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DISCUSSION PAPER SERIES

IZA DP No. 18064

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ABSTRACT

Orchestrating Success: Music Proficiency, Emotional Intelligence and Mental Health in Young Adulthood*

This paper estimates the long-term causal effects of music proficiency on emotional intelligence and mental health. Leveraging the staggered rollout of a school orchestra program as a quasi-experimental setting, we identify the causal impact of adolescent musical engagement. Our findings reveal that music training significantly improves both emotional intelligence and mental health into young adulthood. Specifically, musical proficiency fosters key non-cognitive traits, including self-motivation, optimism and adaptability, while also mitigating symptoms of poor mental health, including depression and anxiety. These positive effects are particularly pronounced for males and second-generation migrants. Our evidence demonstrates that learning music has a lasting positive impact on non-cognitive skills, suggesting that universal educational music programs can be a powerful, long-term tool for human capital development and inequality reduction.

JEL Classification: D91, I24, J13

Keywords: music training, emotional intelligence, mental health, transition to adulthood, extracurricular activities

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1 Introduction

The development of non-cognitive skills during adolescence is increasingly recognized as a crucial determinant of long-term educational and economic success (Deming, 2017; Algan et al., 2022; Sorrenti et al., 2025). These skills encompass a broad array of individual characteristics such as emotional intelligence, social skills and personality traits. Economists and psychologists typically measure these skills using standardized psychometric instruments, such as self-report questionnaires, which capture aspects of an individual's character that are distinct from cognitive abilities. From a policy perspective, a growing body of evidence suggests these crucial skills are highly malleable during childhood and can be effectively developed through educational interventions that exploit less traditional pedagogical approaches (Almlund et al., 2011).

While the impact of school programs on these outcomes has been extensively studied (Alan and Ertac, 2018; Alan et al., 2019; Sorrenti et al., 2025; Biroli et al., 2024; Alan and Kubilay, 2025), the role of leisure activities and informal education, particularly musical training, remains less understood. This paper estimates the causal effect of early-life musical training on young adults' emotional intelligence and mental health. To address the challenge of selection bias, we exploit a unique universal school orchestra program, which generated exogenous variation in musical training during primary school. We leverage rich data on non-cognitive skills collected from the affected cohort in their young adult years.

This work contributes to a large and multidisciplinary body of research on the relationship between musical training and the development of cognitive and non-cognitive skills. While this literature spans educational psychology, neuroscience, sociology, health, and economics, it has primarily focused on the correlation between musical training and brain development (Schellenberg, 2004). A smaller body of work has also explored the link between musical practice and non-cognitive domains, such as personality and social skills (Hille and Schupp, 2015; Cabane et al., 2016), particularly in the context of group instruction or orchestra programs.

A key challenge in identifying the causal impact of out-of-school music training is disentangling its effects from confounding factors, such as student self-selection and reverse causality. More talented students and those from more affluent families are more likely to participate in extracurricular music programs. Similarly, children with certain positive characteristics, such as higher curiosity or academic performance, may be more likely to begin playing an instrument.

This paper overcomes these challenges by exploiting a unique, universal school music program implemented in a municipality in Tuscany, Italy.

The Orchestra in Classe (OIC) program, which offers publicly funded music instruction integrated into the school curriculum, was gradually implemented across different schools and years beginning in the 2007/08 academic year. This staggered rollout generates quasi-experimental variation in program attendance, which we exploit as an instrumental variable to identify the causal effect of musical training. Our objective is not to evaluate the program itself, as we do not believe its long-term impact is direct. Instead, we argue that the program's effect operates as a two-step mechanism: it serves as an initial exposure that increases the likelihood of an individual continuing to study an instrument and engage in musical activities during adolescence. It is through this sustained, endogenous engagement with music that we can test for long-term effects on socio-emotional skills, especially since the earliest participants are now young adults. The program's primary value, therefore, is to act as a catalyst, providing opportunities for musical training to students who would not have otherwise pursued it.

We focus on young adults. The transition to adulthood is a crucial period marked by significant changes in educational, occupational, and social roles (Wachter, 2020; Barbieri and Gioachin, 2025). The importance of cognitive and non-cognitive skills in navigating this transition period is widely acknowledged. This paper focuses on two critical dimensions of young adult well-being –emotional intelligence (EI) and mental health– and their causal relationship with music training. Emotional intelligence, broadly defined as the capacity to perceive, understand, manage, and use emotions effectively, is a cornerstone of adaptive behavior. High EI enables individuals to navigate stress, solve problems in difficult situations, and communicate effectively in professional settings. Alongside mental health, EI is increasingly recognized as a key determinant of both labor market success and overall life satisfaction. This makes both domains particularly important for young adults as they transition into the workforce and contend with occupational instability.

Building on the psychological literature, we hypothesize that music training during adolescence positively impacts these two domains. The discipline and sustained focus required for active musical engagement—whether through playing an instrument, singing, or composing—directly enhance the brain's capacity for self-regulation, a skill fundamental to both emotional management and goal-oriented behavior (Uhlig et al., 2013). Moreover, music provides a structured

and constructive avenue for emotional expression, allowing individuals to channel and process a wide range of feelings, thereby improving emotional self-awareness. The goal-oriented process of learning music can foster higher self-esteem and a stronger sense of purpose.

One of the central contributions of this study to the economics literature is the disaggregation of emotional intelligence into its constituent subdomains. This approach is crucial for understanding the precise mechanisms through which music training may impact emotional well-being. While prior economic studies often treat non-cognitive skills as a single, latent factor, our use of a comprehensive measure allows us to analyze the impact of music training on specific subdomains. By examining how this specific adolescent activity shapes these distinct facets of EI, we provide novel evidence on the formation and determinants of human capital, thereby deepening our understanding of the pathways through which childhood activities translate into skills that are valuable in the labor market and beyond.

Beyond its impact on emotional intelligence, music training may also act as a protective factor for mental health problems such as depression or anxiety, providing a valuable tool against feelings of negativity and hopelessness. The therapeutic influence of music is supported by its ability to modulate physiological stress responses, such as heart rate and blood pressure, and to stimulate the release of dopamine and other hormones that regulate mood and promote relaxation (Schellenberg and Lima, 2024).

We find that musical training has a substantial effect on young adults' development of emotional intelligence and on the prevention of poor mental health. These long-term effects are robust and consistent across different estimation methods. A detailed analysis of specific traits reveals that musical training primarily enhances personal well-being, motivation, and relational abilities. We find a significant positive impact on self-motivation, optimism, happiness, assertiveness and adaptability. Musical training also substantially reduces factors related to poor mental health, including depression, anxiety, and stress. These findings suggest that musical practice can foster critical social and emotional skills, which are relevant for a successful transition to adulthood. The effects are largely consistent across gender and immigrant status, though we observe a larger impact on specific subdomains of emotional intelligence and mental health for males and second-generation migrants.

The paper is organized as follows. Section 2 summarizes the main empirical studies in eco-

nomics and psychology on the impact of music on skills development, focusing on possible mechanisms. Section 3 describes the institutional background and school music program used in the analysis. Section 4 details the data and methodology, while Section 5 presents the results. Section 6 concludes.

2 Music and skills development

While a large body of economic literature focuses on the role of school and family inputs in child development, a complete understanding of the skill production function requires considering children's time investments outside of school (Jürges and Khanam, 2021). This has prompted research into non-formal educational activities, such as physical exercise (Felfe et al., 2016) and out-of-school music training (Hille and Schupp, 2015). For example, Del Boca et al. (2017) show that a child's own time allocation is a more significant predictor of test scores than parental inputs.

A number of studies have investigated the impact of out-of-school music training on adolescent development. Using data from the German Socio-Economic Panel (SOEP), Hille and Schupp (2015) analyze the long-term effects of music engagement on adolescents. Employing propensity score matching to mitigate selection bias, they find a positive correlation between having attended private music lessons and school grades. Their findings are robust to a wide range of parental background controls and suggest that the benefits may be particularly pronounced for low-SES youth. Similarly, using the same SOEP data, Yang (2015) find a positive and significant effect of instrument classes on educational achievement. This literature also extends to a comparison with other extracurricular activities: Cabane et al. (2016) find that music training, when compared to sports, also positively affects academic performance and ambition. From the psychological literature we know that the long-term effects of music training are stronger when training begins during a sensitive period, such as early childhood, particularly by the age of 7 (Penhune, 2020).

Cognitive abilities, particularly Executive Functions (EFs), are deeply engaged during music practice, which demands self-regulation, flexibility, attention, inhibitory control, planning, and executing goal-directed actions (Schellenberg and Lima, 2024). Beyond cognitive effects, music training has been shown to influence a range of non-cognitive skills that are relevant to economic outcomes. Studies suggest that music instruction can enhance self-efficacy and aspirations (Hille

and Schupp, 2015), which may in turn foster greater ambition and drive. These benefits are often linked to improvements in self-esteem and mastery (Gómez-Zapata et al., 2021). Music engagement is also associated with better emotional self-regulation (Uhlig et al., 2013) and reduced symptoms of stress and depression (Schellenberg and Lima, 2024), which are known to influence productivity and labor market outcomes. Furthermore, the collaborative nature of musical performance, fostered by orchestra, ensemble or band experiences, can promote prosocial behaviors, cooperation, and trust[1].

Even if all this previous empirical evidence offers more correlational evidence, if music training causally enhances the development of non-cognitive skills, a universally accessible program could serve as an effective mechanism for mitigating socioeconomic disparities. This is particularly relevant given the established literature that shows that investments in non-cognitive skills are a key strategy for narrowing later-life outcome gaps between low and high SES groups (Cunha et al., 2010; Attanasio et al., 2020).

3 Institutional Background

Due to its history, the municipality of Montepulciano in the South of Tuscany (Italy) represents an interesting case study for music education and its impact on child development. In 1976, German composer Hans Werner Henze founded the *Cantiere Internazionale d'Arte*, a one-month-long music workshop that ends with several public events, with the aim to pursue a unique socio-political and cultural vision. The project was based on three core principles: (1) artistic experimentation and accessibility, (2) community engagement, and (3) equality and shared support for participants. Henze's vision was to create a vibrant, collaborative, and socially-conscious artistic "workshop" that would use music and art as a tool for community development and education.

In 1980, Henze premiered the opera *Pollicino* (Henze, 1980). Composed specifically for the children of Montepulciano to provide them with an inclusive musical experience, it is now the most represented children's opera worldwide. His primary goal was educational: to offer children from predominantly rural areas, where human and social capital were limited, meaningful opportunities for artistic engagement. Today, the *Cantiere* continues to work inspired by Henze's

[1]Table A1 in the Appendix summarizes various mechanisms that may influence the potential outcomes of music training in childhood based on previous empirical findings and underlining pathways through which music training interacts with environmental and individual factors to produce both cognitive and non-cognitive benefits.

vision. Building on this legacy, the local music school (*Istituto Di Musica Henze*) exhibits an unusually high level of community engagement, enrolling about 1.6% of the local population—a rate three times that of other large Italian cities. The public commitment is underpinned by a municipal policy that values music as a public good, evidenced by continuous investment in cultural activities and, specifically, the publicly funded *Orchestra in Classe* program, which emerged as a partnership between the municipality public primary schools and the musical institute.

The *Orchestra in Classe* (OIC) program began in the 2007/08 academic year. It provided students in first through fifth grade of primary school with 16 two-hour orchestral instrument classes per year. The teaching method, which is based on the Orff-Schulwerk approach (Jiang, 2025), is organized in modules with the objective of performing a public concert or opera at the end of each academic year. The program offered professional instruction in violin, cello, orchestra performance, opera singing, and musical play. Initially launched in two classes at the municipality's central school, the program was subsequently expanded to all four primary schools within the municipality.

The implementation of the *Orchestra in Classe* (OIC) program presents several key features that allow it to be exploited as a valid instrument for a causal evaluation of music proficiency's impact on child development: i) When initially introduced, only one school within the municipality participated, enrolling approximately 40% of all 6-year-old children in the municipality; ii) The program was universal, as all children in participating schools attended free of charge and during school hours (This design resolves the issue of self-selection into musical training that has affected most previous studies); iii) The program created a clear discontinuity with respect to standard music teaching in primary schools, as high-quality orchestral instrument lessons taught by music professionals replaced the basic musical propaedeutic instruction delivered by curricular teachers; iv) The teaching method, which relies on teamwork, is expected to be closely linked to the emotionality and sociability subdomains of Emotional Intelligence; v) The program was unanticipated and, therefore, not a reason for parents to self-select their children into the participating school; vi) The program was implemented from the first grade of primary school in 2007, allowing for a comprehensive assessment of the long-term effects of music proficiency on socio-emotional skills observed during the transition to adulthood.

These characteristics collectively identify the OIC program as an ideal candidate to serve

as a source of exogenous variation for evaluating the causal impact of musical training on child development.

4 Data and methods

4.1 Ad-hoc survey

Due to the scarce availability of data on non-cognitive skills in Italy, particularly at the specific geographical level of the OIC program, we conducted primary data collection using a web-based questionnaire. This questionnaire was designed to evaluate the impacts of music proficiency on socio-emotional skills. It was structured into three main sections: (1) demographic questions on family background, education, and current occupation; (2) a time-use section capturing time allocation across various activities; and (3) a personal development section that collected data on economic and psychometric variables using validated scales. These responses were then integrated with administrative data from the schools and the Henze Musical Institute. Data were collected from March to August 2024 through a snowball sampling procedure.To increase the response rate, we offered a 25 euro incentive to participants who completed the entire questionnaire. This incentive, based on the Induced Value Theory (Smith, 1976), helped ensure that participants' preferences would align with the experiment's objectives, which was crucial given the length and complexity of the survey.

The variables most relevant to this study are those concerning musical practice and socio-emotional skills. The battery of questions on musical practice includes: whether the individual can play an instrument, the number and type of instruments played, a self-reported degree of proficiency for each, total years of musical practice, weekly hours of practice, and participation in an orchestra, ensemble, or band.

The main outcome variables for this study are measures of emotional intelligence (Salovey and Mayer, 1990) and poor mental health (Bottesi et al., 2015). Emotional intelligence was assessed using the 30-item Italian validated scale proposed by Chirumbolo et al. (2019), which is adapted from the Trait Emotional Intelligence Questionnaire Full Form (TEIQue-FF) (Petrides, 2009). The scale is divided into four factors, each comprising several facets: emotionality (including emotion perception, empathy, emotion expression, and relationships), self-control (including emo-

tion regulation, stress management, impulsiveness, adaptability, and self-motivation), sociability (inlcuding assertiveness, emotion management, and social awareness) and well-being (including self-esteem, trait happiness, and trait optimism).

For the assessment of mental health, we used the Italian validated scale proposed by Bottesi et al. (2015), which is based on the Depression Anxiety Stress Scale-21 (DASS-21). The DASS-21 is a concise self-report measure designed to differentiate between depressive and anxious symptoms. Their confirmatory factor analysis indicated that the DASS-21 measures general distress along with three distinct dimensions: anxiety, depression, and stress.

4.2 Sample

To address the potential endogeneity of musical practice, we exploit the staggered introduction of the OIC program as our source of exogenous variation. The OIC is a universal music education program, implemented in the first grade of primary school, that began in the 2007/08 academic year in a single school in the municipality of Montepulciano, Tuscany.

The municipality has five primary schools: one in the main town and four in separate suburbs located approximately 7–10 kilometers from the center. Our target population for data collection comprised all children attending first grade in these primary schools during the academic years 2004/05 to 2009/10. This includes students who never participated in the OIC program—those who enrolled in one of the other schools and those enrolled in the central school before 2007/08—and students who attended the OIC program, starting in 2007/08 in the central school.

According to school registries, the target population consists of 636 children. Our data collection campaign aimed to obtain responses from approximately one-third of this population. We used a snowball sampling procedure, which began with direct contact to a number of initial respondents (or associations to which the target population belongs), who were then asked to distribute the survey link to their peers. The data collection, conducted from March to August 2024, yielded a total of 236 responses, of which 198 were fully completed. This final sample corresponds to slightly over 31% of the target population.

Data from the school registries enable us to compare some baseline characteristics of our sample to those of the general population. These characteristics include gender composition,

Figure 1: Comparison with the target population

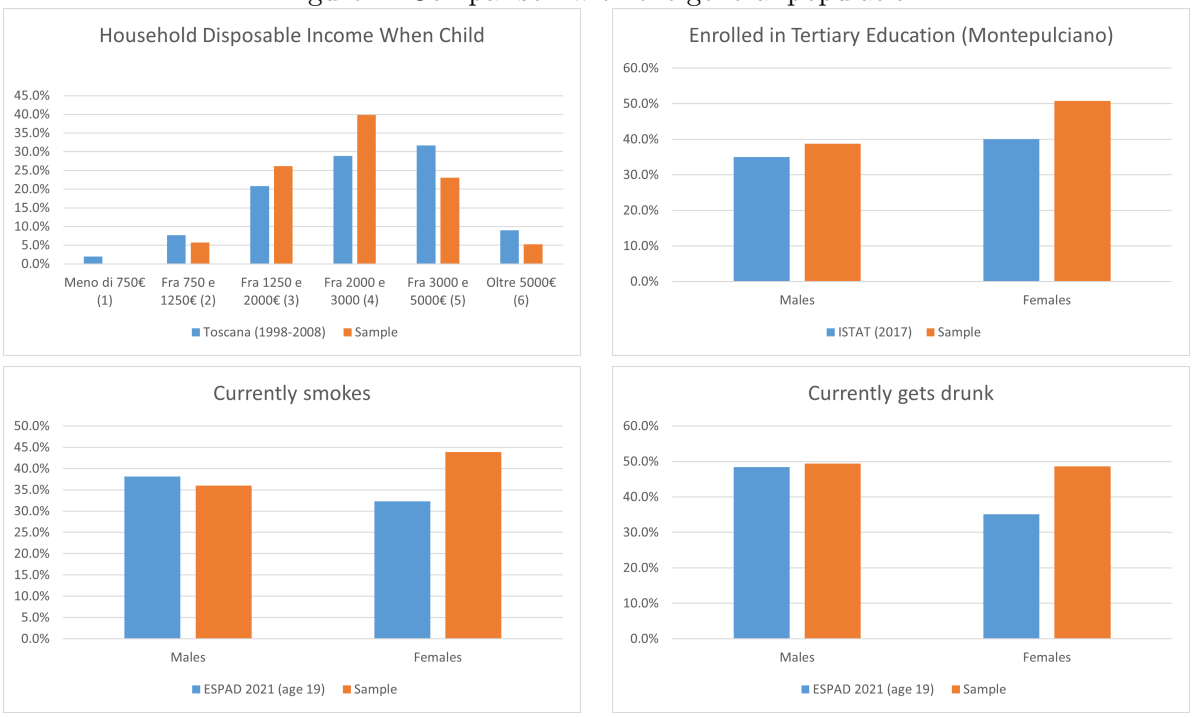
year of enrollment in first grade, and the school attended. Figure 1 presents the mean of these characteristics for both the general population and the sample.

As shown in Figure 1, our sample's gender composition is well-balanced, though it exhibits a slightly larger proportion of females compared to the target population. The second graph, detailing school enrollment, shows that our sample is over-represented in the central school while three other schools are slightly under-represented. Finally, the distribution across school cohorts is well-balanced, with the exception of the 2004 cohort, which is slightly over-represented in the sample.

We further compare our sample to a broader population using data from multiple external sources. Figure 2 reports these comparisons, drawing on ISTAT for university enrollment rates, the Bank of Italy's Survey on Household Income and Wealth for income distribution, and ESPAD-Italy for risky behaviors. A primary challenge in these comparisons arises from the specific characteristics of our target population.

The first panel of Figure 2 compares the self-reported overall family income from our sample with the income distribution for the Tuscany region from 1998–2008. The comparison uses data from the Bank of Italy's Survey on Household Income and Wealth (SHIW) and is based on

Figure 2: Comparison with the general population



the same seven income brackets.[2] Despite this being a retrospective question for individuals who were children at the time, the overall income distributions are very similar. There is a slight over-representation of middle-income households in our sample and a corresponding under-representation of the highest income bracket.

To compare university enrollment rates, we use ISTAT data for the population aged 20–27 in the municipality of Montepulciano. This information is available at the municipal level, allowing for a close territorial comparison. However, the last available data point is from 2017, seven years earlier than our survey. Given the small positive trend in university enrollment observed nationally, we might expect a higher rate in our sample. Indeed, our sample shows higher enrollment rates, particularly for girls.

The final two graphs of Figure 2 compare the prevalence of smoking and drinking in our sample with that of Italian youths aged 19, as recorded by ESPAD 2021. Although there is a mismatch in the age range of our sample (20–28) and a three-year misalignment in the reference period, the prevalence of smoking and drinking is very similar for males. However, we observe a substantially larger prevalence of both behaviors among females in our sample.

[2]The multiple-choice question on family income specified seven income brackets: less than €750/month; €750–1,249; €1,250–1,999; €2,000–2,999; €3,000–4,999; and €5,000 or more.

Table 1: Factor loading correlations and Eigenvalues for music proficiency.

Musical practice variables	Factor 1	Uniqueness
Able to play a musical instrument	0.96	-0.07
Number of instruments played	0.97	-0.15
Years of musical practice (overall)	0.89	0.09
Maximum musical proficiency level for an instrument	0.92	0.04
Weekly hours of musical practice	0.62	0.34
Years at musical institute classes	0.59	0.46
Played in an orchestra, ensemble, band, etc.	0.89	0.11
Play keyboards (piano and similar)	0.63	0.09
Play strings (guitar, bass guitar, etc)	0.41	0.15
Play winds (clarinet, flute, oboe, etc)	0.51	0.10
Play arch (violin, cello, viola, bass, etc)	0.48	0.30
Play brass (trumpet, sax, trombone, etc)	0.34	0.40
Eigenvalue	6.21	

Due to the lack of official statistics on music proficiency in Italy, it is difficult to directly compare our sample to the national youth population. The only available reference is a 2018 survey conducted by YouGov on a representative sample of 1,012 Italian adults.[3] According to this survey, approximately 35% of Italian adults play or have played a musical instrument. Our sample shows a comparable rate, with 39% of respondents reporting similar musical experience.

4.3 Music proficiency

A critical consideration is determining the most relevant dimension of musical practice. The survey, as detailed previously, contains questions on several facets of musical practice. To conduct a meaningful analysis, we performed a factor analysis to create a measure of each respondent's overall music proficiency.

Table 1 reports the factor loadings' correlation with all music-related variables retrieved from the survey. There is a strong positive relationship between all music variables and the first factor, which we name music proficiency. This factor has a very large eigenvalue (above 6.2), while the second largest factor, which shows no meaningful correlations, has an eigenvalue of 1.06. It is also worth noting that the set of questions used to assess music proficiency has a rather high internal reliability, with a Cronbach's alpha of 0.7.

As Figure 3 shows, and as anticipated, the music proficiency factor is highly concentrated at a negative value for non-musicians but is more widely distributed across positive values for those who practice music. Given this non-standard distribution, the primary analysis will be

[3]Results are available on YouGov.com.

performed using a transformation of the factor: a rank variable from 0 to 10 based on the music proficiency factor. Analyses using the untransformed factor and a music proficiency dummy variable (indicating a positive music proficiency score) will be conducted as robustness checks.

4.4 Outcome variables

As mentioned in Section 4.1, we use two different psychologically validated scales to measure emotional intelligence and mental health. The TEIQue-FF scale by Petrides (2009) measures several different dimensions of emotional intelligence. However, for clarity of exposition, we first analyze a single measure of emotional intelligence. This measure is obtained by taking the first factor from a recursive factor analysis performed on all TEIQue-FF questions. This factor positively correlates with all emotional intelligence questions and is characterized by an eigenvalue of 7.23.

We apply a similar strategy to analyze the impact of music proficiency on mental health. The DASS scale (Chirumbolo et al., 2019) assesses three dimensions of mental health: depression, anxiety, and stress. As these three subscales all have a negative valence, we performed a factor analysis on the entire battery of questions and labeled the first factor *Poor Mental Health*. This factor has a substantial eigenvalue of 8.98 and exhibits a positive correlation with all DASS items.

As Figure 4 illustrates, both factors exhibit more standard distributions, suggesting that they should not present significant distributional concerns for the regression analyses. While these two factors serve as the primary dependent variables in this study, we also analyze the impact of music proficiency on all subdomains of emotional intelligence and mental health simultaneously. This parallel analysis aims to provide a clearer understanding of which specific aspects of emotional intelligence and mental health are most responsive to musical practice.

4.5 Control variables

The set of control variables included in all regressions captures important individual and family characteristics from the respondents' childhood period. These include gender; parental education, categorized as low (up to lower secondary school), medium (vocational and high school), and high (tertiary); the number of siblings (zero, one, and two or more); and housing type during childhood (single-family, multifamily, or apartment). We also control for whether either parent held a skilled occupation (defined as including independent contractors with a license, managers, executives,

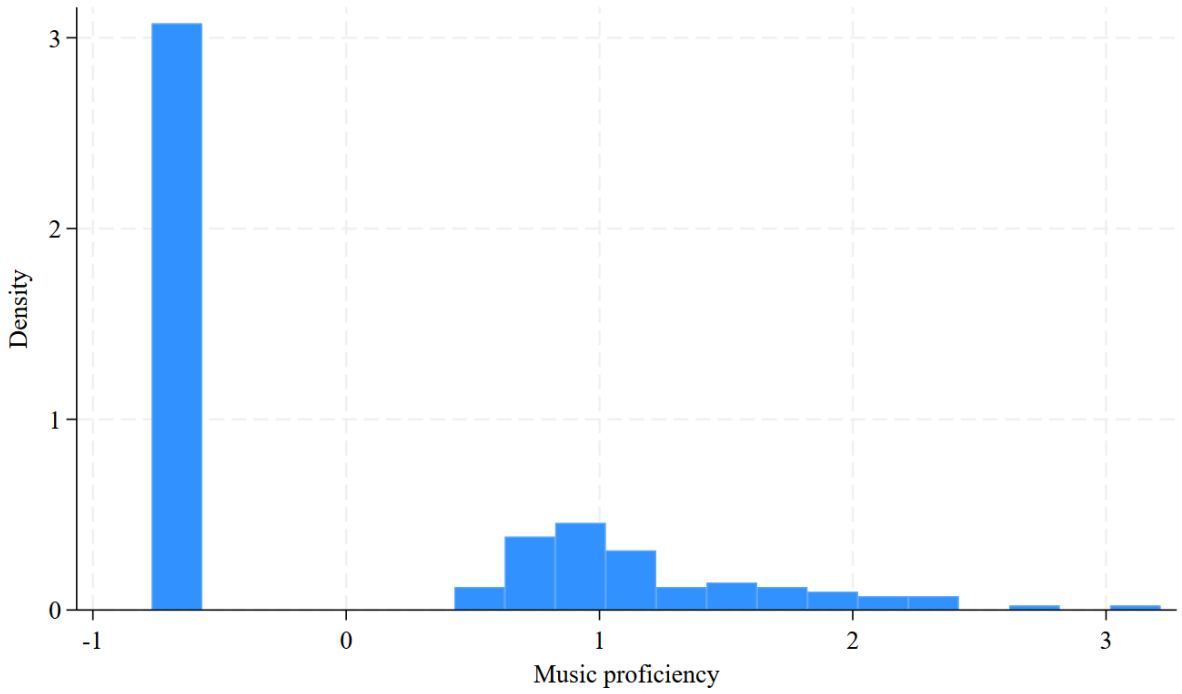


Figure 3: Density distribution of the music proficiency factor

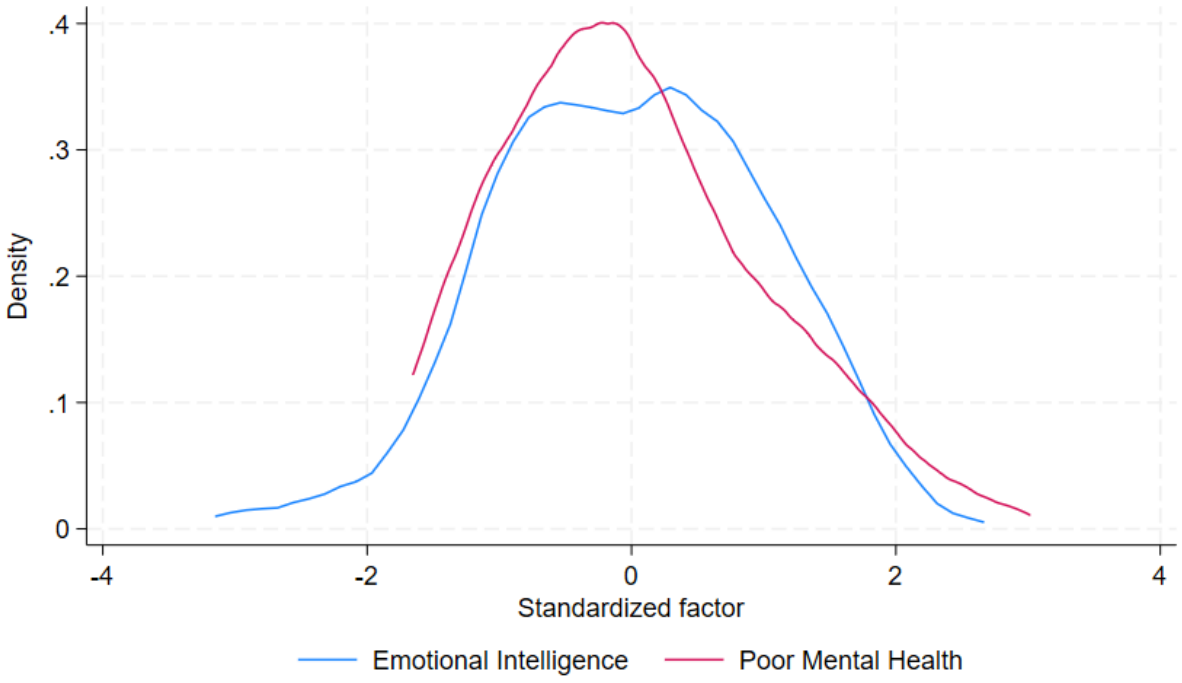


Figure 4: Density distribution of the emotional intelligence and mental health factors

and entrepreneurs with employees, while excluding blue-collar, white-collar, and self-employed workers, teachers, etc.), whether at least one parent was foreign-born, and overall monthly family income during childhood (divided into six brackets).

4.6 Empirical strategy

Accurately measuring the causal impact of music proficiency on child development outcomes is a significant challenge, largely due to concerns of both self-selection and reverse causality. Music education is often a costly and demanding extracurricular activity, and families with higher socioeconomic status (e.g., higher income and education levels) are more likely to pursue it. Simultaneously, the demanding nature of music practice may lead to a form of reverse causality: academically successful children are more likely to engage in it than their less advantaged peers, who may prioritize studying to improve their grades over other time-consuming activities. These selection and reverse causality issues often operate in tandem, as students from lower socioeconomic backgrounds tend to have poorer academic outcomes. Nevertheless, musical practice could have a genuine causal impact on a range of cognitive and non-cognitive skills that are valuable in the labor market.

To address the endogeneity issue, we will employ an instrumental variable (IV) approach, which requires a valid exclusion restriction or instrument. An ideal instrument must satisfy two key conditions: it must be strongly correlated with the endogenous variable (an assumption that can be empirically tested) and it must be correlated with the outcome variable only through the endogenous variable (an assumption that cannot be tested and thus requires a careful discussion). We propose to use the OIC music education program as our instrument. Specifically, using the OIC as an instrument addresses the self-selection issue, provided that the OIC school is comparable to the other schools in the municipality. Additionally, as a music education program, the OIC is expected to be highly correlated with music proficiency. Our empirical strategy departs from a traditional Difference-in-Differences (DID) approach, as our objective is not to estimate the direct causal effect of the program itself. It is more realistic to conceive that the program's impact operates through a two-step mechanism: it serves as an initial exposure that increases the likelihood of an individual engaging in sustained musical activities during adolescence. It is this sustained, endogenous engagement with music, rather than the initial program exposure, that we

Table 2: Schools statistics before implementing OIC

	OIC school	Other schools	Diff.
Middle school grade	8.439	8.547	-0.108
High school type	1.195	1.148	0.047
Final high school grade	79.049	79.5	-0.451
Standardized high school grade	-0.29	-0.24	-0.052
Enrolled or attained univ. degree	0.68	0.74	-0.054
Conscentiousness	0.19	0.08	0.111
Neuroticism	0.06	-0.06	0.12
Gender	0.49	0.52	-0.03
Mother education	1.02	0.80	0.221*
Father Education	1.10	0.77	0.330**
Number of Siblings	0.88	0.98	-0.103
Housing type when child	2.10	2.30	-0.197
Mother had a skilled job when child	0.22	0.12	0.097
Father had a skilled job when child	0.44	0.28	0.158
Foreign born parent	0.15	0.18	-0.029
Parent plays an instrument	0.27	0.19	0.075
Income class when child	4.13	3.90	0.226

Notes: The table reports the mean of selected outcomes and control variables for the OIC school and the other schools in the municipality and tests their statistical difference. The reperence period encompasses three years previous to the implementation of the OIC. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

hypothesize leads to long-term effects on socio-emotional skills. A DID framework, which would attribute any observed long-term changes directly to the program, would thus misrepresent the true mechanism of interest. Instead, our design is constructed to test for the long-term effects of this persistent musical engagement, using the program as a catalyst to create a population with a higher propensity for such involvement.

Table 2 provides descriptive statistics for key school indicators in the OIC school compared to other schools in the municipality. The data cover the three years prior to the implementation of the OIC program, and we test whether any differences are statistically significant. The characteristics examined include: school outcomes of the respective pupils; selected personality traits that may be relevant to both school outcomes and musical propensity; and the control variables included in the analysis, which are mostly related to parents and family characteristics.

The last column of Table 2 reveals that average academic achievements are highly similar between the two groups, though they are marginally lower for the OIC school. In terms of family characteristics, the only statistically significant difference is the educational level of both parents,

Table 3: Musical practice endogeneity: music proficiency vs OIC statistics

	Music proficiency			Orchestra In Classe		
	Proficient	Not proficient	Diff.	Treated	Control	Diff.
Middle school grade	8.64	8.36	0.279*	8.37	8.50	-0.126
High school type	1.27	1.03	0.241**	1.13	1.12	0.007
Final high school grade	84.95	80.56	4.388***	81.96	82.33	-0.365
Standardized high school grade	0.19	-0.12	0.314**	-0.02	0.01	-0.03
Enrolled or attained univ. degree	0.85	0.67	0.185***	0.80	0.71	0.087
Conscentiousness	0.28	-0.18	0.457***	-0.18	0.06	-0.249
Neuroticism	0.00	0.00	-0.003	0.09	-0.03	0.117
Gender	0.58	0.52	0.062	0.53	0.55	-0.018
Mother education	1.20	0.93	0.263***	1.26	0.96	0.297***
Father Education	1.07	0.83	0.249***	1.00	0.89	0.11
Number of Siblings	1.11	0.96	0.151	1.07	1.00	0.074
Housing type when child	2.35	2.08	0.278**	2.27	2.16	0.102
Mother had a skilled job when child	0.24	0.09	0.149***	0.15	0.14	0.008
Father had a skilled job when child	0.44	0.22	0.225***	0.31	0.30	0.01
Foreign born parent	0.14	0.11	0.029	0.09	0.13	-0.035
Parent plays an instrument	0.28	0.14	0.149***	0.20	0.19	0.014
Income class when child	4.04	3.90	0.135	4.05	3.93	0.113

Notes: The table reports the mean of selected outcomes and control variables for the for music proficient vs non proficient respondents, in the left panel, and OIC vs non-OIC respondents in the right panel. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

which is higher in the OIC school. This is a particularly relevant family characteristic, as it is likely to influence both child development and music proficiency. Consequently, we are compelled to control for parental education in all regression analyses.

The OIC program's validity as an exogenous source of variation allows us to provide descriptive evidence on the magnitude of the bias stemming from self-selection and reverse causality. Table 3 presents descriptive statistics for the same variables examined in Table 2. However, it contrasts two separate comparisons: one between music-proficient and non-proficient respondents, and another between OIC and non-OIC students. The results from the first comparison are clear: music-proficient students achieve significantly better academic results, and their parents have a significantly higher socioeconomic status. In stark contrast, the comparison between OIC and non-OIC students reveals only one statistically significant difference: the mother's education.

We conduct IV regressions using both the control function approach (Wooldridge, 2015) and a Generalized Method of Moments (GMM) estimator (Wooldridge, 2010). The control function approach offers more robustness to model mispecification and flexibility advantages over the traditional two-stage least squares (2SLS) method. The GMM estimator, while also relying on weaker assumptions on the error structure, can also provide efficiency gains in presence of heteroskedasticity. For all models, we cluster the standard errors at the school and year level, resulting in 47

clusters, a sufficient number to avoid downwards bias in the standard error estimates.

Crucially, the estimated coefficients from the instrumental variable (IV) strategy must be interpreted as a Local Average Treatment Effect (LATE). Since not all children who participated in the OIC program necessarily improved their musical skills, the IV coefficient captures the impact of music proficiency only for the 'compliers'—that is, the subset of individuals who were induced to become more proficient by their program participation.

To investigate which specific subdomains of Emotional Intelligence and Mental Health are most affected by music training, we employ an instrumental variable (IV) Seemingly Unrelated Regression (SUR) model via a control function approach. This method provides the flexibility to estimate the effect of music proficiency across multiple outcome variables simultaneously. Specifically, we detail the impact of music proficiency on every subdomain of the TEIQue-FF and DASS scales by including the predicted error term from the first-stage regression—where music proficiency is regressed against participation in the OIC program and a full set of controls—among the regressors of the second-stage SUR model. This approach is particularly useful in this case as it allows for arbitrary cross-equation error term correlation while still applying an IV estimator, enabling us to infer the differential impacts that music proficiency may have on various aspects of emotional intelligence and mental health.

Finally, the control function approach also provides the flexibility to conduct a heterogeneity analysis. We will perform this by interacting our music proficiency variable and the first-stage predicted error term with key demographic characteristics, namely gender and parental immigrant status. This will allow us to assess whether the impact of music proficiency on emotional intelligence and mental health is moderated by these individual attributes and whether similar music education programs could also be effective tools to reduce educational inequalities.

5 Results

The first column of Table 4 reports the first-stage regression results, which examine the impact of our instrumental variable—an indicator for enrollment in an OIC class—on our measure of music proficiency, music rank. The regression also includes the full set of second-stage covariates. The instrumental variable is a strong predictor of music proficiency, with a highly significant positive coefficient and a first-stage F-statistic of 61.3. This strong first stage relationship mitigates

Table 4: IV regressions: impact of music rank on emotional intelligence

Emotional Intelligence	First stage		OLS		C.F.		GMM	
Music rank			0.016	(0.022)	0.146***	(0.041)	0.142***	(0.048)
Female	0.674	(0.496)	0.176	(0.150)	0.124	(0.133)	0.140	(0.148)
Mother education:								
- Medium	0.028	(0.603)	0.157	(0.193)	0.050	(0.186)	0.023	(0.198)
- High	1.418	(0.872)	0.065	(0.215)	-0.247	(0.252)	-0.263	(0.287)
Father's education:								
- Medium	0.782	(0.626)	0.175	(0.193)	0.120	(0.201)	0.131	(0.202)
- High	0.557	(1.128)	-0.022	(0.303)	-0.098	(0.272)	-0.055	(0.354)
Number of siblings:								
- One	-0.330	(0.518)	-0.078	(0.197)	-0.055	(0.200)	-0.067	(0.215)
- Two or more	0.458	(0.769)	-0.208	(0.253)	-0.330	(0.242)	-0.354	(0.275)
Housing type when child:								
- Multifamily house	1.074	(0.751)	-0.253	(0.161)	-0.342**	(0.161)	-0.320*	(0.186)
- Single-family house	0.911	(0.577)	-0.161	(0.199)	-0.294	(0.186)	-0.289	(0.199)
Mother had skilled job	0.821	(0.916)	0.125	(0.244)	0.087	(0.239)	0.084	(0.280)
Father had skilled job	0.900	(0.735)	0.072	(0.164)	-0.035	(0.164)	-0.015	(0.202)
Immigrant parents	0.701	(0.818)	0.370	(0.222)	0.339	(0.218)	0.319	(0.210)
Family income when child:								
1250 - 2000	-2.082	(1.274)	0.279	(0.491)	0.522	(0.504)	0.551	(0.481)
2000 - 3000	-1.107	(1.063)	0.469	(0.486)	0.601	(0.506)	0.616	(0.451)
3000 - 5000	-1.006	(0.907)	0.441	(0.491)	0.521	(0.490)	0.542	(0.447)
$>$ 5000	-1.291	(1.435)	0.523	(0.659)	0.743	(0.647)	0.730	(0.601)
Constant	2.417*	(1.435)	-0.573	(0.469)	-0.943*	(0.514)	-0.933*	(0.491)
Participated to OIC	3.537***	(0.452)						
First stage residuals					-0.157***	(0.047)		
F-test: participated to OIC					61.3		63.2	
N. observations	187		180		180		180	

The first column table reports the restults of the first stage instrumental variable regressisons for the impact of music rank on emotional intelligence, where the exclusion restriction is having participated to the OIC program. The second column reports OLS results and the last two columns report IV results, both with the control function approach and GMM. Standard errrors in parentheses are clustered at school/year level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

concerns about weak instrument bias. Importantly, no other control variables in the first-stage regression are statistically significant.

The second column presents the OLS estimation, which finds no statistically significant relationship between music proficiency and emotional intelligence. The coefficient on music rank is near zero.

The final two columns report the IV estimates, obtained using both the control function approach and GMM. Both methods produce a highly significant and quantitatively similar coefficient for music rank.[4] A one-unit increase on the 10-point proficiency scale is associated with about

[4]The results presented for music rank are qualitatively identical to those obtained using the continuous music proficiency factor or the music proficiency dummy variable. However, these alternative specifications yield a lower first-stage F-statistic of around 10 (depending on the specification), as detailed in Tables A4 to A7 of the Appendix.

0.15 standard deviations increase in emotional intelligence. The significant coefficient on the first-stage residuals in the C.F. column confirms that music rank is an endogenous variable. Standard errors are clustered at the school and birth-year level (47 clusters), a sufficient number to ensure consistent estimation of standard errors. So the degree of involvement in music during adolescence has an impact on young adult emotional intelligence, in line with what has previously suggested in the psychological literature (Gómez-Zapata et al., 2021; Schellenberg and Lima, 2024).

The results for the poor mental health factor, reported in Table 5, are consistent with those for emotional intelligence. By construction, the first-stage regression for the C.F. approach is identical to that in Table 4, but the GMM estimator still produces a very high F statistic and a very similar second stage coefficient and standard error. The IV estimates for music rank are again highly significant, though with a negative sign. This implies that a one-step increase in music proficiency is associated with a 0.11 standard deviation reduction in the poor mental health factor. The significant coefficient on the first-stage residuals in the C.F. column confirms the endogeneity of the music rank variable, as was the case for the previous outcome. These findings corroborate the results of a bulk of correlation studies in psychological literature (Schellenberg and Lima, 2024), providing further insights on the causal link.

We extend our analysis by examining the effect of music proficiency on the specific subdomains of emotional intelligence and mental health. The questionnaire's detailed scales allow us to perform this more granular investigation. Table 6 presents the results from an instrumental variable Seemingly Unrelated Regressions (IV-SUR) model. This model estimates a system of equations, with each subdomain serving as the dependent variable for a separate equation. The specification for each equation is identical to our previous regressions, including the full set of control variables and the predicted first-stage residuals to account for the endogeneity of music rank.

The detailed analysis by subdomain reveals several interesting patterns. Music proficiency has a significant positive impact on a range of traits, with the largest effects observed on self-motivation, optimism, happiness, adaptability, assertiveness, impulsiveness, and the quality of relationships. A significant, albeit slightly smaller, positive impact is also found for emotional awareness and emotion regulation. The significant effect on self-motivation can be explained by the demanding and often solitary nature of music practice. The process of breaking down a

Table 5: IV regressions: impact of music rank on poor mental health

Poor mental health	First stage		OLS		C.F.		GMM	
Music rank			-0.000	(0.021)	-0.113***	(0.031)	-0.116***	(0.040)
Female	0.674	(0.496)	0.129	(0.169)	0.170	(0.156)	0.185	(0.156)
Mother education:								
- Medium	0.028	(0.603)	-0.054	(0.198)	0.043	(0.210)	0.038	(0.193)
- High	1.418	(0.872)	0.067	(0.232)	0.333	(0.270)	0.331	(0.303)
Father's education:								
- Medium	0.782	(0.626)	0.170	(0.197)	0.212	(0.206)	0.223	(0.202)
- High	0.557	(1.128)	0.409	(0.320)	0.470	(0.305)	0.478	(0.364)
Number of siblings:								
- One	-0.330	(0.518)	-0.052	(0.190)	-0.068	(0.199)	-0.068	(0.204)
- Two or more	0.458	(0.769)	-0.065	(0.228)	0.050	(0.237)	0.055	(0.232)
Housing type when child:								
- Multifamily house	1.074	(0.751)	0.496***	(0.175)	0.565***	(0.179)	0.561***	(0.204)
- Single-family house	0.911	(0.577)	0.261	(0.180)	0.371**	(0.183)	0.359*	(0.194)
Mother had skilled job	0.821	(0.916)	-0.009	(0.252)	0.034	(0.248)	0.028	(0.285)
Father had skilled job	0.900	(0.735)	0.043	(0.162)	0.126	(0.147)	0.121	(0.195)
Immigrant parents	0.701	(0.818)	-0.209	(0.260)	-0.175	(0.253)	-0.171	(0.258)
Family income when child:								
1250 - 2000	-2.082	(1.274)	-0.081	(0.484)	-0.301	(0.498)	-0.309	(0.443)
2000 - 3000	-1.107	(1.063)	-0.347	(0.472)	-0.470	(0.496)	-0.480	(0.436)
3000 - 5000	-1.006	(0.907)	-0.346	(0.437)	-0.426	(0.456)	-0.416	(0.400)
> 5000	-1.291	(1.435)	-0.319	(0.567)	-0.507	(0.544)	-0.499	(0.506)
Constant	2.417*	(1.435)	-0.195	(0.449)	0.131	(0.487)	0.139	(0.439)
Participated to OIC	3.537***	(0.452)						
First stage residuals					0.133***	(0.046)		
F-test: participated to OIC					61.3		52.9	
N. observations	187		184		184		184	

The first column table reports the restults of the first stage instrumental variable regressisons for the impact of music rank on mental health, where the exclusion restriction is having participated to the OIC program. The second column reports OLS results and the last two columns report IV results, both with the control function approach and GMM. Standard errrors in parentheses are clustered at school/year level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

complex musical piece into manageable parts and dedicating hours of practice to master it instills a powerful sense of goal-setting, delayed gratification, and the understanding that consistent effort yields a tangible, rewarding outcome. Music training likely fosters optimism and happiness through the social and expressive dimensions of performance. The sense of accomplishment that follows a successful performance, coupled with the positive social feedback from audiences or fellow musicians, provides a reliable source of reward and self-efficacy. The largest effects on relational traits—such as adaptability, assertiveness, and relationship quality—can be attributed to the unique social dynamics of ensemble performance. In an orchestra or band, individuals must continuously adjust their tempo, volume, and phrasing in real-time to create a cohesive sound. This process trains individuals in the behavioral skills of active listening, cooperative

Table 6: IV regressions: Impact of music rank on sub-domain of emotional intelligence and poor mental health

Outcome	Music rank	
EI: Emotion Perception	-0.012	(0.049)
EI: Empathy	0.031	(0.048)
EI: Emotion Expression	-0.064	(0.054)
EI: Relationships	0.122***	(0.037)
EI: Emotion Regulation	0.083*	(0.047)
EI: Stress Management	0.055	(0.035)
EI: Impulsiveness (low)	0.158***	(0.055)
EI: Adaptability	0.178***	(0.049)
EI: Self-motivation	0.227***	(0.060)
EI: Assertiveness	0.176***	(0.054)
EI: Emotion Management	-0.002	(0.050)
EI: Emotion Awareness	0.089**	(0.041)
EI: Self-esteem	0.081	(0.071)
EI: Trait Happiness	0.193***	(0.051)
EI: Trait Optimism	0.227***	(0.057)
DASS: Depression	-0.116***	(0.034)
DASS: Anxiety	-0.106**	(0.048)
DASS: Stress	-0.079**	(0.037)

IV regression of music rank estimated using the control function approach in a SUR regression. The number of observations in all equations is 178. Standard errrors in parentheses are clustered at school/year level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

adjustment, and the delicate balance of being assertive with one's own part while simultaneously adapting to the collective. This experience directly translates to improved social fluency and the ability to navigate complex group dynamics outside of music. Finally, the positive impact on emotional awareness and regulation can be understood as a consequence of using music as a tool for expressive communication. Musicians are trained to not only feel emotions but to purposefully convey them through their performance. This process of identifying, translating, and regulating emotional content in a musical context likely enhances an individual's general capacity for both understanding and managing their own emotional states.

Music proficiency also significantly reduces all three factors related to poor mental health: depression, anxiety, and stress, with the largest effects seen on the first two. These results suggest a causal mechanism rooted in the neuro-behavioral pathways of reward and cognitive control. The demanding practice inherent in music proficiency provides a consistent source of self-generated

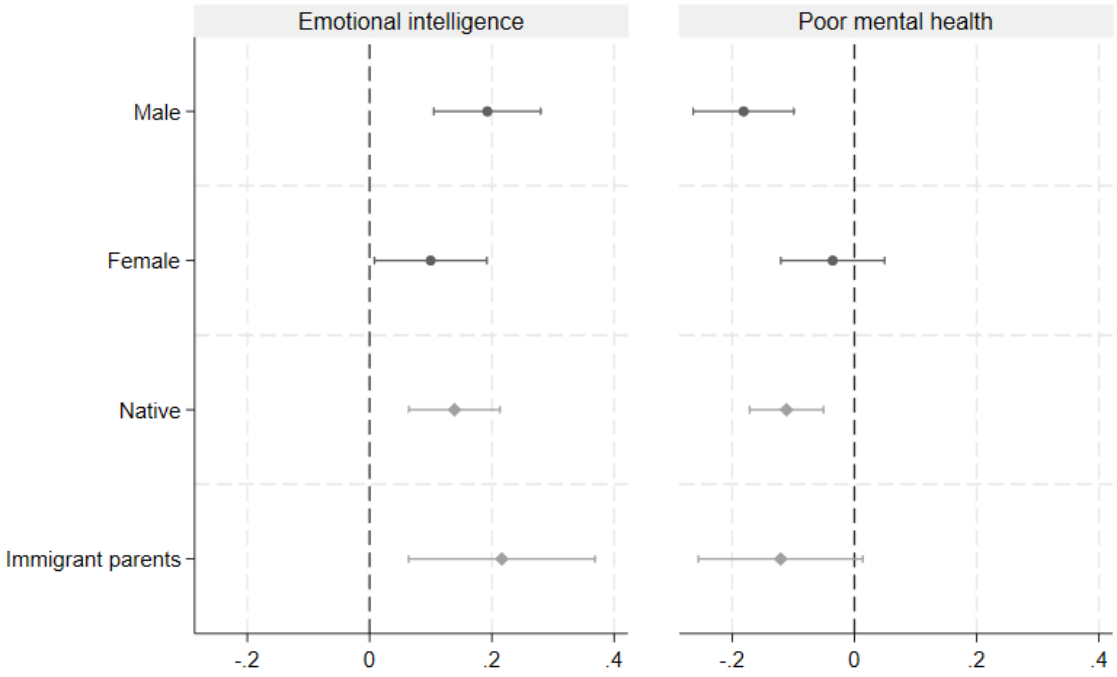


Figure 5: Differential impact of music rank by gender and parental immigrant status

rewards, which counteracts the motivational deficits of depression. Simultaneously, the focused attention required for making music acts as a powerful behavioral intervention, displacing the negative thought patterns of anxiety and stress. In contrast, coefficients for emotion perception, expression and management, self-esteem, empathy, and stress management are not statistically significant.

These findings likely exhibit heterogeneity by gender and migration status, driven by differences in social norms and adaptive needs. Extensive literature on mental health shows that men often face greater social stigma regarding emotional expression, which may lead them to leverage the non-verbal and self-regulatory channels of music to a greater extent than women to mitigate anxiety and depression. Conversely, the social and collaborative benefits of music may be a more potent tool for migrants, who face unique challenges in forming social networks and bridging social capital in a new country. For these reasons we present in Figure 5 results of a heterogeneity analysis by gender and immigrant status. While subgroup coefficients are not significantly different, point estimates suggest that the positive effects on both emotional intelligence and mental health appear larger for males. Similarly, the point estimates for migrants are also larger. These patterns, while not statistically distinct in our sample, are consistent with the hypothesis that

Table 7: IV regressions: Impact of music rank on sub-domains by gender and immigrant status

Music rank	Male		Female		Native		Immigrant	
EI: Emotion Perception	0.054	(0.052)	-0.065	(0.069)	-0.024	(0.056)	0.117	(0.091)
EI: Empathy	0.073	(0.066)	0.000	(0.087)	0.020	(0.050)	0.068	(0.150)
EI: Emotion Expression	-0.052	(0.074)	-0.052	(0.061)	-0.085	(0.061)	0.165	(0.121)
EI: Relationships	0.180***	(0.056)	0.052	(0.047)	0.108***	(0.040)	0.220**	(0.106)
EI: Emotion Regulation	0.080	(0.065)	0.089	(0.084)	0.073	(0.049)	0.194**	(0.081)
EI: Stress Management	0.173***	(0.056)	-0.054	(0.080)	0.062*	(0.035)	0.001	(0.133)
EI: Impulsiveness (low)	0.205***	(0.069)	0.140	(0.092)	0.169***	(0.057)	0.078	(0.135)
EI: Adaptability	0.207***	(0.066)	0.139**	(0.063)	0.178***	(0.048)	0.226*	(0.136)
EI: Self-motivation	0.324***	(0.080)	0.105*	(0.060)	0.206***	(0.063)	0.331**	(0.131)
EI: Assertiveness	0.185***	(0.064)	0.191**	(0.077)	0.183***	(0.061)	0.202	(0.154)
EI: Emotion Management	-0.055	(0.057)	0.049	(0.051)	-0.018	(0.052)	0.020	(0.093)
EI: Emotion Awareness	0.055	(0.052)	0.180***	(0.062)	0.101**	(0.049)	0.081	(0.106)
EI: Self-esteem	0.100	(0.100)	0.046	(0.066)	0.071	(0.077)	0.149	(0.124)
EI: Trait Happiness	0.249***	(0.062)	0.139**	(0.068)	0.187***	(0.056)	0.274**	(0.125)
EI: Trait Optimism	0.264***	(0.080)	0.196***	(0.071)	0.227***	(0.061)	0.264*	(0.144)
DASS: Depression	-0.176***	(0.045)	-0.055	(0.051)	-0.110***	(0.041)	-0.158**	(0.068)
DASS: Anxiety	-0.166**	(0.073)	-0.033	(0.051)	-0.106**	(0.051)	-0.118	(0.100)
DASS: Stress	-0.141***	(0.043)	-0.012	(0.057)	-0.084**	(0.038)	-0.028	(0.091)

IV regression of music rank estimated using the control function approach in a SUR regression interacting the music rank variable and the predicted residuals with gender and immigrant status. The number of observations in all equations is 178. Standard errrors in parentheses are clustered at school/year level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

the behavioral mechanisms of music proficiency may be particularly salient for individuals who face greater social and emotional barriers to well-being, such as men and migrants. These results motivate a deeper look into the heterogeneity of the impact.

Table 7 analyzes the differential of music proficiency across the subdomains of emotional intelligence and mental health. Results show that, for males, the effects are statistically significant across a wide range of subdomains, including relationships, stress management, low impulsiveness, adaptability, self-motivation, assertiveness, happiness, optimism, depression, anxiety, and stress. This broad impact suggests that music may address a diverse set of socio-emotional needs and challenges often associated with male development, particularly in areas like emotional regulation and social expression, which might be less supported through other channels. In contrast, females show statistically significant impacts on a more focused set of subdomains: adaptability, self-motivation, assertiveness, emotion awareness, happiness, and optimism. This finding could imply that while music is beneficial for both genders, it may reinforce existing strengths in females, such as emotion awareness, rather than addressing as wide a range of developmental challenges as it does for males.

Table 7 also shows estimated coefficients for subsamples of natives and migrants. Coefficients

are significant for a larger set of traits among natives, while the magnitude of the coefficient is consistently larger for migrants on the traits where both subsamples show a statistically significant impact. Specifically, for migrants, the effects are particularly strong and significant for relationships, emotion regulation, adaptability, self-motivation, happiness, optimism, and depression. This outsized impact on these subdomains strongly suggests that music serves as a particularly valuable tool for social and emotional integration for migrants, providing a non-verbal and social outlet to navigate the unique barriers they face. In contrast, the significant effects for natives cover a broader range of traits, including low impulsiveness, emotional awareness, anxiety, and stress, suggesting that music may provide a more comprehensive but less intense benefit for the native population.

6 Concluding remarks

Our study contributes to the literature on human capital formation and the economic returns to extracurricular activities. We propose that music training is not merely a leisure activity but a form of human capital investment that develops a specific set of non-cognitive skills.

The analysis provides novel causal evidence on the far-reaching impact of music proficiency on emotional intelligence and mental health. Leveraging a quasi-experimental design, our findings move beyond the extensive correlational literature to establish a causal link, demonstrating that music training is a powerful and multi-faceted form of human capital development. thus shedding new light on the pathways through which early-life investments translate into adult well-being and economic outcomes.

We find that music proficiency has a significant positive causal effect on a range of emotional intelligence subdomains, with the largest effects observed on self-motivation, optimism, and the quality of relationships. The detailed analysis reveals a behavioral mechanism rooted in the disciplined and social nature of music practice. For instance, the routine of goal-oriented practice instills self-motivation and delayed gratification, while ensemble performance cultivates adaptability and cooperative social skills. In parallel, our findings provide the first causal evidence that music proficiency significantly reduces the primary symptoms of poor mental health—depression, anxiety, and stress. The behavioral pathway for these effects could be the use of music as a tool for active self-regulation, as the focused attention required to make music displaces anxious ru-

mination and provides a consistent source of self-generated reward. This is further supported by the non-significant effects on traits like empathy and emotion perception, suggesting the benefits are focused on internal, rather than external, emotional processes.

Our findings reveal a nuanced pattern of heterogeneity in the effects of musical proficiency. We find a broader impact on socio-emotional skills for males, affecting a wide range of traits including stress management and impulsiveness, while the impact on females is more focused on strengths like adaptability and self-motivation. Furthermore, the effects are larger in magnitude for migrants, particularly on skills critical for integration such as relationships and emotion regulation. In contrast, the impact for natives covers a broader range of traits, including low impulsiveness and emotional awareness. This detailed heterogeneity underscores that musical exposure has a distinct, lasting impact tailored to specific demographic challenges and strengths.

The findings from this study have significant policy implications, particularly in an era of increasing demand for non-cognitive skills in the labor market. Particularly for the design of educational curricula and mental health interventions. They suggest that investments in music education may yield substantial external benefits that extend far beyond artistic appreciation, fostering a suite of non-cognitive skills and a resilient mental state that are vital for economic success and overall well-being. By demonstrating a causal link between early-life musical training and the development of emotional intelligence and mental health, our results suggest that integrating arts education into primary school curricula can be a cost-effective public investment.

Traditional human capital policies have often focused on cognitive skills, but our evidence indicates that investments in non-cognitive skill development through programs like universal school orchestras can yield substantial long-term benefits. Such initiatives, by fostering traits like self-motivation, adaptability, and relational abilities, could better prepare young people for the demands of a dynamic and competitive workforce. These programs also offer a potential pathway to improving mental health outcomes, which in turn can lead to higher productivity and overall life satisfaction. By fostering a more resilient emotional and physiological state, music training may equip young adults with a crucial coping mechanism that enhances their capacity to withstand the stress and challenges inherent in the transition to adulthood and the labor market. Specifically, the broad impact on males suggests that music programs should be utilized to address a wide range of developmental challenges in emotional regulation and social

skills. Given the larger and more pronounced effects on migrants, music should be leveraged as a key component of integration policies, providing a non-verbal channel for social bonding and psychological well-being. Such targeted programming, while ensuring universal access to music education, could maximize its positive effects on non-cognitive skill development and mitigate skills inequality among at-risk groups. Therefore, our findings provide a compelling economic rationale for policymakers to support and expand publicly funded, universal music education.

While this study offers novel causal evidence on the far-reaching impact of music proficiency, it is not without limitations. The quasi-experimental design, while robust, relies on a specific set of identifying assumptions that may not hold in all contexts. A key limitation is the small sample size, which, although sufficient for our causal analysis, may not be broadly representative of the general population. This potentially restricts the external validity of our findings, particularly when considering the diverse cultural and socioeconomic contexts in which music education is implemented. For instance, the specific mechanisms we have identified, such as the social dynamics of ensemble performance or the role of music as a tool for self-regulation, may manifest differently in other populations.

Future research should therefore aim to replicate these findings in larger, more diverse samples to validate their generalizability. It is also important to further analyze the complex causal pathways by which music training shapes human capital, focusing on the link between musical practice, academic achievement (including both cognitive skills and grades), educational inequalities, and its long-run impact on key life-cycle decisions such as educational track choice and university enrollment.

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Appendix: Additional tables

Table A1 - Potential mechanisms for the impacts of music training

Outcome	Mechanisms
Cognitive skills	
· Increase in cognitive abilities	Influence on subdomains of cognitive functioning and executive functioning (Schellenberg, 2004)
	Training in music-listening skills transfers to verbal ability and executive-function task related to behavioural measures of intelligence (Moreno et al., 2011)
	Music training has a rapid effect on cognition and brain structure (Moreno et al., 2011)
	Music training transfers to and influences higher cognitive processing (Moreno et al., 2011)
· Problem-solving	Music increase the ability to internalise and externalise problems (Jürges and Khanam, 2021)
	Music pieces' complexity, interpretation and analysis enhances problem-solving and judgment (Yang, 2015)
· Rational thinking	Music helps overcome cognitive dissonance and improved sparial-temporal reasoning (Cabane et al., 2016)
	Better time allocation for reasources that affect IQ (Hille and Schupp, 2015)
Non-cognitive skills	
· Ambition	Ability to judge own capacity and potentials (Hille and Schupp, 2015)
Personality traits	
· Extraversion	Earlier onset of music training predicts higher level of extraversion (Schellenberg and Lima, 2024)
· Conscientiousness	Learning music requires discipline (Hille and Schupp, 2015)
· Openness	Contact with different styles of music (Hille and Schupp, 2015)
Emotional intelligence	
· Emotionality	Music impacts neural areas implicated in emotion processing (Moore, 2013)
· Self-control	Music has been found to be an effective self-regulating tool for emotions (Moore, 2013)
	Educational music intervention can facilitate the increase of emotional regulation skills (Nwokenna et al., 2022)
· Self-esteem	Positive concept of oneself (Hille and Schupp, 2015)
	Children and teenagers that take part in music courses are less prone to low self-esteem (Gómez-Zapata et al., 2021)
· Mastery	Ability to self-evaluate, positive concept of oneself (Hille and Schupp, 2015)
Mental health	
· Stress management	Music practice reduces physical and mental stress symptoms (Taets et al., 2021)
· Depression	Participation in music group increases social interaction and integration decreasing loneliness and depression-like symptoms across age groups (Schellenberg and Lima, 2024)
Educational outcomes	
· Better grades	Linked to improved cognitive skills (Hille and Schupp, 2015; Guhn et al., 2020)
	Students who receive music treatments outperform other groups (Schellenberg, 2004)
	Music is directly related to particular school subjects and improves school-relevant skills (e.g. concentration, patience, memorisation, and commitment) (Yang, 2015)
· Higher STEM enrolment	Musical activity is related to math (Yang, 2015)
	Taking music courses correlated with achievements in mathematics and science (Guhn et al., 2020)

Table A2 - Descriptive statistics of music practice variables

Musical practice variables	Mean	Std. Dev.	Min	Max
Able to play a musical instrument	0.393	0.490	0	1
Number of instruments played				
None	0.610	0.489	0	1
One instrument	0.219	0.415	0	1
Two instruments	0.100	0.301	0	1
Three or more	0.071	0.258	0	1
Years of musical practice (overall)	5.865	6.700	0	22
Maximum musical proficiency level for an instument				
None	0.635	0.482	0	1
Novice	0.072	0.259	0	1
Average	0.158	0.365	0	1
Expert	0.108	0.311	0	1
Professional	0.027	0.163	0	1
Weekly hours of musical practice	2.109	5.689	0	45
Years at muscal institute classes	1.784	3.317	0	15
Played in an orchesra, endambe, band, etc.	0.320	0.467	0	1
Play Keyboards (piano and similar)	0.185	0.389	0	1
Play strings (guitar, bass guitar, etc)	0.090	0.287	0	1
Play winds (clarinet, flute, oboe, etc)	0.161	0.369	0	1
Play archs (violin, cello, viola, bass, etc)	0.081	0.273	0	1
Play brass (tromba, sax, trombone, etc)	0.052	0.223	0	1
Participated to the Orchestra in Classe	0.248	0.433	0	1

Table A3 - Descriptive statistics of other covariates

Control variables	Mean	Std. Dev.	Min	Max
Gender	0.541	0.499	0	1
Mother education				
Low	0.220	0.415	0	1
Secondary	0.528	0.500	0	1
Tertiary	0.252	0.435	0	1
Father Education				
Low	0.266	0.443	0	1
Secondary	0.550	0.499	0	1
Tertiary	0.183	0.388	0	1
Number of Siblings				
None	0.201	0.402	0	1
One	0.579	0.495	0	1
Two or more	0.220	0.415	0	1
Housing type when child				
Apartment	0.260	0.440	0	1
Multifami..	0.291	0.455	0	1
Single-fa..	0.449	0.499	0	1
Mother had a skilled job when child	0.140	0.347	0	1
Father had a skilled job when child	0.302	0.460	0	1
Foreign born parent	0.117	0.322	0	1
Parent plays an instrument	0.189	0.393	0	1
Income class when child				
750-1249	0.058	0.234	0	1
1250-1999	0.262	0.441	0	1
2000-2999	0.398	0.491	0	1
3000-4999	0.230	0.422	0	1
5000+	0.052	0.223	0	1

Table A4 - IV regressions: impact of music proficiency dummy on emotional intelligence

Emotional Intelligence	First stage		OLS		C.F.		GMM	
Music proficiency (dummy)			-0.034	(0.192)	1.943***	(0.517)	1.935**	(0.964)
Female	0.106	(0.065)	0.183	(0.151)	0.013	(0.129)	0.060	(0.161)
Mother education:								
- Medium	-0.079	(0.068)	0.171	(0.200)	0.207	(0.187)	0.168	(0.234)
- High	0.055	(0.102)	0.109	(0.210)	-0.148	(0.235)	-0.169	(0.315)
Father's education:								
- Medium	0.181**	(0.081)	0.195	(0.195)	-0.118	(0.208)	-0.057	(0.264)
- High	0.110	(0.166)	-0.008	(0.293)	-0.234	(0.260)	-0.114	(0.504)
Number of siblings:								
- One	-0.025	(0.066)	-0.083	(0.195)	-0.055	(0.200)	-0.074	(0.241)
- Two or more	0.058	(0.108)	-0.186	(0.253)	-0.373	(0.238)	-0.439	(0.382)
Housing type when child:								
- Multifamily house	0.266***	(0.091)	-0.236	(0.175)	-0.699***	(0.190)	-0.716**	(0.303)
- Single-family house	0.195**	(0.083)	-0.144	(0.205)	-0.540***	(0.200)	-0.562*	(0.294)
Mother had skilled job	0.133	(0.097)	0.137	(0.244)	-0.047	(0.234)	-0.080	(0.342)
Father had skilled job	0.168*	(0.088)	0.091	(0.161)	-0.228	(0.181)	-0.214	(0.290)
Immigrant parents	0.113	(0.099)	0.382*	(0.226)	0.222	(0.216)	0.208	(0.262)
Family income when child:								
1250 - 2000	-0.420**	(0.163)	0.228	(0.499)	1.033*	(0.524)	1.061	(0.686)
2000 - 3000	-0.246*	(0.142)	0.437	(0.490)	0.917*	(0.503)	0.918*	(0.532)
3000 - 5000	-0.279**	(0.118)	0.417	(0.499)	0.915*	(0.485)	0.943**	(0.472)
$>$ 5000	-0.360	(0.224)	0.481	(0.659)	1.253*	(0.626)	1.237	(0.811)
Constant	0.229	(0.179)	-0.521	(0.462)	-1.032*	(0.524)	-1.051*	(0.574)
Participated to OIC	0.267***	(0.086)						
First stage residuals					-2.102***	(0.551)		
F-test: participated to OIC					9.9		9.8	
N. observations	187		180		180		180	

The first column table reports the restults of the first stage instrumental variable regressisons for the impact of music proficiency dummy on emotional intelligence, where the exclusion restriction is having participated to the OIC program. The second column reports OLS results and the last two columns report IV results, both with the control function approach and GMM. Standard errrors in parentheses are clustered at school/year level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A5 - IV regressions: impact of music proficiency continuous factor on emotional intelligence

Emotional Intelligence	First stage		OLS		C.F.		GMM	
Music proficiency			0.056	(0.090)	0.776***	(0.218)	0.781**	(0.361)
Female	0.177	(0.121)	0.176	(0.150)	0.086	(0.131)	0.118	(0.144)
Mother education:								
- Medium	-0.277*	(0.160)	0.178	(0.206)	0.268	(0.195)	0.232	(0.235)
- High	0.103	(0.230)	0.087	(0.207)	-0.121	(0.232)	-0.161	(0.296)
Father's education:								
- Medium	0.411**	(0.176)	0.165	(0.201)	-0.085	(0.210)	-0.037	(0.246)
- High	0.080	(0.314)	-0.014	(0.304)	-0.077	(0.276)	0.027	(0.432)
Number of siblings:								
- One	-0.067	(0.155)	-0.078	(0.197)	-0.052	(0.202)	-0.060	(0.238)
- Two or more	0.090	(0.229)	-0.204	(0.257)	-0.335	(0.243)	-0.382	(0.345)
Housing type when child:								
- Multifamily house	0.443**	(0.204)	-0.266	(0.168)	-0.527***	(0.170)	-0.537**	(0.229)
- Single-family house	0.290	(0.199)	-0.163	(0.207)	-0.385*	(0.192)	-0.399	(0.266)
Mother had skilled job	0.431*	(0.221)	0.110	(0.255)	-0.128	(0.241)	-0.151	(0.342)
Father had skilled job	0.406**	(0.176)	0.062	(0.167)	-0.217	(0.185)	-0.204	(0.261)
Immigrant parents	0.377	(0.254)	0.359	(0.227)	0.147	(0.217)	0.136	(0.266)
Family income when child:								
1250 - 2000	-0.596*	(0.319)	0.278	(0.490)	0.683	(0.505)	0.713	(0.540)
2000 - 3000	-0.301	(0.281)	0.467	(0.483)	0.674	(0.501)	0.673	(0.442)
3000 - 5000	-0.307	(0.250)	0.442	(0.486)	0.614	(0.484)	0.620	(0.408)
$>$ 5000	-0.711*	(0.420)	0.539	(0.663)	1.106*	(0.632)	1.093	(0.692)
Constant	-0.442	(0.335)	-0.510	(0.456)	-0.246	(0.496)	-0.262	(0.459)
Participated to OIC	0.665***	(0.182)						
First stage residuals					-0.784***	(0.245)		
F-test: participated to OIC					13.3		13.2	
N. observations	187		180		180		180	

The first column table reports the restults of the first stage instrumental variable regressisons for the impact of music proficiency continuous factor on emotional intelligence, where the exclusion restriction is having participated to the OIC program. The second column reports OLS results and the last two columns report IV results, both with the control function approach and GMM. Standard errrors in parentheses are clustered at school/year level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A6 - IV regressions: impact of music proficiency dummy on mental health

Mental health	First stage		OLS		C.F.		GMM	
Music proficiency (dummy)			0.163	(0.181)	-1.542***	(0.397)	-1.622**	(0.816)
Female	0.106	(0.065)	0.128	(0.171)	0.272*	(0.156)	0.280*	(0.156)
Mother education:								
- Medium	-0.079	(0.068)	-0.028	(0.205)	-0.057	(0.201)	-0.055	(0.190)
- High	0.055	(0.102)	0.064	(0.227)	0.277	(0.259)	0.288	(0.324)
Father's education:								
- Medium	0.181**	(0.081)	0.113	(0.202)	0.378*	(0.194)	0.375*	(0.210)
- High	0.110	(0.166)	0.369	(0.310)	0.560*	(0.292)	0.561	(0.488)
Number of siblings:								
- One	-0.025	(0.066)	-0.040	(0.190)	-0.059	(0.203)	-0.061	(0.202)
- Two or more	0.058	(0.108)	-0.079	(0.227)	0.092	(0.236)	0.100	(0.297)
Housing type when child:								
- Multifamily house	0.266***	(0.091)	0.454***	(0.169)	0.849***	(0.202)	0.861***	(0.319)
- Single-family house	0.195**	(0.083)	0.246	(0.173)	0.582***	(0.191)	0.585**	(0.278)
Mother had skilled job	0.133	(0.097)	-0.039	(0.246)	0.129	(0.247)	0.164	(0.351)
Father had skilled job	0.168*	(0.088)	0.008	(0.156)	0.274*	(0.138)	0.264	(0.252)
Immigrant parents	0.113	(0.099)	-0.229	(0.262)	-0.085	(0.238)	-0.079	(0.286)
Family income when child:								
1250 - 2000	-0.420**	(0.163)	-0.015	(0.499)	-0.717	(0.506)	-0.753	(0.546)
2000 - 3000	-0.246*	(0.142)	-0.280	(0.477)	-0.702	(0.503)	-0.723	(0.523)
3000 - 5000	-0.279**	(0.118)	-0.296	(0.443)	-0.734	(0.465)	-0.744	(0.458)
$>$ 5000	-0.360	(0.224)	-0.245	(0.565)	-0.907*	(0.529)	-0.927	(0.660)
Constant	0.229	(0.179)	-0.254	(0.450)	0.196	(0.492)	0.235	(0.526)
Participated to OIC	0.267***	(0.086)						
First stage residuals					1.803***	(0.489)		
F-test: participated to OIC					9.9		8.3	
N. observations	187		184		184		184	

The first column table reports the restults of the first stage instrumental variable regressisons for the impact of music proficiency dummy on mental health, where the exclusion restriction is having participated to the OIC program. The second column reports OLS results and the last two columns report IV results, both with the control function approach and GMM. Standard errrors in parentheses are clustered at school/year level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A7 - IV regressions: impact of music proficiency continuous factor on mental health

Mental health	First stage		OLS		C.F.		GMM	
Music proficiency			0.039	(0.079)	-0.595***	(0.161)	-0.649**	(0.315)
Female	0.177	(0.121)	0.124	(0.172)	0.200	(0.157)	0.215	(0.148)
Mother education:								
- Medium	-0.277*	(0.160)	-0.049	(0.206)	-0.126	(0.199)	-0.136	(0.190)
- High	0.103	(0.230)	0.056	(0.228)	0.233	(0.253)	0.245	(0.329)
Father's education:								
- Medium	0.411**	(0.176)	0.158	(0.201)	0.373*	(0.195)	0.373*	(0.204)
- High	0.080	(0.314)	0.406	(0.317)	0.457	(0.302)	0.455	(0.417)
Number of siblings:								
- One	-0.067	(0.155)	-0.051	(0.189)	-0.069	(0.200)	-0.079	(0.213)
- Two or more	0.090	(0.229)	-0.073	(0.229)	0.052	(0.234)	0.062	(0.279)
Housing type when child:								
- Multifamily house	0.443**	(0.204)	0.482***	(0.172)	0.707***	(0.189)	0.722***	(0.259)
- Single-family house	0.290	(0.199)	0.250	(0.175)	0.441**	(0.182)	0.435*	(0.261)
Mother had skilled job	0.431*	(0.221)	-0.024	(0.254)	0.194	(0.256)	0.245	(0.362)
Father had skilled job	0.406**	(0.176)	0.030	(0.163)	0.269*	(0.143)	0.253	(0.218)
Immigrant parents	0.377	(0.254)	-0.221	(0.265)	-0.029	(0.228)	-0.011	(0.294)
Family income when child:								
1250 - 2000	-0.596*	(0.319)	-0.057	(0.490)	-0.421	(0.499)	-0.455	(0.455)
2000 - 3000	-0.301	(0.281)	-0.335	(0.476)	-0.524	(0.500)	-0.549	(0.440)
3000 - 5000	-0.307	(0.250)	-0.337	(0.440)	-0.495	(0.459)	-0.495	(0.404)
$>$ 5000	-0.711*	(0.420)	-0.289	(0.569)	-0.785	(0.533)	-0.807	(0.576)
Constant	-0.442	(0.335)	-0.184	(0.445)	-0.408	(0.456)	-0.399	(0.399)
Participated to OIC	0.665***	(0.182)						
First stage residuals					0.685***	(0.206)		
F-test: participated to OIC					13.3		10.2	
N. observations	187		184		184		184	

The first column table reports the restults of the first stage instrumental variable regressisons for the impact of music proficiency continuous factor on mental health, where the exclusion restriction is having participated to the OIC program. The second column reports OLS results and the last two columns report IV results, both with the control function approach and GMM. Standard errrors in parentheses are clustered at school/year level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$