Subjects ($n=32$) were all right-handed students (whose mother tongue was Portuguese) from the third grade of two Portuguese schools. All subjects came from the same middle class socioeconomic background and none of them, nor their parents, previously received a formal class of music or painting. They were divided pseudo randomly in two groups (class of music or painting) of 16 students (7 girls, 9 boys in the music class and 6 girls, 10 boys in the painting class). Over a period of three weeks, children were individually pretested with neuropsychological and pitch discrimination tasks. These results were used in the pseudo randomly assignment of experimental conditions to students. To do so, the 10 sub-tests of WISC-III (Wechsler 2003, Portuguese adaptation), digital span sub-tests and a reading test (Portuguese European Reading Battery, Sucena & Castro, in press) were used. The measure of pitch discrimination was conducted using software featuring 90 melodies and sound recordings of 90 sentences read at a normal pace in Portuguese. Children were asked to identify if the last note or word seemed strange.

Music and painting classes took place over a period of 24 weeks (two lessons of 75 minutes per week). For each of the four sub-groups of children, teachers specialized in music or painting were hired. The music classes were inspired by the approaches developed by Kodály, Orff and Wuytack (Wuytack & Palheiros, 1995). They included work on rhythm, melody, harmony and timbre components. The painting classes worked on the development of visual-spatial performance through light and colors, lines, perspectives, materials and textures components. At the end of the program, students were post-tested with the same tests as the pretest. A series of ANOVAs and Turkey tests identified a significant improvement in the reading tasks performance, but only for the music group and only for the « inconsistent » words. Overall, musical training was associated with improvements in certain reading abilities and the discrimination of small variations in speech pitch. Though conducted with a lot of rigor, we must mention some limitations to this study. Firstly, the small number of subjects ($n=32$) somewhat limits the generalization of the results. Moreover, four different teachers were hired to teach the music and painting classes, which may have led to different dynamics in each group, influencing the results in the process. In summary, not all of the quasi-experimental studies presented above led to significant results. In some cases, music seems to be a factor which can influence certain reading abilities while in other cases, no particular effect was observed. Moreover, each study does not possess the same methodological limitations, which may impact their respective validity and by extension, the variability of the results they obtained.

5. Conclusion

While results from correlative studies indicate an existing link between certain musical abilities and reading at the beginning of the elementary level (Chamberlain, 2003; Hester, 2005; Southgate & Roscino, 2009), the existence of a causal relationship between these two variables is still unclear. The quasi-experimental studies presented in this literature review do not all lead to conclusive results. While some failed to observe differences between the control and experimental groups (Bowles, 2003; Darrow et al., 2009; Kennedy, 2007; Kingsriter, 1998; Olson, 2000; Overy, 2000), others saw some. However, these differences took different forms according to the study. Sometimes, nonsignificant improvements in reading scores were observed in the experimental groups (Darrow et al., 2009; Fisher, 2001; Lowe, 1998; 1995). Other times, the increased scores of the experimental groups could not be solely attributed to the « music » variable (Cardarelli, 2003; Gardiner et al., 1996) or were significantly higher only for part of the sample, such as boys from first and second grade (Olson, 2003). Music also seemed to have a significant effect on specific components of reading, such as words knowledge (Register et al., 2007) or the reading of inconsistent words (Moreno et al., 2009).

These disparate results are similar to the observations of a meta-analysis of thirty experimental studies on the influence of a musical formation on reading conducted by Stanley (2008). Stanley came to the conclusion that musical interventions have generally positive and significant effects on the teaching of reading abilities (effect size = 0.32), despite some negative results (where the control group obtained higher scores in reading than the experimental group) as well as very different results from one study to another. All these mixed results have to be set alongside the many limitations that have been raised, the most common one being the use of intact classes (Cardarelli, 2003; Darrow et al., 2009; Fisher, 2001; Gardiner et al., 1996; Lowe, 1998; 1995; Olson, 2003; 2000; Overy, 2000; Register et al., 2007) instead of assigning the subjects randomly to the experimental conditions. This last condition is, for many authors, essential to establish a causal relationship between two variables (Boudreault 2004; Schellenberg & Peretz, 2007; Schellenberg 2008; 2006). However, it is a characteristic specific to quasi-experimental designs (Busch & Sherbon, 1992; Shadish, Cook & Campbell, 2002; Vellutino & Schatschneider, 2004) which limits the generalization of results and the precise control over the external variables. We must also mention that the reading and music skills measured varied considerably from a study to another.

This makes it difficult to associate precise music skills (e.g. rhythm discrimination) to precise reading skills (e.g. word recognition). Moreover, identification of specific musical experiences influencing specific reading developmental aspects is almost impossible for the moment since : 1) manipulations and musical programs are different from a quasi-experimental study to another ; 2) small samples size are often present in the majority of the studies ; 3) many studies done to date are theses, dissertations or pilot work that have not been reviewed for publication. For these reasons, we must keep in mind the precise context of each study while considering practical ways to establish more precise causal relationships between music and reading. However, these studies still provide indications of the possible benefit of integrating musical components when reading is taught to children at the primary level. Follow-up researches using stronger methodological characteristics will undeniably help specify the type of musical interventions that are the most effective in helping children learn to read.

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