

# The Effect of Artistic Activities on the Development of Cognitive and Non-Cognitive Outcomes in Chile: the Case of the Curanilahue Youth Orchestra

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# The Effect of Artistic Activities on the Development of Cognitive and Non-Cognitive Outcomes in Chile: the Case of the Curanilahue Youth Orchestra<sup>1</sup>

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## Abstract

Research of extracurricular activities in Chile on the development of cognitive and non-cognitive outcomes is scarce, despite increasing international evidence that such activities are highly relevant and even, in some cases, more effective than traditional school improvement support programs. Based on an unprecedented intervention in the area of music, this paper evaluates the impact of intensive participation of vulnerable children and young students in the creation and development of the first youth orchestra of the municipality of Curanilahue, a small and poor county in the south of Chile. The positive effects of this experience on the young participants can be found at both the cognitive and non-cognitive levels. We observe an increase of scores on higher education admission tests (known in Chile as the PAA and the PSU) among participants in the Program. Employing information from 2001, 2002, 2003, and 2004, we find positive and statistically significant effects, both in mathematics and language test scores. Furthermore, having analyzed increase in test scores for those students participating in the orchestra who take the test more than once, we find results that indicate a progressive increase in their scores, both in mathematics and in language, an indicator that can be considered as a proxy of non-cognitive outcomes related to the orientation and persistence to obtain personal goals.

Classification JEL: I2, Z11

Key Words: Economics of Education, Matching, Cognitive outcomes, Non-cognitive outcomes.

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## 1. Motivation

Economic literature provides us with examples of numerous studies that show a direct link, both empirical and theoretical, between education level or individual human capital and a person's future income.<sup>5</sup> Heckman, Stixrud, and Urzua (2006) examine the relevance of both cognitive and non-cognitive outcomes on performance in the American labor market. They specifically mention that non-cognitive outcomes are generally more relevant than cognitive ones, since they influence the acquisition of cognitive outcomes and other skills that are decisive if one wants to attain economic and social success. In essence, they recommend the promotion of this type of abilities from an early age.<sup>6</sup>

At the same time, the comparative literature in education shows a close link between school outcomes - measured by the results in different standardized tests given during different grades of primary and secondary education - and families' socioeconomic characteristics, school characteristics, and environment conditions. However, the analysis of learning outcomes among Chilean students is highly heterogeneous in their score distribution across schools and classrooms where they are enrolled.<sup>7</sup> Furthermore, the identification of effective policies that improve students' academic results is scarce, at both the national and global level, both because of design factors and implementation.<sup>8</sup> Indeed, we have to emphasize that there are no experiences to evaluate the impact of extracurricular activities on the educational process in Chile, and even less so for the highly vulnerable.<sup>9</sup> Likewise, in the Chilean context, there are not any impact evaluations of intensive participation in artistic activities on the development of cognitive and non-cognitive outcomes.

In this article, we analyze the experience of the Curanilahue Youth Orchestra (CYO), which existed between 1996 and 2004. Curanilahue is a small county located in the Arauco Province, the poorest of Chile's 51 provinces.<sup>10</sup> In 2003, Curanilahue county was rated 258 of 341 of municipalities in the Human Development Index (HDI),<sup>11</sup> which means that it is one of most vulnerable counties considering educational, health, and income characteristics. Therefore, we will evaluate an experience developed in a context of deep socioeconomic vulnerability. In particular, we investigate the effects of intensive participation in youth orchestras, beginning in primary education and continuing until the end of secondary school, as a factor associated with a higher development of non-cognitive outcomes that lead, among other things, to increased cognitive outcomes. We use an original dataset that was collected exclusively for this

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<sup>5</sup> For example, Becker (1964), Larrañaga (1997), Contreras (2003).

<sup>6</sup> The authors have explored the effects of education at an early age, for example, Urzúa and Noboa-Hidalgo (2009).

<sup>7</sup> Ramirez (2007)

<sup>8</sup> For example, at a national level, as of 1997, a policy of an extended school day has been implemented; however, the evaluation of said policy shows minimum effects on the improvement of school performance (Valenzuela (2005); Bellei (2009)).

<sup>9</sup> However, Contreras and Herrera (2007) evaluate a school reinforcement program carried out after school hours in shanty towns in Santiago, Chile. Nonetheless, according to what has been proposed by the authors this can be understood as the extension of school hours, along the same lines as what has been done by Valenzuela (2005) and Bellei (2009).

<sup>10</sup> Valenzuela *et al.* (2009).

<sup>11</sup> PNUD (2003)



evaluation. The hypothesis is based on that the study of a musical instrument and participation in an orchestra drives the development of non-cognitive outcomes and thus leads to improved school performance. This specific hypothesis is based on international evidence that the study of an instrument and participation in an orchestra increase various factors in children's development such as self-esteem, reaching objectives, commitment, social intelligence, improvement in study habits, thoroughness, among others (Fiske, 1999).

The aim of this paper is to establish if, in the context of a local Chilean school system, the participation in artistic activities increase participating students' cognitive and non-cognitive outcomes.

The document is organized in the following way: the subsequent section describes the youth orchestra of Curanilahue, its environment, and the candidate selection process, jointly with the incipient research in Chile. Then, the third section establishes the theoretical framework based on international experience. Section four describes the data compilation process. The fifth section develops the methodology. Section six estimates the educational effects due to the participation in the orchestra and, finally, section seven concludes.

## 2. The Curanilahue Orchestra

### History and Context

In Chile, youth orchestras were first launched more than three decades ago; an effort that was conceived, from the very beginning, to focus on vulnerable students. Although there are still several different orchestras, this paper will analyze the Curanilahue Youth Orchestra (CYO) that existed between 1996 and 2003, because it makes an excellent case study to analyze the relationship between it and educational results of its participants. Despite having this advantage, we cannot generalize the results of this study to other youth orchestras in Chile, since we do not have specific data on others, and furthermore, the Curanilahue orchestra might be affected by other observable and non-observable factors that would make it a unique and very specific experience. Nevertheless, because of the high socioeconomic vulnerability in the municipality of Curanilahue, we can use this study as a reference point for public policies in other impoverished municipalities.

The municipality of Curanilahue is part of the Arauco Province located in Region VIII (Biobio Region), five hundred kilometers to the south of Chile's capital, Santiago. The population of Curanilahue is approximately 31,000 people and is considered socioeconomically vulnerable given that 8.7% of local population was described as extremely poor and 25.6% was non-extremely poor,<sup>12</sup> double the national average. The Arauco Province had the highest poverty rate in Chile in 2003.<sup>13</sup> Similarly, in 2003 the location was placed among the 25% of the most vulnerable municipalities according to the Human Development Index prepared by UNDP,<sup>14</sup> based on the education, health, and income levels of each municipality.

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<sup>12</sup> MIDEPLAN, Casen 2003, [www.mideplan.cl](http://www.mideplan.cl).

<sup>13</sup> MIDEPLAN, Casen 2003, [www.mideplan.cl](http://www.mideplan.cl).

<sup>14</sup> PNUD (2003)

The Curanilahue orchestra was created in 1996 thanks to the initiative of the principal of the Mariano Latorre School. His main aim was for the orchestra to increase the expectations of the school's students of their futures. In 1996, securing the help of several public and private institutions and with each orchestra student's family to pay \$10,000 pesos a month,<sup>15</sup> the orchestra was finally launched.<sup>16</sup> At first sight, the last point is key to the analysis, given that the monthly payment represented a significant effort from the children's families, however scholarships were granted to families that could not afford it.<sup>17</sup>

All the orchestra participants were students of the Liceo Mariano Latorre, a higher school in Curanilahue at the secondary level. The main teaching areas of the school are science, humanistic, technical and arts. Considering scientific-humanistic, technical (wood, electronics and mechanics) and the artistic track, the school has 10 courses per level. An important institutional characteristic of this school is that it assigns students to a specific course according to his or her academic achievement via tracking. That is to say, it groups students by certain characteristics in order to make classmates as similar as possible, principally by considering their general performance in primary education. All the orchestra participants were part of arts and science courses.<sup>18</sup>

The families of the students who participated in the CYO were quite poor. According to the data obtained from the 2003 survey carried out by the National Board for Student Aid and Scholarships (JUNAEB) to construct the School Vulnerability Index (IVE), 70% of the participants' parents were miners, micro-mine workers, laborers, retirement pensioners in the national pension system, taxi drivers, and small traders, while the remaining 30% were public workers in the areas of health, education, municipal and other public services. Their homes are minimally equipped to barely satisfy their basic needs and their fiscal valuation does not exceed 400 UF.<sup>19</sup> In short, we can deduce that both orchestra participants and their classmates were part of the middle, middle-lower, and lower socioeconomic classes.

After several years and after increasing municipal achievements, the quality of the orchestra began to be recognized beyond the borders of Curanilahue, and the orchestra toured both nationally and internationally, including several concerts in Germany and Spain. Certainly, these boys and girls would have never had the same opportunities had they not been involved in the orchestra.

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<sup>15</sup> Exchange rate for \$1US was 412 pesos in 1996,.

<sup>16</sup> The public and private institutions were the Government's Division of Culture, through FONDART; Arauco Educational Foundation; Andes Foundation; the Municipality of Curanilahue; and ENAGAS.

<sup>17</sup> According to an interview with the orchestra's manager this did not lead to a selection according to payment capacity in a direct manner given that payment was not a mandatory condition to be able to take part in the initiative, Egaña *et al.* (2008)

<sup>18</sup> The "artistic" courses were created after the positive experience of the school orchestra, which led to the implementation of a program known as "Artistic Schools" (acronym in Spanish – EA), from an collaboration between the Ministry of Education and the Ministry of Culture. The EA program contemplates a regular curriculum (mainly mathematics and language) with an intensive artistic development program.

<sup>19</sup> 1 UF is approximately US \$40.

## Recent Evidence

Chilean evidence on the impact of artistic activities, in particular children's orchestras, on students is scarce. However, there is an incipient research in Chile on the Curanilahue experience and of similar initiatives in the Arauco Province, carried out by some of the same authors of this article. In particular, Egaña et al. (2008) estimate the impact on school performance, both on the SIMCE test (2001) and the PSU test (2003)<sup>20</sup> for one cohort of students. The entire group was graduated from secondary school in 2005. There were seven orchestra participants in a group of forty regular students. The results for both tests, for both the language and mathematic segments, are positive and statistically significant. This is especially true for the PSU, orchestra participants had higher scores, with 50 points in for the language and approximately 30 points for mathematics. In standardized values, the effect of the program was 0.53 standard deviations (sd) in language and 0.30 in mathematics. Conversely, the impact on 10th grade SIMCE test is approximately 37 points for language and 17 points for mathematics. That is to say, 0.9 s.d. and 0.3 s.d respectively.<sup>21</sup>

At the same time, Egaña and Valenzuela (2009) carried out a qualitative study to identify the structural factors for youth orchestras to strengthen territorial identity in the Arauco Province where Curanilahue is located. In particular, they establish the conditions needed to permit youth orchestras to become part of the local development process. The most relevant factors are as follows:

- **Specialized Teachers:** The quality of the orchestras is critically related to the quality of the teachers specializing in each instrument. Good teachers lead to an increasing learning curve, which, in turn, motivates students, while at the same time giving new opportunities to the orchestra. With lower quality teachers, students quickly catch up to the teachers' skills and lose motivation to progress.
- **Network creation:** Between orchestras and prestigious universities for the formation and exchange of musicians and teachers. The benefits vary from coordinated infrastructure for activity creation, to sharing and training of music teachers.
- **Meeting and Gathering Spaces:** Local musical meetings and ex-musicians as invited guests in the orchestras strengthen territorial identity. In that way, authentic local activities have a special meaning for the community in general that traveling shows don't have.
- **Educational Community:** Encouraging the participation of diverse educational community players – parents and representatives, schoolmates, municipal education

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<sup>20</sup> SIMCE is the national evaluation of learning outcomes implemented by the Ministry of Education of Chile. It is a standardized test given to the following grades: 4<sup>th</sup> primary, 8<sup>th</sup> primary, and 2<sup>nd</sup> secondary education (or 10th grade) depending on the year. It includes reading, mathematics, and natural science sections. For more information on the PSU, see footnotes on previous pages.

<sup>21</sup> The authors show through a case study that some orchestra participants were significantly oriented towards achieving academic goals in frequently precarious initial conditions, sometimes even much more difficult than their classmates. The systematical participation in a structured and high quality orchestra becomes a relevant resilience factor.

directors, universities, among others – gives orchestras institutional and financial sustainability while at the same time reinforcing local connections.

- **Interculturality:** Orchestras offer an opportunity to incorporate and encourage creativity. Music, in many cultures, is a fundamental piece of ceremonies and rituals. Consequently, orchestras that merge styles stemming from local, popular, native, and elaborate music carve out an intercultural space within the territory.

In brief, these five structuring factors make it possible for the Arauco Province Children's and the Youth Orchestra to become a mechanism that strengthens territorial identity.

Besides, both Egaña et al. (2008) and Egaña and Valenzuela (2009), carrying out multiple semi-structured interviews with musicians, the orchestra director, managers, and teachers from the CYO, show significant changes in the orchestra participants' behavior. For instance, Egaña et al. (2008) develop a qualitative analysis based on information self-reported to examine the attainment of academic objectives in comparison with the control group. In particular they observe that the participants are more likely to be interested in desirable and, usually, more traditional careers. This development can be considered as a proxy of non-cognitive outcomes related to the "orientation and persistence to reach personal goals." As we will analyze, we find results that indicate a progressive increase in standardized test scores taken at the end of secondary education, first the PAA (Prueba de Aptitud Académica) and later the PSU (Prueba de Selección Universitaria) for both mathematics and the language sections.<sup>22</sup> These results will support the literature.

### 3. International Evidence and Theoretical Framework

There is international evidence that estimates effects of participation in artistic activities on the development of cognitive and non-cognitive outcomes. Most of this literature focuses on formal aspects of the music studies curriculum and not on programs comparable with youth orchestras.<sup>23</sup> They typically include three subjects: music instruction; the effects of including music in the teaching of language, mathematics, foreign languages, and other areas; and the

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<sup>22</sup> The aim of the Academic Aptitude Test (Spanish acronym PAA) was to measure students' skills in the areas of language, general mathematics, history, and Chilean geography and was mandatory with optional tests in biology, chemistry, physics, mathematics, and social sciences. This test was replaced in 2003 by the University Selection Test (Spanish acronym PSU), whose aim is to measure the mastery of secondary education topics. It is similar to the SAT in the US. Therefore it not only measures language and mathematics, but has optional tests in exact sciences and social sciences. This test is voluntary for students who have finished the secondary education, but required for applying to university. The PSU is the principal selection mechanism along with average secondary education grades, which are combined. The PSU, has a relative weight in the final university application score of around 20 %. The PSU score is normalized to an average 500 points and a standard deviation of 100 points, with a fixed status ranging from 150 to 850 points. For each wrong answer in any of the tests, a quarter of all the correct answers is deducted (Universidad de Chile, 2010). Thus the PSU and secondary school grades are the principal instruments to access the most prestigious careers and universities in the country.

<sup>23</sup> Morrison (1994) carried out an empirical study using information from 1990 and the US National Education Statistics Center. From 13,327 students, 22.3 % took part in musical activities. The author discovered that the difference between those who do and those who do not participate intensively in musical activities, favors participants in four principal curriculum areas. Said difference is 6.1 % in mathematics, 10.9 % in language, 8.9 % in history, and 8.5 % in sciences. That is to say, students who participate in musical initiatives obtain higher scores more frequently than their peers who do not take part in such activities. Nevertheless, the article does not clearly address the problem of self-selection of participants. In other words, it could be that it is the best students who participate and drive the positive impact.

effect of listening to music while learning or studying.<sup>24</sup> In addition, some literature is focused in the link between artistic education and effective learning process<sup>25</sup> as well as in the essential elements behind an effective learning projects based on art.<sup>26</sup> Moreover, there is some evidence about the positive impact in teacher's attitudes.<sup>27</sup>

In fact, the international literature does not have much research focused on youth orchestra experience or their link with non-cognitive outcomes or school results. One study is Bryce et al. (2002), who develop a study that includes artistic programs in Australia. It evaluates four programs, two music related. The programs are quite varied, both in their school coverage – students from the fourth grade until the second year of secondary education - and in the diversity of implemented contexts. The programs include remote rural areas and indigenous as well as vulnerable communities. It is quite interesting that the authors conclude that the more vulnerable the context, the higher the program's impact. At the same time, the authors conclude that orchestra participation improves group work dynamics, that is to say, participating students develop social and communication skills. Likewise, the program allows students to learn planning and reaching their goals. Similarly, it is estimated that musicians improve their self-esteem, because they participate in authentic activities and present to the public. Everything considered, there is certain evidence proving the link between participation in children's orchestras and the development of cognitive and non-cognitive outcomes.

At the same time, Fiske (1999) compiles a number of relevant studies on the impact of art on learning outcomes, concluding that students who have more intensive artistic education are

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<sup>24</sup> For example, Hannon and Treharne (2007) propose that children who formally play music improve the processes of domains specific to music and general domain processes, such as attention capacity or carrying out different actions.. At the same time diverse studies indicate a positive impact when music is included in a foreign language learning process. Furthermore, Hodges and O'Connell (2005) exhaustively review the literature analyzing some 120 articles on these three subjects. They conclude that music has a positive impact on academic achievements depending both on the type of musical experience and also on the circumstances in which it develops. The authors indicate that they have insufficient information to reach more precise conclusions.

<sup>25</sup> For example, Gardner (1994) establishes the links between artistic education and human development, concluding, through a review of the literature, that students learn in an effective way when they are committed to content-rich and significant projects; when their artistic learning is anchored in artistic production; when there is an easy exchange between the diverse forms of knowledge, including intuitive, crafted, symbolic and notational forms; and when students reflect upon their progress.

<sup>26</sup> For example, compared evidence shows that not all programs or artistic activities work in favor of school opportunities. Steinberg (1998) identifies six critical elements for the effective design of learning projects based on art, namely: authenticity, academic rigor, applied learning, active exploration, relation with adults, and practical achievements as short or medium-term goals. Similarly, Durlak and Weissberg (2006) find four key elements similar to those raised by Steinberg (1998). First, it must be a sequence of activities that continue in time and keep some structure and coherence. Second, the participation should not be merely a passive reception of messages from adults. Third, it must focus on personal and social skills, establishing spaces in the program for the development of such skills. Finally, it is necessary to explicitly know the skills that the program wishes to develop. Fiske (1999) also shows that the principal factor that makes art education sustainable, both in and outside school, is the active participation of an influential segment of the community in terms of driving and implementing the required policies and programs. Similarly, establishing alliances between schools and artistic institutions vastly improves academic accomplishment. Finally, it is better to develop artistic communities than to just encourage "artistic stars" who, up to a point, are lucky enough to have an innate ability. That is to say, the learning process is deepened when sustained integrated and complex artistic initiatives are held.

<sup>27</sup> For instance, Seidel (1999) believes that art learning energizes or re-energizes teachers, which is why teaching careers should place more emphasis on art education. Besides, Hodges and O'Connell (2005) point at the importance of considering and analyzing teacher characteristics in the effects coming from music in future research. They believe that the most enthusiastic teachers will obtain better results, even if they use the same methodologies as the ones used by less motivated teachers.



more original, creative, fluent, and resistant to frustration. They are also more skilled in expressing their ideas, imagining new things, and taking risks when they learn.

The author also indicates, as does Bryce et al. (2002), that the impact of participating in artistic activities is more significant in a lower socioeconomic context. It is important to consider that the probability of participation in artistic initiatives is positively correlated with higher socioeconomic levels. This conclusion permits us to anticipate that the extension of quality cultural opportunities for students from low socioeconomic levels can become an excellent strategy to enhance equal opportunities and to increase the access to quality education.

Subsequently, the author concludes that artistic activities modify the dynamics of school learning outcomes, since, unlike regular subjects that increase knowledge in one direction, art develops cognitive, social, and personal skills all at the same time.

According to the literature on the effects of artistic activities on education, we can conclude that they might have positive effects because they permit students: (a) To feel part of a community or school. (b) To develop in areas that otherwise they would not. This is relevant for children who do not adapt easily to the traditional format of the classroom. Often these children are those who achieve better results when learning art. (c) To connect them with their inner selves and with others. The process of artistic expression is, in itself, a personal process; furthermore all kinds of personal resources are used to achieve results. This is why Seidel (1999) and Catteral et al. (1999) believe that artistic activities improve the relation and connection with partners and with the community. (d) To transform the learning experience. When art becomes relevant in the learning process, the search for the discovery and creation of new things significantly increases, teachers are renewed and schools experience both visible and cultural changes. (e) To provide an opportunity for adults (parents, teachers, and others) to learn from young people, promoting the notion that the process of knowledge and learning is a continuous process that never ends. (f) To provide young people with new challenges. Finally, (g) to connect learning with labor experiences. For example, an orchestra works in similar way to a company. Therefore, to take part in on helps to teach development and functioning of organizations in the labor market.

In summary, international evidence confirms diverse positive effects caused by intensive participation in artistic activities in general. Furthermore, we would like to point out the impact of participating in musical initiatives while at the same time, seeing that these results are higher for the most disadvantaged students. We observe that the results in young people's cognitive aspects are affected and influenced through the development of non-cognitive outcomes. Therefore, international evidence supports the hypothesis that participation in youth orchestras positively impacts cognitive and non-cognitive outcomes Further, since there are better results in vulnerable populations, the introduction of orchestras into Curanilahue is of particular interest.<sup>28</sup>

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<sup>28</sup> MIDEPLAN, Casen 2003, [www.mideplan.cl](http://www.mideplan.cl)

## 4. Methodology

Our methodology allows us to measure the average impact of the participation in orchestras over students' cognitive and non-cognitive outcomes.

Due to the restrictions caused by tracking between classes by different characteristics, we cannot directly estimate the impact of the participation in the orchestra by using other students who did not participate as an control, without leading to important bias in the estimation. To solve the selection bias problem we use techniques based on the Propensity Score Matching methodology. In simple terms, we build one or more statistical clones for each participant, based on non-participating classmates from the same grade and course for each program participant. Subsequently we estimate the difference between the participants and their clones by average PAA and PSU scores for each specific discipline.

To estimate the effects on educational outcomes of the participation in the Curanilahue Youth Orchestra we used different techniques based on the Propensity Score Matching (PSM) methodology which were tested to establish the degree of reliability of the estimations.<sup>29</sup> Below we briefly explain both the PSM and also the quality test.

To establish the impact of the CYO on young people we consider university admission test scores: the so-called Academic Aptitude test (Prueba de Aptitud Académica or PAA) and later University Selection Test (Prueba de Selección Universitaria or PSU). Both the PAA and the PSU allow students to apply for university admission, while at the same time there are clear incentives to score as high as possible since students are competing for acceptance the most prestigious universities and careers in the whole country. Indeed, students make usually that effort since it is a one-a-year test, not a secondary school cumulative score. As previously mentioned, academic success is not only a result of better intellectual and socioeconomic conditions, but is also affected by other factors such as motivation, capacity to overcome obstacles, discipline, achieving medium-term goals, all skills that might have been developed through their participation in the orchestra.

Econometric estimations based on PSM are non-parametric and by using estimations through matching, consider the probability of being treated given the observable characteristics of the participating students and those used as a control group.

To evaluate the impact of participation in CYO, measured as an increase in participant test scores, we must estimate what the test scores would have been without intervention. Of course, we do not have the chance of having both test scores. To solve this problem, each student is identified in one group, either the (treated) participants or the non-participants (control). Based on the control group we construct statistical clones of the participants i.e. students from the same school who were not a part of the orchestra but who, due to their observable characteristics, are the most similar to those who did participate. Specifically, we estimated the probability of having participated in the orchestra conditioned by the observable

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<sup>29</sup> For example, Rosenbaum and Rubin (1983), Augurzky and Kluve (2004), Imbens (2003), Leuven and Sianesi (2002), and Todd (1999).

characteristics described earlier in the previous section. For more details on this methodology, see Egaña et al. (2008).

There was an open call to all the primary schools for recruiting participants. Considering that it was a new project, without any previous experience at the county and implemented with meager resources, the boys and girls who registered did not undergo any selection process.

The database to evaluate the impact of this cultural experience on students' academic results not only presents small vulnerability but, given its non-experimental character, it contains diverse restrictions that cause the selection bias of its participants. Nevertheless, based on the seminal nature of this research and the construction of a rich database built ad-hoc for this study, these problems are acceptable for preliminary research. They permit us to use an evaluation methodology that identifies statistical clones based on the observed variables for each participant, managing to estimate the impact that the program had among the participating students. It is possible that the participants and their families display unobservable characteristics different from non-participants, which would explain the differentiated behavior. This might stem from parents' motivation or valuation of extra-curricular activities. All the same, as reported by the orchestra management, several pupils registered because they were simply curious or wished to be part of something new and different, without their parents affecting their decision. There could also be a bias associated with student retention, but given that the abandonment rate was very low, only 3 out of 46 students left in the first few months, so it can be regarded as irrelevant in this preliminary study.

Despite this correction, given that the treated and control students come only from those who took the PSU, the estimation of the impact of the program is only valid for that particular subset of students from the Liceo Mariano Latorre.

## 5. Strategy for Database Construction

We constructed a database that would include information on students and their families, as well as their participation in the orchestra. We gained hard copy documents with permission to remove them from the school by guardians. This allowed us to establish if the student actively continued participating in the orchestra. Additionally, we obtained some identifiers both for the participants and for their classmates to associate the information coming from diverse databases. From school records (class books) we obtained the national legal identification numbers (known as the RUT) and additional information such as attendance rates to regular classes. Furthermore, from the same records gave us the specific grade that each student attended, which permitted us to select the control group from their classmates. Similarly, we obtained the results and administrative data of the PAA and PSU for 2001-2004, from the Department of Evaluation, Measuring and Educational Records (Departamento de Evaluación, Medición y Registro Educativo or DEMRE), which is part of the University of Chile.<sup>30</sup>

Thus, we obtained the scores of the Mathematics and Language tests for both the participating students and those in the control group. Furthermore, this source of information provided us

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<sup>30</sup> DEMRE. [www.demre.cl](http://www.demre.cl)

with some socioeconomic characteristics of the students and their families such as household income and paternal and maternal education. The scores were available for each year that the students took the PAA or PSU, permitting us to examine the number of times the test was taken for each group, as well as the inter-temporary score evolution for those that took it more than once. In brief, the database considers 18 participants who graduated from school in 2001-2002, plus 8 who graduated in 2003 and 2004. This way, we have a total of 27 orchestra participants who represent approximately 68% of all orchestra participants during its history.<sup>31</sup> The control group was 207 students. In short, we have constituted an unprecedented database that is a representative sample of the Curanilahue Youth Orchestra and its social environment, which permits us to explore the association of extracurricular activities with test scores in the context of a highly vulnerable background. This is an important policy study on what could positively affect learning outcomes of the most vulnerable students.

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<sup>31</sup> The orchestra had 43 regular musicians. Nonetheless, only 40 would generally play due to absenteeism for various reasons.

**Table 1: Description and Bias Reduction of Variables from Students Graduated in 2001 and 2002**

Variable	Sample	Mean		Bias Reduction (%)	P value t-test
		Participants	Controls		
Years Mother Education	Unmatched	14.17	10.46		0.00
	Matched	14.17	14.02	96.00	0.88
Year Father Education	Unmatched	13.56	11.32		0.01
	Matched	13.56	13.71	93.20	0.88
Genre( = 1 if male)	Unmatched	0.67	0.30		0.00
	Matched	0.67	0.54	65.10	0.45
Low Income (1)	Unmatched	0.44	0.70		0.04
	Matched	0.44	0.48	85.60	0.83
Medium Income (1)	Unmatched	0.50	0.29		0.08
	Matched	0.50	0.49	93.90	0.94
High Income (1)	Unmatched	0.06	0.01		0.21
	Matched	0.06	0.03	46.20	0.74
PAA Language	Unmatched	542.67	466.52		0.01
	Matched	542.67	487.89	28.10	0.14
PAA Mathematics	Unmatched	593.61	510.70		0.01
	Matched	593.61	576.56	79.40	0.68
NEM (2)	Unmatched	693.22	625.78		0.00
	Matched	693.22	659.22	49.60	0.17
Observations		18	90		

**Source:** Records of the Liceo Mariano Latorre and DEMRE.

**Notes:** (1) Family income is a simple approximation based on income bands declared by students' families. There are three bands: Low: 0-278,000; Medium: 278,001-834,000 and High: 834,001-1,400,000 pesos.

(2) Average grades for secondary education. This is the average of all subjects taken between 1<sup>st</sup> and 4<sup>th</sup> grade.

Significance at <10 % (\*), <5 % (\*\*) and <1 % (\*\*\*).

Tables 1 and 2 show the description of the variables used in the analysis of the graduates from 4th grade in 2001, 2002, 2003 and 2004, as well as the number of students in the treated and control groups.



**Table 2: Description and Bias Reduction of Variables from Students Graduated in 2003 and 2004**

Variable	Sample	Mean		Bias Reduction (%)	P value t-test
		Participants	Controls		
Years Mother Education	Unmatched	13.00	10.98		0.15
	Matched	13.00	11.98	49.40	0.62
Year Father Education	Unmatched	14.00	11.01		0.04
	Matched	14.00	11.88	29.00	0.30
Genre( = 1 if male)	Unmatched	0.38	0.38		0.96
	Matched	0.38	0.46	-757.10	0.76
Low Income (1)	Unmatched	0.50	0.66		0.37
	Matched	0.50	0.56	61.40	0.82
Medium Income (1)	Unmatched	0.50	0.33		0.34
	Matched	0.50	0.43	59.10	0.80
High Income (1)	Unmatched	0.00	0.01		0.80
	Matched	0.00	0.01	15.60	0.83
PSU Language	Unmatched	536.25	508.60		0.44
	Matched	536.25	517.22	31.20	0.67
PSU Mathematics	Unmatched	574.50	533.94		0.25
	Matched	574.50	546.91	32.00	0.52
NEM (2)	Unmatched	635.38	655.21		0.50
	Matched	635.38	670.88	-79.00	0.46
Observations		8	117		

**Source:** Records of the Liceo Mariano Latorre and DEMRE.

**Notes:** (1) Family income is a simple approximation based on income bands declared by students' families. There are three bands: Low: 0-278,000; Medium: 278,001-834,000 and High: 834,001-1,400,000 pesos.

(2) Average grades for secondary education. This is the average of all subjects taken between 1st and 4th grade.

Significance at <10 % (\*), <5 % (\*\*) and <1 % (\*\*\*).

As we can see in Tables 1 and 2, the Mathematics and Language scores are higher for the orchestra participants. At the same time, the average secondary education grades (known as NEM) are higher for the participants who graduated in 2001 and 2002, compared to 2003 and 2004. Additionally, socioeconomic family characteristics – paternal and maternal education and family income- show higher average values for the orchestra participants. These results show that the students participating in the orchestra, even though they are from an impoverished area, have better familial characteristics than their peers. Finally, when we contrast the scores we can see substantial and statistically significant higher scores for the orchestra participants. Nevertheless, when we compare the average secondary school grades, the orchestra participants had higher results than their peers for 2001-2002, but not for 2003-2004.<sup>32</sup>

<sup>32</sup> We must emphasize that the Liceo Mariano Latorre has better academic results than the national average. For example, in 2001 and 2002 the national average was 479.05 points in language and 478.81 points in mathematics, whereas for average

However these raw results, after we apply our methodology the bias is corrected in a substantial proportion and, as any Probit estimation, we are correcting by difference in all observables variables.

## 6. Evaluation of the Impact of Curanilahue Youth's Orchestra

### 6.1 Academic Effects on 2001-2002 Cohorts

Given the important differences between participants of the CYO with their peers, the propensity score matching estimation permits us to adequately estimate the impact of the program.<sup>33</sup> However, this methodology is applied in differentiated way according to cohort, because the impact of orchestra participation can be highly heterogeneous, not only because of the diverse characteristics for each cohort, but also because of the differentiated life cycle effect. For example, the Curanilahue orchestra toured internationally during 2003-2004, which lead to participants having fewer hours of class time compared to the control group.

**Table 3: Impact of the Orchestra on the Participants (2001 and 2002): first time taking the test.**

Graduates 2001 and 2002: First time taking the test							
Matching		Language		Math.		NEM	
1 Closest neighbor		75.62		75.81		63.66	
<i>Standard deviation</i>		<i>(26.63)</i>		<i>(30.19)</i>		<i>(17.17)</i>	
Kernel-Epanechnikov (Band Width 0.3)		55.09		39.86		43.69	
<i>Standard deviation</i>		<i>(29.53)</i>		<i>(34.10)</i>		<i>(20.29)</i>	
Kernel-Epanechnikov (Band Width 0.6)		69.27		66.50		58.34	
<i>Standard deviation</i>		<i>(28.50)</i>		<i>(32.72)</i>		<i>(19.20)</i>	

  

Variable	Obs(1)	Average	Std. Dev.	Min	Max	Impact Approx.	Std. Dev. Prop.
PAA Language	108	481.70	106.12	268	757	66.66	0.63
PAA Maths	108	524.88	127.17	299	780	60,73	0.48
NEM	108	636.00	86.47	435	785	55,23	0.64

(1) Corresponds to 18 orchestra participants plus 90 control group students.

Source: Records from Liceo Mariano Latorre and DEMRE

Table 3 describes the estimated effect of orchestra participation on 18 students from the 2001-2002 cohorts. The results indicate that the students who participated had much higher scores

NEM it was 552.93 points. Similarly, the average for 2003 and 2004 was 490.78 in language, 491.84 in mathematics and 564.33 in NEM (DEMRE).

<sup>33</sup> The PSM was conditioned by gender, family income per capita (dichotomous variables per band), education of the father and of the mother, and student's course

than their peers from the same course, generation, and others with relatively similar observable characteristics, for both Mathematics and Language. Despite that the magnitude of the estimated effect differs according to the PSM technique, the effect is positive and significant in all of them. The effect ranges from 0.5 to 0.6 standard deviations whose magnitude is considerably high compared to other policies aimed at specifically improving academic results.<sup>34</sup> The impact tends to be higher for the language test than for mathematics.

The additional effect of orchestra participation can also be seen in improved average scores associated with secondary education grades.

## 6.2 Academic Effects on 2003-2004 Cohorts

Unfortunately, there are only 8 students for the 2003-2004 cohort. However the large number of peers from the same course and generation allowed us to identify control peers who are quite similar to the participants. For this sub-group, the results again are positive and significant when we consider the mathematics and language scores, although to a lesser degree than for the 2001-2002 cohort in the case of language, and a higher one for mathematics.

**Table 4: Impact of the Orchestra on the Participants (2003 and 2004): first time taking the test.**

### Graduates 2003 y 2004: First time taking the test

Matching	Language	Math.	NEM
1 Closest neighbor	29.02	41.83	-17.58
<i>Standard deviation</i>	<i>21.04</i>	<i>20.16</i>	<i>34.21</i>
Kernel-Epanechnikov (Band Width 0.3)	26.82	40.35	-17.71
<i>Standard deviation</i>	<i>22.74</i>	<i>21.85</i>	<i>34.91</i>
Kernel-Epanechnikov (Band Width 0.6)	29.43	42.38	-17.00
<i>Standard deviation</i>	<i>22.70</i>	<i>21.81</i>	<i>34.89</i>

Variable	Obs(1)	Average	Std. Dev.	Min	Max	Impact Approx.	Std. Dev. Prop.
PSU Language	125	509.03	96.59	298	778	28.42	0.29
PSU Mathematics	125	535.27	94.53	301	822	41.52	0.44
NEM	125	652.09	80.32	435	805	-17.43	-0.22

(1) Corresponds to 8 orchestra participants plus 117 control group students.

Source: Records from the Liceo Mariano Latorre and DEMRE

<sup>34</sup> For example, since 1997 a policy of an extended school day has been implemented at a national level and its impact evaluation shows minimum effects on the improvement of school performance (e.g. Valenzuela, 2005; Bellei, 2009). As a reference, Bellei (2009) found that the effect-size on language achievement was 0.05–0.07 standard deviations while effect-size on mathematics achievement ranged from 0.00 to 0.12 standard deviations.

The principal difference in the results for students from the 2003-2004 cohorts with regard to those from the previous group is the negative effect of participating in the program on the average secondary education grades: while in this cohort the net effect was 17.4 points lower than in control group, in the 2001-2002 cohorts the program had a positive effect of 55.2 points.

### 6.3 Net effects on Academic Results: Relevance of the effect on NEM.

The negative effect of orchestra participation on NEM must be analyzed carefully, given that, as we said before, it has a direct relation with attending better universities and careers for students who took the PAA and PSU tests. If we make a simple equivalence of 22 PSU points for each tenth of the NEM average (in a scale ranging from 1.0 to 7.0), the impact for the 2001 and 2002 graduates would be 2.5 more tenths in the concentration of secondary education grades (NEM), whereas for the 2003 and 2004 graduates it would be approximately 0.77 tenths less on NEM.<sup>35</sup> This can be analyzed from another perspective. In particular, 55 additional points in NEM for the 2001 and 2002 cohorts would mean approximately 11 more points in the weighted score, when we weigh up by 20%, which is the weight generally assigned to the NEM score by universities. In the same way, if we consider a simple average between the mathematical and language sections with the rest weighed up to 80%, we have a positive net impact of approximately 51.0 points in university applications. Following the intuition on university entrance for the 2003-2004 cohorts, 17 negative points in NEM would mean approximately 3.4 points less in the weighted score, if it is weighed up by the same 20%. Likewise, if we consider a simple average between the mathematics and language sections and the rest is weighed up by 80%, we have a positive impact of approximately 28.0 points in university application. Therefore, the net effect from a baseline will be 24.6 more points for the 2003-2004 cohorts.

In brief, the net impact will be defined as the sum of the positive impacts deducted from the adverse effects weighed by the participant proportion for each cohort compared to all of the orchestra participants. The net impact of orchestra participation would be a 43.2-point increase in the weighted average when applying to a university. This result is particularly high if we consider that to apply to a university 43.2 points can mean a better or worse university, career track, up to defeating more than 100 other candidates for the same university and career.

In conclusion, the impact of orchestra participation is positive and has a relatively high magnitude if we compare it with the impact of other programs or public policies aimed at improving educational results, since in standardized terms, the impact of orchestra participation falls within the 0.3-0.6 standard deviation range at individual level.

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<sup>35</sup> NEM ranges from 1.0 to 7.0, a result that becomes a score whose range is comparable with PSU scores in such a way that these results can be easily turned into a general score. Different career program and universities choose candidates according to the highest scores and the number of places available.

## 6.4 Potential effects of non-cognitive outcomes

As we described at the beginning of the paper, the systematic development of cultural activities can lead to the generation of cognitive and non-cognitive capacities in students, which can both improve academic performance. Given that there is not any information that would describe the psychosocial behavior of the Mariano Latorre students before the beginning of the initiative, we could only test the results of extracurricular in an indirect and partial way.

An indicator associated with the development of non-cognitive outcomes is persistence. It is understood as the capacity to focus while facing intermediate adverse results at the same time, to reach an initially proposed goal.<sup>36</sup> We can pose the hypothesis that participation in the orchestra strengthened persistence, given that the development of musical skill entails a systematical and dedicated effort, which can be to be applied in other challenging spheres of students' lives, including academic performance.

In this study we have selected two indirect persistence indicators. To start with, we compare the participants and their control group peers by the number of times they took the university admission test, as well as the scores achieved the last time both groups took the test. When we analyze both aspects we can, as a whole, establish persistence seen as the number of times students take the test, under the assumption that they take it more than once to attain higher scores and thus access to better higher education. It is important to notice the bias that might exist if we only have the orchestra participants who participated in the whole period, given that they can have been persistent individuals even before joining the orchestra. Nevertheless, according to information provided by the manager, only three children left before being in the orchestra at least six months.

For this analysis we considered only the 2001 and 2002 graduate cohorts since they had the most cases. This means that the estimated impacts depend closely on the participant in particular that is considered and, therefore, they are not attributable to the persistence of orchestra participants in general.

**Table 5: Number of times Students take the PSU from the 2001-2002 Group**

Number of times student takes test	Students participating in orchestra		Control students	
	Frequency	Percentage	Frequency	Percentage
1	6	31.6	77	70.6
2	10	52.6	26	23.9
3	3	15.8	4	3.7
4	0	0	1	0.9
5	0	0	0	0
6	0	0	1	0,9
Total	19	100.0	109	100.0

Source: Records from Liceo Mariano Latorre and DEMRE

<sup>36</sup> This type of motivation is supported by Bowles, Gintis and Osborne (2001) and Heckman, Stixrud and Urzua (2006).



Table 5 indicates that the orchestra students took the PSU more times, on average, than their peers. While 68.4% of orchestra participants took the test at least twice; only 29.4% of their peers did so. However, as we have indicated previously, the characteristics of the young musicians are not exactly the same as their peers'. Thus to estimate the effects on the most recent test scores, we followed three PSM strategies used to measure the impact of orchestra participation on the first testing scores.

The results displayed in Table 6 lead us to conclude that orchestra participants who took the test multiple times experienced a significant score increase for both language and mathematics in comparison with the control group. In the language section they increased from an average 66.66 points (0.63 s.d.) to 87.21 points (0.77 s.d.), achieving a net increase of 21 points, their math scores also increased by almost 21 points. When carrying out a simple 80% weighing similar to the one before, the musicians scored nearly 67.6 weighted points more than their control group on their last test score.

**Table 6: Impact of the Orchestra on the Participants (2001 and 2002): Last time**

Matching	Language	Math.
1 Closest neighbor	97.23	97.26
<i>Standard deviation</i>	28.55	28.43
Kernel-Epanechnikov (Band Width 0.3)	73.71	59.90
<i>Standard deviation</i>	31.67	32.37
Kernel-Epanechnikov (Band Width 0.6)	90.69	88.15
<i>Standard deviation</i>	30.43	30.82

Variable	Obs(1)	Average	Std. Dev.	Min	Max	Impact Approx.	Std. Dev. Prop.
PAA Language	108	498.6	112.7	268	790	87.21	0.77
PAA Mathematics	108	528.5	123.9	299	788	81.77	0.66

(1) Corresponds to 18 orchestra participants plus 90 control group students.

Source: Records from the Liceo Mariano Latorre and DEMRE

In brief, both the number of times taken and the impact on the final test score provide powerful arguments in favor of the hypothesis of increased persistence. Consequently, it seems likely that the young musicians take the test on several occasions in order to achieve higher scores higher than their first one and also those of their peers. This indicates that the participant's persistence was quite effective in increasing the possibility of attending more prestigious career paths and universities.

## 7. Conclusions

This research evaluates the impact on test results for the first generation of participants in the Curanilahue Children's and Youth Orchestra between 1996 and 2003. Despite that the study is based on a small sample of cases, students who took part in the orchestra –and also took the PSU, in the context of a specific municipality and school, it creates strong precedents. One of these was the simply innovation of the study, focused on the effects of extracurricular activities on children's educational results. Another was the methodology that allowed us to construct a rich database, permitting to carry out several econometric evaluation techniques. Finally was the feasibility of replicating the impact of this experience on other municipalities and schools with vulnerable students, given that tradition and musical opportunities did not originally exist in Curanilahue.

The impact on the results in the standardized tests for the admission to Chilean universities was evaluated for both language and mathematics test scores, as well as for the effect on average secondary education grades (NEM). Additionally, we examined the development of persistence in obtaining higher scores in higher education admission tests as a sample of the development of non-cognitive outcomes promoted by the orchestra. The first type of analysis was carried out based on the scores obtained in the PAA for 2001 and 2002 and the PSU for 2003 and 2004, whereas the second used only the 2001 and 2002 cohorts due to a lack of participants for later cohorts.

In the quantitative analysis we estimated three matching metrics in three different methodologies, finding favorable results in bias and coverage reduction. The above adds additional robustness to the impacts found in previous papers in the evaluation of the Curanilahue orchestra (Egaña et al., 2008). Additionally, all the participants considered are representative of the Curanilahue orchestra. Consequently, this research is a substantial progress in relation to Egaña et al. (2008).

We found, in particular, that orchestra participation positively affects both language and mathematics in subsequent testing. For the graduate cohorts 2001 and 2002, the impact on the mathematics section of the PAA was approximately 0.48 standard deviations whereas for the language component it was approximately 0.63 s.d. For the 2003 and 2004 cohorts, a positive effect ranging around 0.29 s.d. was found for language whereas in mathematics the impact was about 0.44 s.d.

Unlike the positive effect on the scores of the standardized tests, the effect seems to be potentially negative on secondary education grades although this situation is evident only among the 2003-2004 cohorts. With regard to the impacts on the NEM, 2001 and 2002 participants did not have systematically miss school due to the orchestra, given that they had few national or international tours, unlike the later cohorts. Despite the negative effect on NEM the additional net effect for university application turned out to be positive and significant. However, it is important to note that, according to the data, it is not clear if the treated students and the control group have faced similar life or educational conditions.

Meanwhile, there is positive evidence on increased perseverance for orchestra participants. The musicians took the admission test more times than the control group and had higher final test scores than the control group.

The discovered results must be interpreted simultaneously with the characteristics of the municipality of Curanilahue and the Mariano Latorre School. That is to say, it is relevant to consider that it is quite difficult to successfully finish school when living in precarious socioeconomic conditions, and even more so when we consider the additional responsibilities from orchestra participation.

To sum up, the results show the relevance of extracurricular activities, in particular youth orchestras, for both cognitive and non-cognitive outcomes. We must emphasize the wealth of information available, which permitted us to complete this first seminal study in the Chilean experience. Additionally, the research was developed in a context of high socioeconomic vulnerability, which has large policy implications. Finally, the results after having been tested by diverse robustness strategies, are consistent internally and also with prior international research.

We believe it is necessary to conduct future research on extracurricular activities, specifically the characteristics required to improve test scores and higher well being for Chilean children living in vulnerable conditions. This is key based on the results found in this case study, specifically the high effectiveness in learning outcomes of the students who actively and permanently participate, which improved their academic results greater than other policies aimed at specifically increasing academic results of Chilean children and young people.

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