Spring 1-29-2022

The Effects of Musical Experience and Aptitude on Phonological Skills in a Foreign Language

Joshua Shockley
Harding University, jshockley@harding.edu

HARDING UNIVERSITY
HONORS COLLEGE
Undergraduate Thesis Certification

This form is to certify that the undergraduate thesis prepared

By Joshua Shockley

Entitled

The Effects of Musical Experience and Aptitude on Phonological Skills in a Foreign Language

Is dually approved by the Harding University Honors College and the student's thesis advisor(s) with input from the entire thesis advisory committee.

Thesis Advisory Committee:

Kristi Bond, Ph.D.	Jay Walls, Ph.D.
Genevieve Jones, M.Ed.	
Whitaker Jordan, Ph.D.	

This thesis, to the best of our knowledge, was published with the highest standards of academic integrity as outlined in the Harding University Academic Integrity Policy and in the use of any materials that are copyrighted.

Thesis Advisor(s): Kristi Bond, Ph.D.

Honors College Representative: James L. Huff, Ph.D.

The Effects of Musical Experience and Aptitude on Phonological Skills in a Foreign Language

Joshua Shockley

HNRS 4460: Honors Thesis

Harding University

Dr. Kristi Bond

January 2022

Acknowledgments

The completion of this project would not have been possible without the help of many people who have guided me throughout the entire process. First I would like to thank Dr. Kristi Bond whose expertise, kindness , and often patience as well, led me through countless steps in this project that I would not have been able to accomplish otherwise and whose mentorship in the Foreign Language Department has truly guided me throughout my college career.

I would also like to thank Dr. James Huff of Harding University's Honors College without whom I would not have known how to start this project at all and who worked with me throughout much of the planning and preparation during the Summer of 2021. I am incredibly grateful for this opportunity he has brought me to, and for the guidance he provided that was invaluable.

Finally, I would like to thank those on my advisory committee, namely Dr. Whit Jordan, Dr. Jay Walls, and Professor Genevieve Jones, for their support throughout the research process and their input as I completed this thesis. Their presence during this project and their feedback from the presentation of it to the completion of this manuscript was instrumental and I can not thank them enough.

Abstract

Music has been shown to have an important effect on L2 language acquisition. Recently, researchers have investigated how musical ability or experience can give an advantage to L2 learners attempting to acquire specific aspects of a second language in the beginning stages of language acquisition. This study investigates this connection between musicality and early L2 ability in Spanish through a series of tests including a musical aptitude test, two language aptitude tests, a Spanish receptive test, and a Spanish imitation test. Results revealed no significant correlations between musical ability or experience and language ability as tested by the aptitude, receptive, or imitation tests, which questions the universality of the effect of musicality on early stages of L2 acquisition in all languages. Certain demographic characteristics such as worship background were shown to have an effect on performance on one of the language aptitude tests. These results are discussed in relation to how music plays into language learning and how it is observed to play different roles with different languages.

Keywords: musicality, phonological, language acquisition, language aptitude, phonemic, suprasegmental, language production, musical aptitude,

Introduction

It has been known that music can play a large role in language acquisition. Articles such as "Music in the Language Classroom: How and Why?" (Degrave 2019) discuss the benefits of using music in the language classroom and how using music has historically produced positive results for language acquisition citing various factors of both a linguistic and non-linguistic nature. This points to the educational concept that describes how individual differences of learners affects their ability to retain different information or acquire different abilities such as their tendency for learning auditorily versus visually or tactilely. Music specifically for years has been employed in foreign language education as one way to reach different kinds of learners, and now researchers are further examining what role music has in second language acquisition.

Beyond using it as a tool to teach language, research is also showing that experience with music could give an advantage to learning language as well. In one study, Milovanov (2009) investigated how musical aptitude could connect with second language pronunciation skills, reporting to find a "significant relationship" between the two (340). Additional studies such as that of Daniele Schön, Cyrille Mange, and Mireille Besson (2013) investigated further the connection between musical experience with language ability from a neurological perspective as well, showing that musical training gives an advantage in recognizing pitch differences in language by the same neural processes as musical pitch recognition. These studies among others have shown how the quality often referred to as musicality can be a reliable predictor of phonological performance for participants in the basic stages of language acquisition.

Phonological performance in this context specifically refers to the ability of participants in these types of studies to replicate the sounds, tones, and/or rhythm of a language. Furthermore, musicality is a broad term that can express different concepts, but for this study will refer to the

ability to perceive and recognize aspects of music as defined by Christiner and Reiterer (2016) who also found that this capacity they refer to as musicality can be a predictor of language reproduction ability. The current study aims to recreate these results to further reveal the link between musicality and phonological production; additionally, it aims to show how differences in past musical experience can influence these results. For the foundation of this study, three specific studies will be discussed in detail including the one by researchers Christiner and Reiterer (2016) which discusses the connection between musicality and language production with the Hindi language; a study by researchers Zhengwei Pei, Yidi Wu, Xiaocui Xiang & Huimin Qian (2016) in which they studied how this same concept can be observed across 4 different languages as well; and finally a study by researchers Lieve Vangehuchten, Veronique Verhoeven, and Peter Thys (2015) which examines this concept specifically in the Spanish language.

Background

First, the study by Christiner and Reiterer (2016) investigated the question of how musicality could affect the language acquisition process. One question they had in particular was if then the effect of musicality on phonological performance differed between those who had singing ability versus instrumental ability. To test this, they tested participants on their musical aptitude, ability to produce music, their working memory, and their ability to reproduce and imitate language. In order to measure this language reproduction ability, the researchers instructed the participants to listen to 11-syllable sentences in Hindi and in English three times and repeat them. Additionally, the participants were instructed to read aloud an Aesop's fable in the English accent of their choice. These tasks were then judged by a panel of raters, 7 Hindi native speakers and 7 English native speakers, who scored them based on the overall

performance of the participants on accent imitation and how native the raters thought the participants sounded.

Christiner and Reiterer (2016) took the participants through various tests in order to measure the production and perception aspects of their musical aptitude. They measured musical production ability by having the participants repeat parts of a song they didn't know. This involved them listening to and memorizing sections of the song in increasingly longer portions and repeating the song parts without the background music after listening to it for a third time. In the second part of the production test the participants were instructed to sing the song "Happy Birthday" creatively. The recordings of these tasks were then judged by 7 singing experts. It is important to note that this panel was reported to have a very high inter-rater reliability for the three songs used in the singing tasks. Then, in order to measure receptive music aptitude, Christiner and Reiterer (2016) utilized the Advanced Measures of Music Audiation test (AMMA; Gordon 1989), which tests the participants' abilities to recognize rhythmic and tonal changes between music sequences.

Working memory was also specifically tested by giving the participants a digit span forward and one backward that they would have to memorize and repeat back. After every second attempt the string of numbers would increase, ending up with nine digits in the forward span and eight in the backward. This factor was shown to be the highest predictor of performance on the language proficiency test accounting for 46% of the correlation (r=.46, p<.01). As such, similar studies would need to control for working memory if it is not being tested for.

One of the overarching questions the researchers Christiner and Reiterer (2016) attempted to test was how musicality influences language ability, and if that influence varied

between those who could sing and those who could play instruments. What they found was there was a degree of positive correlation of musicality to accent imitation in an unfamiliar language from both groups, but the correlation was stronger with those who had singing experience (singing ability: r=.57, p=.01). Additionally, the results showed that those with singing ability performed better as a whole in language and accent imitation than those with just instrumental abilities ($F^{2,93}$=47.98, p<.01). Overall, this study revealed a relationship between musicality or specific music experience and language learning ability; however, it only tested this concept using one language.

Expanding this research in their own study, Zhengwei Pei, Yidi Wu, Xiaocui Xiang & Huimin Qian (2016) addressed the correlation between musicality and language production in 4 different languages (including Chinese, French, English, and Hindi) rather than just one. The differences between languages were helpful in fleshing out some of the results of the study. Similar to Christiner and Reiterer (2016), they tested both perception and production of music in this study, and the AMMA test was also utilized to test the musical perception ability of tonality and rhythm,

For the language production test, Pei, et al. (2016) had the participants, who were students without much previous experience with these languages, repeat various sentences in each language . They specifically note that each sentence was short (lasting 2.6 seconds) and therefore remained in the realm of short-term memory. This is particularly important regarding what Christiner and Reiterer (2016) found about the effect that working memory had on their results. Their model also controlled for memory in that they had each sentence repeated for the participants twice before having them say it themselves. To score this test, the four professors who created the sentences (each one experienced in one of the languages being tested) also rated

the samples from the participants on a 5-point scale for both segmental and suprasegmental aspects of their language production, segmental being the individual sounds pronounced and the suprasegmental being intonation and stress.

Pei, et al. (2016) results showed that there was in fact a certain degree to which musical aptitude could predict performance on the language production test, although the correlation was weaker than expected (r=.281, p=.001). Specifically, the relationship between musicality and phonological production manifested more in the suprasegmental aspects of language. The researchers hypothesized that this was because the suprasegmental elements of language were more similar to musical elements such as tone or rhythm. They also reported specifically on the differences between the high, medium, and low performing participants on the music aptitude test, and noted specifically the differences between the high and the low in how they performed in the phonological test. In particular, Russian demonstrated a stronger difference in performance from high and low musical aptitude than some of the other languages. Pei, et al. (2016) hypothesized that this difference was due to the way the different languages are timed, with languages such as Russian being stress-timed and languages such as French or Spanish being syllable-timed.

Another study by Lieve Vangehuchten, Veronique Verhoeven, and Peter Thys (2015) further investigates how this research applies to the Spanish language at early stages of language learning. This study used university students, all recorded as basic beginners in the language. Each participant was also provided with a questionnaire that recorded their linguistic and musical background. To measure their language skills they took an auditory test and an imitation test. The auditory test consisted of groups of words to which the participants were instructed to listen in order to determine which one was different. This test was specifically designed in Spanish and

therefore did not necessarily test their general language aptitude. Use of an imitation test to measure language production skill was similar to previously mentioned studies; however, it was rated by only one Spanish speaker who was a university teacher in contrast to Christiner and Reiterer (2016) which used a panel of 7 to rate the production quality.

Vangehuchten et al. (2015) also included two tests to measure musicality in their procedures, one to measure perception and one to measure production. The researchers conducted the perceptive music aptitude test utilizing the Seashore Musicality test (Seashore, Saetveit, and Lewis 1960), which is a common test but older than the AMMA that was used in other studies. With this test, 7 aspects of music were tested including pitch, loudness, rhythm, length, timbre, tonal memory, and stress. The music production test that was included in this study was similar to the production test seen in the Christiner and Reiterer (2016) study described above. The participants for this test were asked to sing a well-known lullaby after listening to a recording of it, and they were rated by the co-author of the test (a professional musician) on their performance based on pitch, intervals, stress, and rhythm.

Unlike in some of the other studies, Vangehuchten et al. (2015) did not find significant correlations between music perception/production skills and Spanish language production ability, but there was a correlation between Spanish language perception and music perception (r=.51, p=.007). They acknowledge that the lack of correlation that they encountered for production is in contrast to the results of other similar studies; however, it revealed a manner in which the correlation of musicality and phonological production can be studied with regards to the Spanish language specifically, providing valuable insight into useful testing protocols and methods that are useful for testing other aspects of this area of study. Additionally, it showed differing results for perception and production of language for Spanish, demonstrating that each may involve

different processes that are involved differently in at least the early stages of language acquisition. Finally, it showed different results testing for the relationship between musicality and Spanish compared to results found with other languages that could support the findings by Pei, et al. (2016) that demonstrated results for the different languages.

Using these studies as a basis, the current study attempts to contribute to the knowledge of the connection between musicality and early L2 language abilities. Knowledge in this field is key to unlocking the potential of how music can be used in language acquisition and instruction and is therefore a valuable asset in language pedagogy. Research indicates that there is in fact a correlation between musicality and language production, but previous studies do not discuss or test for how informal music production experience can affect this correlation, but only formal vocal and instrumental training. The current study looks to investigate how informal music experience also correlates to performing well on such language reception and production tests in order to expand the knowledge on how to utilize past experiences to support language learning. Research questions include:

-Does musical aptitude correlate with phonological performance in the early stages of foreign language learning in Spanish?

-Does musical aptitude correlate with language aptitude ?

-Does music/vocal training have an effect on phonological performance?

-Does informal music experience like worship background have an effect on phonological performance?

Methods

Participants

For this study there were 19 participants who were all university students between the ages of 18-24 and had minimal experience with foreign language learning or were in an introductory Spanish course. Ten of the participants had no experience learning a foreign language at all while the other 9 came from the lowest level Spanish in the university or had experience learning additional languages outside of Spanish. 16 of the participants reported having had multiple months of vocal training of some kind (musical or other vocal training such as theater) with only 3 reporting having had no experience with vocal training. This study focused on the participants' vocal music training because of the results of Christiner and Reiterer (2016) that showed vocal music training and ability as having a larger impact on phonological performance than instrumental training. There were then 18 participants who reported having consistent worship experience with only one reporting not having worship exposure. There were 12 of the participants who reported coming from a principally acapella worship background, while 5 of the participants came from a principally instrumental worship background. All participants reported attending worship services of some kind when they were young.

Materials

The test consisted of 5 sections including a demographic questionnaire (seen in Appendix A), a musicality perception test, two sections of a language aptitude test, a Spanish receptive test (seen in Appendix B), and a Spanish imitation test (seen in Appendix C). For the tests, each participant was identified only by a participant number in order to maintain anonymity. Each participant was given an informed consent form to look over and sign that explained the goal of the test, and from there they were instructed on how to progress through

each section of testing. Each test was opened in separate tabs of Google Chrome on a computer for each participant, except the imitation test which was given by the test proctor themselves in a room separate from the other participants. The order of the different tests was random, with the exception of the demographic questionnaire which always was first and the music perception which was always last so as not to tip off the participants to the exact nature of the study.

To start, the questionnaire collected demographic data such as age, gender, and the extent of the participants' experiences with music and language. After the questionnaire, the participants completed the next 4 tests in varying orders. One of these tests was a music aptitude test which examined the ability to perceive tonality and rhythm in music. The test used was the Advanced Measures of Music Audiation (AMMA; Gordon 1989) test, which is a standardized assessment used to measure the musical aptitude of participants, and as modelled by previously mentioned studies, is considered a reliable test of musical aptitude. The AMMA test consists of 30 items of two lines of music each that were either the same or different from each other. If they were dissimilar, they would differ tonally or rhythmically, and the participant would be prompted to choose which way they differed or if the lines of music they heard were the same.

Another section included two parts of the LLAMA language aptitude test (Meara and Rogers 2019) which tested the participants ability to perceive and learn an invented language. The LLAMA is a series of five tests, and for the study's purposes two of these were chosen for the participants to take. One, the LLAMA D test, involved a series of sounds given to the participant, none of which were from any true language, and they had to decide if each sound they heard was a new sound or one they had already heard. They would click the button for each sound until they had determined that they had heard every one. The other, the LLAMA E test, involved a panel of buttons displayed to the participants with different symbols on them. The

participants had ten minutes to click on each button and attempt to memorize the sound associated with that symbol, and after the ten minutes expired they would then match sounds played for them with the correct combination of those symbols in a selection displayed on their screen.

Also included was a Spanish aptitude test based on the one modelled by Lieve Vangehuchten et al. (2015) that tested specifically for the participants' abilities to perceive phonological differences in the Spanish language. This test was created by the researchers by arranging 23 triplets consisting of one word in Spanish said twice and one word that differed only in the placement of stress or in phonetic differences. There were 10 word sets with a phonemically different word (Ex. apertura - apertura - abertura) and 13 with a word different by stress (Ex. disfrutó - disfruto - disfruto), and the position of the different word was random in each triplet. The words were arranged in a random order so that the different word was in a different position from item to item. The participants listened to a recording of a native speaker saying these words, and the participants were asked to listen to the recording once and indicate which word they believed to be different. The purpose of this was to test how well the participants would be able to perceive differences in phonological elements of the Spanish language.

The final part was a phonological imitation test that included various phrases in Spanish. These were phrases that would be said with varying intonation and emphasis such as questions, commands, and exclamations in order to better gauge how the participants could replicate the intonation/stress elements of the phrases (the suprasegmental elements) when repeating them. The suprasegmental aspects of language were chosen to be the focus of the tests based on the previous studies' results that showed these elements most correlated to musical aptitude. These

sentences were recorded by a native speaker of Spanish. After hearing each one twice, the participants were recorded repeating the phrases aloud, being instructed to replicate what they heard to the best of their ability. In consideration of the results presented by Christiner and Reiterer (2016) that showed a strong effect of working memory, the imitation tests consisted of short sentences that would remain in the short-term memory in order to control for the effect of working memory on performance.

Analysis

Using SPSS (SPSS for Windows, Version 28.0 (IBM Corp)), correlations were examined between scores on each of these tests. Then this data was further tested in individual samples t-tests for group effects based on the demographic information collected from the participants by the questionnaire at the beginning of the testing process, including factors such as music experience, language-learning experience, and worship background.

Results

First, the descriptive statistics of the tests are presented, followed by the results of the Pearson correlations. Next, the results of independent sample t-tests run for the demographic information reported by the participants are presented along with the descriptive statistics of each demographic group.

Descriptive Statistics of the Receptive Musicality Test

The AMMA musicality test was scored by computer and divided into the Tonal and Rhythm section scores as well as a total composite score. As seen in Table 1, the Tonal scores of the participants produced a mean score of 24.00 with a standard deviation of 5.16, the Rhythm scores produced a mean of 26.68 and a standard deviation of 4.67, and the Composite scores produced a mean of 50.68 with a standard deviation of 9.41.

Table 1

Descriptive statistics of the receptive musicality test

Test	Mean	Standard Deviation	N
AMMA Tonal Score	24.00	5.16	19
AMMA Rhythm Score	26.68	4.67	19
AMMA Composite Score	50.68	9.41	19

Descriptive Statistics of the Receptive Spanish Test

The Spanish Receptive Test was given via a Google Form quiz in which the participants were able to choose the word they thought was different based on the recording they heard, and this would show their score based on how many they chose correctly. Like the AMMA, the scores were also divided, this time into Phonemic and Stress sections as well as a Total score. As seen in Table 2, the participants' scores from the Phonemic section produced a mean score of 7.95 with a standard deviation of 1.43, the scores from the Stress section produced a mean score of 11.16 with a standard deviation of 1.30, and the scores from the Receptive test as a whole produced a mean score of 19.11 with a standard deviation of 2.13.

Table 2

Descriptive statistics of the receptive Spanish test

Test	Mean	Standard Deviation	N
Total Receptive	19.11	2.13	19
Phoneme Receptive	7.95	1.43	19
Stress Receptive	11.16	1.3	19

Descriptive Statistics of the Spanish Imitation Test

The Imitation test was judged by two experimenters who rated the reproductions on a scale of 1-4 based on the factors of word stress and overall sentence intonation as produced by the participant. On this scale 4 indicates total flawless and native-like word stress and

intonation, a 3 indicates correct stress on words and overall sentence intonation but not to the same extent as a native speaker, a 2 indicates either correct stress on the words or overall sentence intonation, but not on both, and a 1 indicates non-native word stress and intonation on the entire phrase. The Imitation test scores were rated separately by the two experimenters, and the scores recorded demonstrated an inter-rater reliability of (86%). The two sets of scores were then averaged together into a single score for each test item for each participant. The mean of the participants' average scores for the Imitation test was 2.14 with a standard deviation of .42.

Descriptives of the Language Aptitude Tests

The scores for the LLAMA D and E tests were given by the program after the participants took the tests as a score out of 20. As seen in Table 3, the LLAMA D scores produced a mean of 10.21 and a standard deviation of 2.93. The LLAMA E scores produced a mean of 6.21 and a standard deviation of 5.13.

Table 3

Descriptive statistics of the general language receptive tests

Test	Mean	Standard Deviation	N
LLAMA D	10.21	2.93	19
LLAMA E	6.21	5.13	19

Tests for Pearson Correlations

Based on the data found by the Pearson correlations, the AMMA test scores did not reliably predict performance on the Receptive or Imitation Spanish tests. As seen in Table 4, there were no statistically significant correlations found between the AMMA test scores and the Spanish language test scores.

Furthermore, the AMMA test scores also did not reliably predict performance on the language aptitude test sections LLAMA D and E. Also shown in Table 4, the LLAMA E test

showed positive, but weak, correlations to the the AMMA scores including the Tonal score (r=.31, p=.20), the Rhythm score (r=.34, p=.16), and the Composite score (r=.34, p=.16), but none were found to be statistically significant.

Table 4

Pearson correlations with the musicality test

		Imitation Average	Receptive Phoneme	Receptive Stress	Receptive Total	LLAMA D	LLAMA E
AMMA Tonal Score	*Pearson Correlation*	0.13	0.04	-0.11	-0.40	-0.19	0.31
	Sig. (2 Tailed)	0.61	0.88	0.66	0.87	0.44	0.20
	N	19.00	19.00	19.00	19.00	19.00	19.00
AMMA Rhythm Score	*Pearson Correlation*	0.19	0.07	0.14	0.13	-0.16	0.34
	Sig. (2 Tailed)	0.43	0.77	0.58	0.59	0.52	0.16
	N	19.00	19.00	19.00	19.00	19.00	19.00
AMMA Composite Score	*Pearson Correlation*	0.17	0.06	0.01	0.04	-0.18	0.34
	Sig. (2 Tailed)	0.50	0.82	0.97	0.86	0.46	0.16
	N	19.00	19.00	19.00	19.00	19.00	19.00

However, as seen in Table 5, the results of the Pearson tests for correlation did reveal that the LLAMA E test was a reliable predictor of participant performance on the phonemic section from the Spanish Receptive test (r=.56, p=.01) and the total Receptive score (r=.56, p=.01).

Table 5

Pearson correlations with the language aptitude test

		LLAMA E
Imitation Test Average	*Pearson Correlation*	0.44
	Sig. (2 Tailed)	0.06
	N	19.00
Receptive Total	*Pearson Correlation*	0.56
	Sig. (2 Tailed)	0.01
	N	19.00
Receptive Phoneme	*Pearson Correlation*	0.58
	Sig. (2 Tailed)	0.01
	N	19.00

Testing for Group Effect By Independent Sample t-tests

The following sections provide the results of the independent sample t-tests that were run using the results of the tests and the demographic information reported by the participants in the initial questionnaire. With only 19 participants, the group numbers are not conducive to true statistical analysis but could give preliminary insight into how these factors affect performance on these tests.

Effect of Experience With Musical Training

Of the participants, 16 had experience with musical training and 3 did not, which was a problem for comparing statistics between the two groups because of the inequality of participants in each group. Table 6 below shows the descriptive statistics based on the participants' results by group.

Table 6

Descriptive statistics of participant groups by musical training

	With Musical Experience		Without Musical Experience	
	Mean	SD	Mean	SD
LLAMA D	10.25	2.95	10.00	3.46
LLAMA E	5.94	5.32	7.67	4.62
AMMA Tonal Score	24.06	5.34	23.67	5.03
AMMA Rhythm Score	26.94	4.28	25.33	7.50
AMMA Composite Score	51.00	9.25	49.00	12.29
Imitation Test Average	2.13	0.46	2.15	0.16
Receptive Total	19.00	2.28	19.67	1.15
Receptive Phoneme	7.81	1.47	8.67	1.15
Receptive Stress	11.19	1.42	11.00	0.00

As shown in table 7, independent samples t-tests did not show that the participants' experience with musical training had a significant effect on any test. All tests were shown to be above the .05 level that is required to indicate a significant effect by the variable.

Table 7

Independent Sample t-test for effect of musical training

	t-test for Equality of Means	
Test	**t**	**Two-Sided p**
LLAMA D	0.13	0.90
LLAMA E	0.52	0.61
AMMA Tonal Score	0.12	0.91
AMMA Rhythm Score	0.53	0.60
AMMA Composite Score	0.33	0.75
Final Average Imitation	0.32	0.76
Total Receptive	0.49	0.63
Phoneme Receptive	0.95	0.36
Stress Receptive	0.22	0.83

Effect of Language Learning Experience

Of the participants, 9 had previous experience learning a second language and 10 did not. In Table 8 are the descriptive statistics for these groups including their means and standard deviations for all tests followed by the results of the independent sample t-test for group effect. As shown in the table, the participants with language learning experience did score with a slightly higher mean on the LLAMA tests, but had either a slightly lower or nearly the same mean score on the other tests; however, none of the differences in means was found to be significant by the t-tests.

Table 8

Descriptive statistics for participant groups by language experience

	With Language Experience		Without Language Experience	
	Mean	SD	Mean	SD
LLAMA D	11.00	2.78	9.50	3.02
LLAMA E	6.89	6.31	5.60	4.06
AMMA Tonal Score	23.89	6.33	24.10	4.20
AMMA Rhythm Score	25.11	5.41	28.10	3.60
AMMA Composite Score	49.00	11.50	52.20	7.37
Imitation Test Average	2.27	0.55	2.01	0.23
Receptive Total	18.44	2.69	19.70	1.33
Receptive Phoneme	7.44	1.50	8.40	1.26
Receptive Stress	11.00	1.73	11.30	0.82

As shown in Table 9, independent samples t-tests showed that the participants' previous experience with language experience did not have a significant effect on testing performance with the difference in means of the two groups not being found to be significant.

Table 9

Independent samples t-tests for effect of language experience

	t-test for Equality of Means	
Test	t	Two-Sided p
LLAMA D	1.12	0.28
LLAMA E	0.54	0.60
AMMA Tonal Score	-0.09	0.93
AMMA Rhythm Score	-1.43	0.17
AMMA Composite Score	-0.73	0.48
Final Average Imitation	1.36	0.19
Total Receptive	-1.31	0.21
Phoneme Receptive	-1.50	0.15
Stress Receptive	-0.49	0.63

Effect of Worship Background

Of the participants, 12 reported coming from a principally acapella worship background and 8 from a principally instrumental background. There was only one participant who reported coming from no consistent worship background, so a third group of those with no worship

background was not possible and as such was not included; therefore, the effect of different types of worship backgrounds (principally acapella or principally instrumental) was tested instead of testing if having a worship background is more beneficial in this test than having none. In Table 10 are the means for each test by group for the participants divided by their worship background followed by the results of the independent samples t-tests for group effect. As seen in the table, those from a principally acappella background had a higher mean score for the LLAMA E test scores and all AMMA test scores while having either a lower or nearly identical mean score for the others.

Table 10

Descriptive statistics for participant groups by worship background

	Principally Acappella		Principally Instrumental	
	Mean	SD	Mean	SD
LLAMA D	9.83	2.75	11.33	3.38
LLAMA E	7.83	5.60	3.17	2.85
AMMA Tonal Score	24.92	4.20	21.33	6.43
AMMA Rhythm Score	27.17	4.08	24.50	5.01
AMMA Composite Score	52.08	7.68	45.83	11.23
Imitation Test Average	2.17	0.51	2.09	0.23
Receptive Total	19.00	2.52	19.33	1.50
Receptive Phoneme	7.75	1.54	8.33	1.36
Receptive Stress	11.25	1.60	11.00	0.63

As seen in Table 11, independent sample t-tests showed that worship background did not have a significant effect on phonological production. As with the other groups, worship background was not shown to have a significant effect on scores across all tests for all participants.

Table 11

Independent samples t-tests for the effect of worship background

	t-test for Equality of Means	
Test	**t**	**Two-Sided p**
LLAMA D	-1.01	0.33
LLAMA E	1.90	0.08
AMMA Tonal Score	1.43	0.17
AMMA Rhythm Score	1.21	0.24
AMMA Composite Score	1.40	0.18
Final Average Imitation	0.33	0.74
Total Receptive	-0.30	0.77
Phoneme Receptive	-0.78	0.45
Stress Receptive	0.36	0.72

Discussion

In the previously mentioned studies, various aspects of the connection between music and language were revealed, and this study aimed to add to this understanding. Unlike some studies, such as that of Christiner and Reiterer (2016), there was no significant correlation found between musical aptitude and phonological performance, nor was there a correlation between musical experience and phonological performance; however, a relationship was found between language aptitude and phonological performance as evidenced by significant correlations between the certain test scores and LLAMA E test scores including the Phonemic Receptive test scores (r=.56, p=.01), the Total Receptive test scores (r=.56, p=.01). By these correlations this study provides further confirmation of the validity of the LLAMA E test for predicting performance on language aptitude tests.

When tested for group effect with independent sample t-tests, there was no group demographic shown to have a significant effect on any test scores. For the groups with and without musical training it is probable that the sample size alone prevented it from showing any

kind of effect because the majority of participants had this background (16:3) making it statistically difficult to compare scores of the two groups. Furthermore, as stated previously, participants who were in the group with previous language learning experience came from low-level Spanish classes after only a couple of months into the course, and as a result, it is likely that although they had a level of L2 Learning experience, it may not have been enough to create a significant difference between their scores and those of the group with no L2 learning experience. Finally, the test for the effect of types of worship background may not have shown significant results due to the smaller group sizes that were being compared. Although it was not tested in full due to the lack of sufficient participants, this study also looks to raise the question for future research of how informal music training and/or exposure in settings such as religious worship can give an advantage to L2 learners in language acquisition and performance.

Although the results of this study do not match those of other studies regarding musicality and phonological performance, they do match more closely the results of Vangehuchten et al. (2015) who studied this concept in the Spanish language, as the current study did, and found a significant correlation between music and Spanish language perception ability but did not find a significant correlation between music production ability and Spanish imitation ability. Given the small sample size, it is difficult to definitively draw conclusions based off these results, but if they are reliable they could suggest that the effect of musicality on receptive or productive language aptitude is not seen in Spanish as it was with other languages such as Hindi in the study by Christiner and Reiterer (2016), further supporting the findings of Pei et al. (2016) that showed differing results between languages. The variance from one language to another could imply that the connection between music and language is more complex than previously presented. This is particularly important in the field of language

acquisition as researchers seek to more fully understand how to apply certain backgrounds and abilities to teach languages - if musical ability or background does not interact with language ability the same in every language, then those factors would likewise need to be utilized differently. More research is needed on how musicality affects the acquisition of individual languages.

It should be recognized that, as in the study by Vangehuchten et al. (2015), this study had certain limitations that prevented it from being completely thorough and likely affected the results shown. Among these limitations, time was the most restricting. so there was not a sufficient number of participants nor sufficient variety of participants (including those with and without musical experience) to test every aspect of this study fully. Additionally, this study did not include a musical performance task as others did. Finally, perhaps due to the lack of variation among participants, some tests showed a narrow range of scores, which made it statistically difficult to find correlations one way or another.

Conclusion

Music could be a powerful tool to be used for language acquisition and ability, but there is still much to learn to understand fully how it should be used, and in what ways these two abilities connect. Language acquisition is a complex process, and it is difficult to state the effect of one factor over another because of the immense variability of effects and factors involved. This study aims to continue to raise and draw attention to the potential relationship between musicality and L2 language acquisition as an area of future research while also bringing to light the potential usefulness of the LLAMA language aptitude test in studying aspects of language acquisition and aptitude. Finally, this study aims to also question how an informal music experience such as worship settings could have an effect on productive or perceptive language

aptitude. As this line of research is just emerging there is still much to learn, but this study hopes to draw more attention to this area of study and the benefits of continuing research in this field.

Appendices

Appendix A: Demographic Questionnaire

What is your participant number for this research study? _____

Gender

- **Male**
- **Female**

Age

- **18-24**
- **25-30**
- **31-40**
- **41-50**
- **50+**

Are you currently experiencing any hearing impairments?

- **Yes**
- **No**

Have you ever been diagnosed with long-term hearing or auditory processing problems?

- **Yes**
- **No**

What is your native language?

- **English**
- **Spanish**
- **Other**

Have you had any experience learning another language?

- **Yes**
- **No**

If "yes," which language(s)? _____

How would you describe your experience with music or vocal training? (ie. theater, chorus, choir, or formal vocal training of any kind)

- **No formal music or vocal training**
- **Multiple months of music or vocal training**
- **Other**

If you selected "Other," please explain. _____

How frequently do you attend religious/worship services?

- **At least weekly**
- **At least monthly**
- **Infrequently**
- **Never or almost never**

How would you describe your religious/worship background?

- **No consistent singing worship background**
- **Principally acapella-based singing worship (non-instrumental)**
- **Principally instrumental-based singing worship**

Did you consistently attend worship services as a child?

- **Yes**
- **No**

Appendix B: Spanish Receptive Test Items

límite - limite - limite; apertura - apertura - abertura; célebre - celebre - celebre; crítico - crítico - critico ; morelos - modelos - morelos; disfrutó - disfruto - disfruto; asilados - afilados - asilados; gestiono - gestiono - gestionó; avancé - avancé - avance; enterar - enterar - enterrar; garantizo - garantizó - garantizó; planeará - planeará - planeara; depósito - depositó - depósito; pesaba - besaba - besaba; evaluara - evaluará - evaluara; sábana- sabana - sábana; carretas - caretas - carretas; campana - campana - campaña; cantará - cantara - cantara; padecer - parecer - parecer; ejercitó - ejército - ejército; faltaban - saltaban - saltaban; teñido - tenido - tenido

Appendix C: Language Imitation Test Items

Participants will listen to each phrase twice and then attempt to imitate it. Recordings will be analyzed for word stress and sentence intonation.

¿Cómo te sientes? - ¡No me lo quites! - No es ella, ¿verdad? - ¡Qué casa más linda! - Aquí lo tienes - Pásame el pan. - Es el tuyo, ¿no? - El jefe no está. - ¿De verdad lo crees? - No miró el partido. - ¿Cuándo llega el tren? - Escuchen, por favor.

Works Cited

Christiner, M., & Reiterer, S. (2016). Music, song, and speech: A close look at the interfaces between musicality, singing and individual differences in phonetic language Aptitude. In G. Granena (Ed.), *Cognitive Individual Differences in Second Language Processing and Acquisition*, (pp. 131-156). John Benjamins Publishing Co.

Degrave, P. (2019). Music in the foreign language classroom: How and why? *Journal of Language Teaching and Research*, *10*(3), 412–420. **doi.org/10.17507/jltr.1003.02**

Gordon, E. E. (1989). *Manual for the advanced measures of music audiation*. G. I. A. Publications.

IBM SPSS Statistics for Windows, *Version 28.0*. (2021). IBM Corp.

Lee, C. Y., & Hung, T. H. (2008). Identification of Mandarin tones by English-speaking musicians and nonmusicians. *Journal of the Acoustical Society of America*, *124*(5), 3235-48. **doi.10.1121/1.2990713**

Meara, P. M., & Rogers, V. E. (2019). *The LLAMA Tests v3. LLAMA D+3.2*. Lognostics.

Meara, P. M., & Rogers, V. E. (2019). *The LLAMA Tests v3. LLAMA E+3.0.* Lognostics.

Milovanov, R. (2009). Musical aptitude and foreign language learning skills - neural and behavioral evidence about their connections. *JYX*. **jyx.jyu.fi/handle/123456789/20935**

Pei, Z., Wu, Y., Xiang, X., & Qian, H. (2016). The effects of musical aptitude and musical training on phonological production in foreign languages. *English Language Teaching*, *9*(6), 19–29. **doi:10.5539/elt.v9n6p19**

Schön, D., Mange, C., & Besson, M. (2004). The music of speech: Music training facilitates pitch processing in both music and language. *Psychophysiology*, *41*, 341-349. **doi.org/10.1093/cercor/bhs180**

Seashore, C. E., Saetveit, J. G., & Lewis, D. (1960). *The Seashore Measures of Musical Talents*. Psychological Corporation.

Vangehuchten, L., Verhoeven, V., & Thys, P. (2015). Pronunciation proficiency and musical aptitude in Spanish as a foreign language: Results of an experimental research project. *Revista De Lingüística y Lenguas Aplicadas*, *10*(1), 90–100. **doi:10.4995/rlyla.2015.3372**