

Extramural Sport and Music Activities: Impact on Elementary School Students' Grades in Math and in Science

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ABSTRACT

In this study, evidence-based information is provided about the impact of extramural music (EMA; number of hours/week spent in music extramurally), and extramural sport activities (ESA; number of hours/week spent in sports extramurally) on 1st to 5th graders' scholastic performance in Math and Science. This is done by estimating the impact of EMA and ESA: [1] on 6 assessment periods, and [2] on performance trajectories over 36 weeks (1 assessment period = 6 weeks). On a per assessment period analysis, linear regression analysis was employed; for the 36-week trend analysis, a multilevel model of change was performed. On a per assessment period analysis, the impact of mothers' education (with vs. without graduate degree), and number of hours spent in music had the greatest impact on math and science grades. In terms of performance trajectories, mothers' education showed the most impact on initial performance.

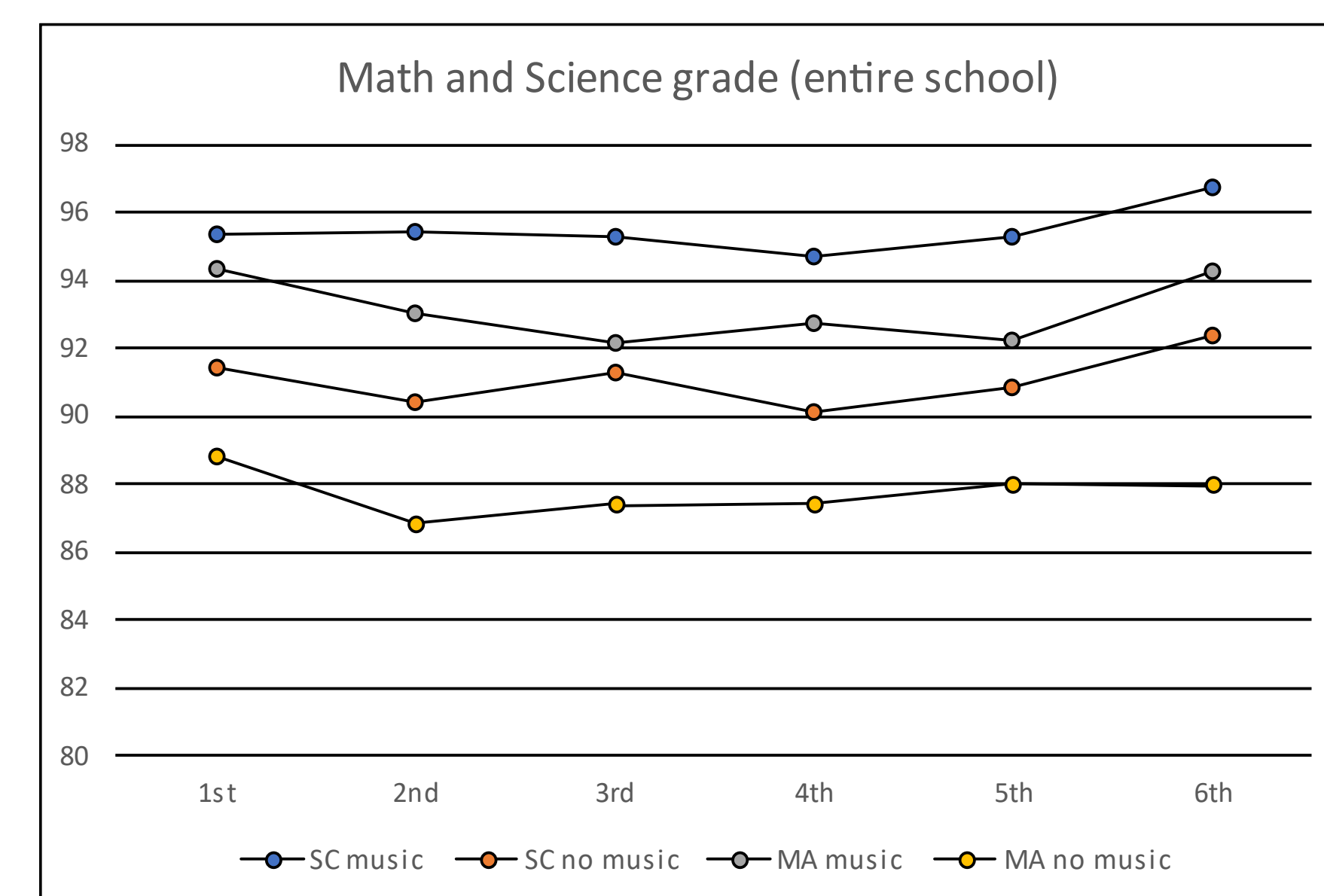
INTRODUCTION

Academic Context: Several studies have documented the enhancing effect of music (e.g., Abeles 2007; Kinney & Forsythe 2005) and sports (e.g., Castelli, Hillman, Buck & Erwin 2007; Grissom 2005) on scholastic performance across various contexts and populations. However, these studies are *limited to intramural* music and sport activities. To date, there are no studies that have researched the impact of EMA and ESA on scholastic performance and its trajectory. Addressing this knowledge gap informs the debate on whether EMA and ESA improve performance and if these activities should be supported, or even whether intramural and extramural activities reinforce each other in ways that have synergistic effects on performance and trajectory.

Social Relevance: This study informs parents about the benefit to their children of EMA. Most parents worry that EMA take study-time away from their children and that these activities have adverse effect on scholastic performance. Also, many children think that they cannot do both music and sports, and many are faced with the dilemma of picking one over the other. It is usually sports that is chosen. These are the reasons why this study was conducted. Ultimately, the broader impact of this study is to help parents and children make informed decisions based on scientific evidence.

Study Location and Respondents: This study was conducted at Col. Santos Elementary School, a school under Laredo, Texas' United Independent School District. The target population comprised students who were in grades 1-5 in 2018-19. Students took both intramural music and sports classes as school requirements. Extramural music and sport activities, however, were totally up to the students and their parents to decide on. Because socioeconomic status (SES) impacts parents' decision to support their children's extramural activities, this school was selected as students were from families that belonged to a homogeneous income bracket with incomes ranging from \$80K-\$120K/year for a family of three; thus, allowing the impact of SES to be statistically controlled. This school is located along the U.S.-Mexico border and is home to a population (Hispanics) grossly underrepresented in STEM education.

METHODS



- Regression analysis, and multilevel model of change with level-1 and level-2 predictors.
- Outcome variables were math and science grades.
- Level-1 predictor is the *assessment periods* (1,...,6).
- Level-2 predictors are grade level, mother has graduate degree, father has graduate degree, hours per week spent in sports, and hours per week spent in music.

Table 1: Descriptive Statistics.

Variable	Mean	SD	Variable	Mean	SD	Variable	Mean	SD
Age	8.35	1.49	Math P1	89.61	7.66	Science P 1	92.02	6.488
Gender	0.60	0.49	Math P2	87.79	8.88	Science P 2	91.17	6.312
Ma has grad degree	0.74	0.44	Math P3	88.13	8.08	Science P 3	91.91	6.231
Pa has grad degree	0.59	0.49	Math P4	88.19	7.55	Science P 4	90.37	7.282
Hours sports per week	6.06	5.39	Math P 5	88.36	7.85	Science P 5	91.42	6.702
Hours music per week	0.49	1.65	Math P 6	88.82	8.78	Science P 6	92.98	7.147

P denotes assessment periods which goes from P1 to P6.

Table 1A: Multiple Linear Regression Analysis for Math Grade (by Assessment Period).

Predictors	1st 6 weeks			2nd 6 weeks			3rd 6 weeks			4th 6 weeks			5th 6 weeks			6th 6 weeks		
	B	SE	p-value	B	SE	p-value	B	SE	p-value	B	SE	p-value	B	SE	p-value	B	SE	p-value
Intercept	80.04	8.29	0.000 ***	92.74	10.10	0.000 ***	87.08	9.43	0.000 ***	98.00	8.49	0.000 ***	90.10	8.98	0.000 ***	88.32	10.69	0.000 ***
Grade	-1.87	1.50	0.216	0.30	1.83	0.869	-0.43	1.71	0.802	0.38	1.55	0.809	-1.27	1.65	0.441	-0.59	1.96	0.764
Age	1.25	1.49	0.403	-1.36	1.81	0.455	-0.30	1.69	0.862	-1.74	1.53	0.259	-0.13	1.62	0.938	-0.02	1.94	0.993
Gender	0.27	1.44	0.854	1.43	1.75	0.417	2.57	1.64	0.120	0.72	1.47	0.625	0.07	1.56	0.965	0.70	1.85	0.705
Ma has grad degree	4.94	1.69	0.004 **	3.24	2.06	0.119	1.21	1.92	0.531	2.50	1.73	0.152	1.91	1.84	0.301	2.20	2.20	0.321
Pa has grad degree	0.16	1.51	0.917	1.33	1.84	0.471	1.54	1.72	0.373	0.36	1.55	0.818	1.29	1.64	0.435	0.34	1.96	0.861
Hours sports per week	0.14	0.13	0.270	0.21	0.16	0.183	0.22	0.15	0.133	0.12	0.13	0.347	0.12	0.14	0.369	-0.03	0.16	0.875
Hours music per week	0.82	0.43	0.057	0.80	0.52	0.127	0.61	0.48	0.213	1.07	0.43	0.015 *	1.04	0.46	0.024 *	0.98	0.54	0.073
adj. R-square	0.14			0.08			0.05			0.13			0.11			0.00		

Table 1B: Multiple Linear Regression Analysis for Science Grade (by Assessment Period).

Predictors	1st 6 weeks			2nd 6 weeks			3rd 6 weeks			4th 6 weeks			5th 6 weeks			6th 6 weeks		
	B	SE	p-value	B	SE	p-value	B	SE	p-value	B	SE	p-value	B	SE	p-value	B	SE	p-value
Intercept	91.15	7.17	0.000 ***	95.75	6.92	0.000 ***	95.98	6.81	0.000 ***	89.75	8.88	0.000 ***	89.51	7.90	0.000 ***	94.25	8.35	0.000 ***
Grade	-0.45	1.30	0.727	0.29	1.26	0.817	0.07	1.23	0.956	0.82	1.63	0.615	-1.37	1.45	0.349	-0.58	1.53	0.706
Age	-0.36	1.29	0.781	-1.17	1.24	0.350	-0.98	1.22	0.424	-0.58	1.60	0.720	0.41	1.43	0.776	-0.21	1.50	0.889
Gender	3.05	1.24	0.016 *	1.20	1.20	0.319	1.33	1.18	0.264	0.45	1.54	0.770	1.51	1.37	0.274	2.14	1.44	0.141
Ma has grad degree	3.64	1.46	0.014 *	5.07	1.41	0.001 **	3.22	1.39	0.023 *	1.31	1.81	0.472	2.13	1.62	0.192	1.38	1.70	0.419
Pa has grad degree	0.95	1.31	0.467	-1.39	1.26	0.273	0.76	1.24	0.543	0.59	1.62	0.718	-0.32	1.45	0.824	-0.99	1.53	0.516
Hours sports per week	0.02	0.11	0.851	0.08	0.11	0.450	0.04	0.11	0.717	0.19	0.14	0.162	0.03	0.12	0.831	0.10	0.13	0.435
Hours music per week	0.41	0.37	0.268	0.59	0.36	0.103	0.52	0.35	0.141	0.51	0.45	0.264	0.69	0.40	0.090	0.67	0.42	0.115
adj. R-square	0.16			0.18			0.13			0.00			0.05			0.02		

Table 2A and 2B: Multilevel Model of Change for Grades in Math and in Science over Six 6-Week Assessment Periods.

Science Grade	Parameter	Y	S.E.
Fixed Effects	Initial Status Intercept	89.35	1.82 ***
	Grade level	-0.65	0.38
	Mother has graduate education	4.63	1.33 **
	Father has graduate education	0.52	1.18
	Hours sports per week	0.03	0.10
	Hours music per week	0.51	0.34
Rate of Change	Intercept	0.65	0.37
	Grade level	0.01	0.08
	Mother has graduate education	-0.67	0.27 *
	Father has graduate education	-0.22	0.24
	Hours sports per week	0.01	0.02
	Hours music per week	0.04	0.07

*, **, *** significant at the .05, .01, and .001 level.

Math Grades	Parameter	Y	S.E.
Fixed Effects	Initial Status Intercept	86.16	2.32 ***
	Grade level	-0.80	0.49
	Mother has graduate education	3.98	1.70 *
	Father has graduate education	1.01	1.50
	Hours sports per week	0.20	0.13
	Hours music per week	0.79	0.43
Rate of Change	Intercept	0.67	0.38
	Grade level	-0.05	0.08
	Mother has graduate education	-0.49	0.28
	Father has graduate education	-0.06	0.24
	Hours sports per week	-0.03	0.02
	Hours music per week	0.05	0.07

*, *** significant at the .05 and .001 level.

CONCLUSIONS

Overall, this study's findings indicate *mother's advanced education* plays a robust and importantly enhancing role in determining the *level* of math and science grades. However, its impact on the *rate of grade improvement* over time (trajectory) ranges from no effect (for math) to having a slight negative effect (for science). On a per period analysis, the positive impact of mother's advanced education is also clear.

This study suggests that between EMA and ESA, it is EMA that appears to have an enhancing effect on performance. This result, however, will require further verification and validation through large scale and rigorously designed studies.

That said, there is a need for future large scale studies on student success in STEM (science, technology, engineering, & mathematics) education; studies with sound mechanisms for internal and external validity to examine and verify the impact of EMA in greater detail and with increased methodological rigor.

ACKNOWLEDGMENTS

Thanks go to the Texas A&M International University (TAMU), University Research Grant initiative; and the Center for Earth and Environmental Studies at TAMU for the printing of this poster. Thanks also go to the College of Arts and Sciences 2019-2020 Course Research Release initiative for awarding release time.