THE IMPACT OF MULTILINGUALISM ON MUSICAL ABILITIES

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Research has shown that musical ability influences language capacity across multiple domains. In this study, we reversed this perspective by investigating whether the degree of multilingualism – measured as the number of foreign languages spoken at B2 level – impacts musical ability. We recruited 176 participants who completed perceptual musicality, singing, foreign language pronunciation, and short-term memory (STM) tasks, and self-reported their educational status. As expected, results revealed significant correlations among all variables examined. We conducted conventional regression models with degree of multilingualism as the dependent variable, followed by the reverse model predicting musicality from language-related predictors. Both models successfully accounted for variance in their respective outcome variables. Critically, the reverse model showed that degree of multilingualism and STM capacity jointly predict musical ability (R^2 = 17%), suggesting bidirectional rather than unidirectional influences between these auditory domains. This suggests that musicality and foreign language training engage similar underlying mechanisms applicable across both domains.

Keywords: musicality, musical perception, musical production, foreign language learning.

INTRODUCTION

The relationship between musicality and language abilities has been a subject of extensive research, and studies investigating the overlaps between both domains are increasingly recognized as a promising resource for developing innovative approaches for both language and music learning. The rationale behind this development is well-founded, as music and language share a number of fundamental characteristics, particularly in terms of rhythm and pitch (Jackendoff and Lerdahl, 2006, 161). Pitch is the most prominent aspect in language and music (Liu and Kager 2017, 56). In both, speech and music, the pattern of pitch over time, also referred to as pitch contour, is relevant. Research has postulated that perception of pitch changes in spoken language is enhanced following musical training, suggesting a transfer effect whereby auditory processing skills acquired through musical practice facilitate improved language abilities (Schön et al. 2004, 387). Another key feature shared by language and music that is most relevant is rhythm: In language it helps to group sounds and pauses into meaningful units such as words, and sentences, while in music, it serves to organize phrases and motives into coherent sequences (Roncaglia-Denissen et al. 2018, 2).

As Aniruddh Patel p. 141 notes, words are often grouped into "rhythmic chunks" (Patel 2003, 140–143). The presence of parallel rhythmic structures in music and speech may thus contribute to deeper cognitive and neural links between these two domains. These shared features of rhythm and pitch contour support the assumption that musical abilities may exert a positive transfer effect on linguistic processing, potentially enhancing skills such as speech perception, imitation and pronunciation in foreign language learning (Christiner and Reiterer 2018; Milovanov et al. 2010).

Musicality is not only linked to enhanced perceptual abilities, but also to performance skills. It could be assumed that individuals with strong perceptual capacities are likewise more proficient in musical performance or singing. While this tends to be the case, research has also demonstrated the opposite: accurate perception does not necessarily translate into accurate performance, either in phonetic language tasks or in music (Golestani and Pallier 2007; Christiner and Reiterer, 2019; Christiner and Reiterer 2015; Christiner et al. 2022a). To more comprehensively capture the construct of musicality and its relation to language, it is essential to assess both music perception and production abilities. Including both dimensions allows for a more complete representation of an individual's musical skills. Singing is one of the most accessible tasks for assessing productive musical skills, as it measures musical training and can be applied to both professionals and non-professionals (Dalla Bella et al. 2007, 99; Dalla Bella and Berkowska 2009, 105).

Singing in particular – as a form of musical-linguistic expression – demonstrates promising overlaps with productive linguistic skills, including aspects such as (foreign language) pronunciation and the ability to mimic accents (Coumel et al. 2023, 5; Christiner et al. 2022b). Relatedly individuals who perceive certain languages as more melodic tend to retrieve and pronounce melodic-sounding utterances more accurately (Christiner et al. 2021, 15). Recent research also suggests that the ability to produce intelligible utterances in unfamiliar languages is related to singing ability (Christiner et al. 2023, 14). The findings of this study suggests that both musical perception and singing ability correlate with the intelligibility of newly acquired utterances. However, when entered together into regression analyses, singing aptitude emerges as the stronger predictor, while perceptual measures no longer account for unique variance. This pattern indicates that singing constitutes the more decisive factor in explaining early L2 speech production (Christiner et al. 2023, 11).

Studies investigating singing have also shown that singing new vocabulary enhances memorization (Ludke et al. 2014, 51), which may clarify the connection between singing ability and foreign language pronunciation (Christiner 2020; Christiner and Reiterer 2018, 11) as well as vocabulary acquisition (Thiessen and Saffran 2009). This emphasizes the close connection between productive musical skills such as singing abilities and language acquisition and demonstrates the value of conducting more in-depth research in this area.

On the other hand, research on perceptual musical ability has revealed positive transfer effects to language perception, highlighting substantial overlaps that imply shared cognitive and neural mechanisms supporting auditory processing in both the musical and linguistic domains. Musicians exhibit perceptual enhancements in various language-specific abilities, including phonological processing (Anvari et al. 2002), verbal memory (Chan et al. 1998), verbal intelligence (Moreno et al. 2011), as well as voice pitch discrimination (Bidelman and Krishnan 2010) and tone syllable perception in Mandarin (Christiner et al. 2022b). Musicians also show sensitivity to prosodic cues and improved second language proficiency (Slevc and Miyake 2006). Moreover, musical training has been shown to improve the neural processing of speech (Besson et al. 2011; Parbery-Clark et al., 2012; Intartaglia et al. 2017). More recent research has shown that musically trained participants exhibit superior auditory–phonological pattern recognition, particularly for longer speech sequences with low linguistic content (Christiner and Groß 2025, 9). Here "pattern" refers to the comparable perceptual ability to retain short melodies and unfamiliar multi-syllabic phrases in memory – suggesting that musical auditory skills facilitate the processing of both musical and phonological sequences. Following the above discussion, musicality emerges as a multifaceted construct. When assessing musicality, measuring perceptual abilities alongside singing ability offers a comprehensive approach to capturing its complexity.

In studies examining the relationship between language and music, STM – a subcomponent of working memory (WM) capacity – plays a crucial role and should therefore always be assessed, as STM capacity influences both language and musical abilities. In language research, STM and WM capacity has been shown to be one of the most important predictors that influence mastery in first and second language capacity (Wen et al. 2017; Wen et al. 2019). More recent research demonstrates that music and language rely on overlapping STM and WM resources, particularly verbal rather than visuospatial subsystems. The aforementioned study revealed that musicians tend to achieve higher accuracy on WM tasks involving verbal and musical material, consistent with an enhanced verbal WM capacity associated with musicianship (Bugos et al. 2021, 7).

Numerous studies have demonstrated that musical ability predicts language functions, while considerably less research has examined the relationship in the opposite direction or conceptualized it as a bidirectional process. For instance, bidirectional transfer effects have been demonstrated for pitch experience, from speech to music and vice versa (Bidelman et al. 2011, 432). This study demonstrates that neural mechanisms recruited for both musical and linguistic pitch processing are sharpened by years of active listening to complex pitch patterns, contributing to bidirectional transfer effects between the domains (Bidelman et al. 2011, 432). Consistent with this view, neuroscientific research demonstrates that both musicians and bilinguals exhibit increased grey matter volume (Mechelli et al. 2004, 757; Schneider et al. 2055, 388), which is associated with musical ability (Schneider 2002, 688) and enhanced language learning capabilities (Mechelli et al. 2004, 757).

Building on these behavioral and neuroscientific parallels, the mostly considered unidirectional transfer from music to language warrants reconsideration as bidirectional. Notably, the number of languages spoken predicts further language learning aptitude (Christiner et al. 2021), paralleling how proficiency across multiple instruments facilitates additional musical skill acquisition (Christiner 2020). Both multilingualism and musicality also enhance unfamiliar language learning (Christiner and Groß 2025) – raising the question of whether extensive multilingual experience might likewise boost musical performance. See figure 1 for the directions of influence.

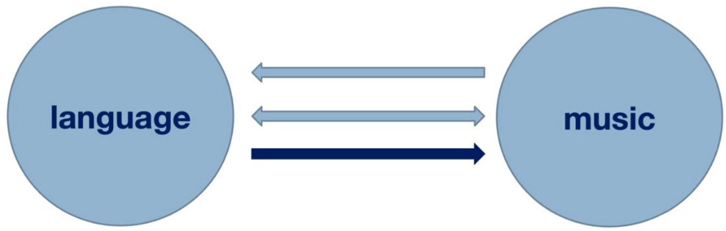

Figure 1. Depicts the influence from the musical domain to the linguistic domain (light blue arrow), the bidirectional direction in which the domains influence each other (second light blue arrow with two arrowheads), and the direction hypothesizing the influence of linguistic abilities to musical abilities (dark blue arrow).

This study addresses three main hypotheses. First, we examine whether multilingualism – measured as the number of foreign languages spoken at B2 level or higher – is positively associated with musicality. Second, since previous research has found positive associations between multilingualism, STM, and pronunciation skills, we included a pronunciation task and a STM measure as control variables. This approach allowed us to verify whether our variable capturing the degree of multilingualism aligns with established findings linking foreign language proficiency to enhanced STM capacity and pronunciation ability. Third, since individuals with higher education levels are more likely to have learned musical instruments and thus may perform better on musicality measures, we considered education as a confounding variable to assess whether it influences the relationship between musicality and the degree of multilingualism.

METHODS

Participants

The study included a total of 176 German native speakers (95 women, 81 men; M = 24.23 years, SD = 11.48). The recruitment criteria were designed to include native German speakers with an interest in foreign languages, who, however, were neither able to comprehend nor speak Mandarin, the language used in the L0 production tasks. Additionally, participants were expected to have achieved at least a B2 proficiency level in at least one foreign language, indicating a fluent command capable of understanding complex texts, engaging in spontaneous conversation with native speakers, and expressing detailed viewpoints on a variety of topics. Based on these recruitment criteria, 187 participants were originally invited to take part in the study. However, 11 were excluded from the final sample, because they did not complete the tests. All participants provided informed consent before the test session and took part voluntarily. The study was approved by the Rīga Stradiņš University (RSU) Research Ethics Committee (2-PĒK-4/3/2022).

To collect detailed data about the participants' language and musical background, and to verify that they met the recruitment criteria, participants were invited to complete a self-report questionnaire and were also interviewed. The questionnaire and interview responses showed that all participants were German native speakers who had been raised in primarily monolingual environments. Besides German, the participants could speak other foreign languages such as English, French, Italian, Spanish, Portuguese or Dutch. While 57 participants reported never having learned to play a musical instrument, 119 participants reported having learned to play a musical instrument at some point in their lives.

Testing procedure

Prior to testing, participants' suitability for participation in the study (e.g. language background) was assessed. If participants fulfilled the inclusion criteria, they were provided with login data and completed all measures, except for the singing and language pronunciation tasks, online, as all tests and questionnaires were computer-based. First, participants filled in the questionnaire, which was followed by the musicality and STM measures. Finally, the singing and language pronunciation tasks were recorded in the lab.

Musicality tests and language assessment

Gordon's Advanced Measures of Music Audiation (AMMA)

We used the Advanced Measures of Music Audiation (AMMA; Gordon 1989) to assess individual differences in musical aptitude. It measures an individual's ability to perceive and discriminate tonal and rhythmic patterns. The AMMA consists of rhythm and tonal discrimination tasks, in which participants must determine whether the second excerpt is the same as the first or differs in tonality or rhythm. In the tonal part, excerpts differ in pitch/tonality but have the same rhythm. In the rhythm part, excerpts differ in tempo, meter or duration, but have the same tonality. The AMMA assessment is made up of 33 items in total, yet the first 3 items are familiarization tasks that are excluded from the ultimate data analysis. The AMMA provides a measure of innate musical aptitude, considered a strong predictor of potential for musical achievement and learning. This assessment is recognized for its role in predicting musical achievement and learning potential. It is widely employed in both educational and professional contexts to evaluate individuals musical abilities. The AMMA's design and implementation enable a nuanced understanding of participants' perceptual competencies in music, contributing valuable insights into their capabilities and areas for development.

Singing ability (Happy Birthday) and rating criteria

To test singing ability, the participants were asked to sing "Happy Birthday" as well as they could, using a key that they found most comfortable and enjoyable for their own singing voice. We chose a singing task to measure musical production because singing is a universal activity accessible to nearly everyone. Additionally, it is a skill that both professional musicians and non-professionals can perform, allowing us to obtain a musical production score from all participants, including those who do not play an instrument. Since singing ability improves with training, it is not solely an innate skill. This evaluation approach has been applied in several previous studies (Christiner 2013; Christiner and Reiterer 2013; Christiner et al. 2018, 2021; Christiner 2020). The singing performances of the participants were then rated and evaluated by a panel of singing experts, consisting of two male and two female raters. The raters were provided with detailed instructions regarding their tasks and the specific criteria for their assessments, namely evaluating the participants' melodic and rhythmic abilities. Melodic singing ability was defined as the accuracy with which participants reproduced the melody of the original song, whereas rhythmic singing ability referred to the accuracy of reproduction of the original song's rhythm. These two criteria were then combined into a single overall score for each participant. Specifically, the raters were instructed to evaluate the participants' performances on scales ranging from 0 (lowest score) to 10 (highest score). To ensure the reliability of the ratings, intraclass correlation coefficients (ICCs) were calculated. The results demonstrated that the ratings provided by the expert panel were reliable, exceeding the commonly accepted threshold of 0.7. The AMMA score, measuring perception and the singing score, measuring musical production, were z-standardized and then added together to receive a valid musicality score ("musicality complex") which comprises both musical perception as well as musical production.

Assessing Foreign Language Proficiency: Foreign Language Pronunciation Task

The study involved a speech production task where participants were asked to repeat three phrases of varying lengths (7, 9, and 11 syllables) of an unfamiliar language (Mandarin). This type of measurement has high ecological validity, as it resembles a language learning situation in the initial learning stages when individuals hear phrases for the first time (Christiner 2020; Christiner et al. 2021). Previous research has shown that individuals imitating unfamiliar, typologically different languages perform well regardless of the specific language repeated, suggesting that when language material is unfamiliar, its typological characteristics do not influence performance. Factor analyses have further demonstrated that short sequences of typologically diverse unfamiliar languages load onto the same factor, indicating that they measure general pronunciation ability (Christiner 2020, 155). Therefore, we selected Mandarin – a language typologically distant from the participants' native (German) and foreign languages – to minimize educational and sociolinguistic biases, ensuring a reliable assessment of general speech imitation skills (Christiner and Reiterer 2013, 5). The original phrases of the Mandarin samples were spoken by native speakers. The participants listened to each sample three times before they had to imitate it. The assessment procedure followed previous research: the participants' recordings were normalized for loudness and then evaluated by five native speakers. The evaluators were tasked with assessing how well the participants preserved the rhythmical structure, melodic aspects, completeness of the sentence material, and the overall performance. They provided a score ranging from 0 to 10 for each of these four criteria, which were then combined into a single score. The inter-rater reliability of the evaluations was assessed using an intra-class coefficient analysis. The results demonstrated that the ratings provided by the expert panel were reliable, exceeding the commonly accepted threshold of 0.7.

Educational Status

The educational status of the participants revealed a diverse range of educational backgrounds. 50 participants completed the main general secondary school, 27 the apprenticeship, technical and vocational school, 54 the secondary academic school (general qualification for university entrance), 19 had a bachelor's degree, and 26 had obtained a master's or doctoral degree. The educational level scoring system used in this study, ranging from 2 to 6, was applied following previous research to reflect the hierarchical educational attainment levels from main general secondary school to master's or doctoral degrees (Christiner 2021).

The level of education of the participants should be taken into account, because education generally has an influence on other domains and can be seen a confounding variable: It is important to consider that people who have received a higher level of education are more likely to learn to play a musical instrument.

Degree of Multilingualism: Number of foreign languages (Level B2)

The number of languages spoken was assessed via a self-report questionnaire in which participants were asked to report only those languages they could speak at a B2 proficiency level or higher (i.e., "I can speak and understand most things without difficulties" or above). The maximum number of languages spoken at this level was four. Based on this information, a multilingualism score was calculated to quantify the degree of multilingual proficiency among participants.

Short-Term Memory (STM)

To assess the STM capacity of participants, the Wechsler Digit Span test (Wechsler, 1939) was employed. This assessment consists of two parts: the forward digit span (STMF) and the backward digit span (STMB). Conducted online, the test presented auditory stimuli, requiring participants to repeat sequences of digits in either forward or backward order. The forward span included sequences ranging from 3 to 9 digits, while the backward span involved sequences from 2 to 8 digits. Participants received individual scores for each task, based on the number of digits they accurately recalled, with a maximum possible score of 14. Previous research indicates that adult participants typically achieve average scores of 7 to 8 on the forward span, while scores for the backward span are generally about one point lower (Christiner 2020, 275; Christiner et al. 2021). STM has been found to influence language competences (Dörnyei 2005; Wen and Skehan 2011; Wen et al. 2017). Therefore, when assessing language abilities, the capacity of STM should also be examined. In this study, STM capacity was assessed as a composite score of forward and backward digit spans.

RESULTS

Statistical Analysis

First, we calculated descriptive statistics and conducted correlational analyses to explore the relationships between the variables of interest, refer to Table 1 for more information. Next, we applied two regression models: the first representing the conventional approach, in which musicality beside other variables is treated as an independent variable and the degree of multilingualism as the dependent variable, examining which musical and other predictors explain multilingual abilities. In the second model, we reversed this direction by using musicality as the dependent variable to investigate whether language-related variables predict individual differences in musicality. Finally, we assessed whether the association between musicality and multilingualism might be confounded by participants' educational background.

Table 1. Descriptive statistics provide the descriptives of the variables under consideration

Variables	M	SD
Degree of Multilingualism	1.78	0.794
Education	3.68	1.378
Musicality Complex	0.00	0.81
Foreign Language Imitation	3.14	1.23
STM	13.50	3.14

Correlational Analysis

We conducted correlational analyses to examine the relationships among the variables of interest. All variables showed significant positive correlations with degree of multilingualism, confirming our hypothesis. Our initial objective was to identify which specific variables showed positive correlations with this degree of multilingualism. These patterns indicate that cognitive and perceptual skills underpin multilingual success, with education emerging as the strongest contributor and musicality as the second most prominent factor. Consistent with our hypotheses, the results confirmed that each variable under investigation was positively correlated with multilingualism to varying extents, see table 2 for details.

Table 2. Results of the correlational analysis.

	Degree of Multilingualism	Musicality Complex	Foreign Language Imitation	STM	Education
Degree of Multilingualism	1	.309**	.243**	.164*	.337**
Musicality Complex	.309**	1	.255**	.308**	.281**
Foreign Language Imitation	.243**	.255**	1	.244**	-0.026
STM	.164*	.308**	.244**	1	.251**
Education	.337**	.281**	-0.026	.251**	1

** *means that p<0.01 (uncorrected, two-tailed)*

* *means that p<0.05 (uncorrected, two-tailed)*

Partial Correlations

Given that individuals with higher education levels are more likely to have received training in playing musical instruments which may enhance performance on musicality measures, and are also more likely to have received extensive foreign language education, we treated education as a potential confounding variable in our analyses. To assess whether education influences the relationship between musicality and the degree of multilingualism, we conducted partial correlation analyses. These controlled for educational attainment while examining the associations between language proficiency scores, musicality measures, and the degree of multilingualism. Our approach allowed us to isolate the unique contribution of musicality to multilingualism beyond the shared variance explained by education. The original correlation between the degree of multilingualism and the music complex was r =0.309, p (two-tailed) < 0.01. The partial correlation, controlling for education, revealed a reduced but still significant association, r =0.237, p (two-tailed) < 0.01. This indicates that while the relationship between multilingualism and musicality diminishes when accounting for educational attainment, it remains statistically significant.

Regression analysis

While previous research and our introduction have emphasized that the connection between musicality and language may not be unidirectional, but rather reciprocal, our analyses were designed to examine both possible directions of influence.

Following inspection of the correlation matrix, two sets of regression analyses were conducted. In the first analysis, the degree of multilingualism was entered as the dependent variable. Only predictors that correlated significantly with this variable ($p < 0.05$; change in F) were included in the model. Results indicated that highest level of education, foreign language imitation, and the musicality complex together accounted for 20% of the variance in the degree of multilingualism. For further details, see Table 3.

Given the theoretical possibility that these associations could also operate in the opposite direction, a second regression analysis was performed with musicality as the dependent variable, and linguistic predictors (including degree of multilingualism, imitation ability, STM, and education) as independent variables. This approach allowed examination of whether musicality can also be predicted by linguistic variables in addition to the reverse, providing a more comprehensive understanding of the interrelationships between language and musical abilities. Details are provided in Table 4.

Table 3. Regression models explaining the variance in the degree of multilingualism

Predictor	**Partial correlation (pr)**	***p*-Value**
Dependent variable: *Degree of Multilingualism* $R = 0.34$, $F(1, 174) = 22.35$, $p < 0.001$		
Education	0,34	< 0.001
Dependent variable: *Degree of Multilingualism* $R = 0.42$, $F(1, 173) = 13.30$, $p < 0.001$		
Education	0,35	< 0.001
Foreign Language Imitation (production)	0,27	< 0.001
Dependent variable: D*egree of Multilingualism* $R = 0.45$, $F(1, 172) = 5.55$, $p = 0.026$		
Education	0,30	< 0.001
Foreign Language Imitation (production)	0,22	< 0.001
Musicality Complex	0,18	0.020

Table 4. Regression models explaining the variance in musicality complex

Predictor	**Partial correlation (pr)**	**p-Value**
Dependent variable: *Musicality Complex* R = 0.31, F(1, 174) = 18.33, p < 0.001		
Degree of Multilingualism	0,31	< 0.001
Dependent variable: *Musicality Complex* R = 0.41, F(1, 173) = 14.12, p < 0.001		
Degree of Multilingualism	0,31	< 0.001
STM	0,31	< 0.001

Discussion

In this study, we aimed to investigate whether musical capacity can be predicted by the degree of multilingualism – specifically, whether individuals who speak more languages also exhibit enhanced musical skills – contrary to many previous studies that predominantly examined the influence in the opposite direction.

In order to examine the impact of foreign languages on musical ability, a multifaceted approach was employed. This involved the measurement of musical ability and linguistic abilities, the assessment of STM and educational status, and the number of foreign languages spoken at a B2 level, resulting in the degree of multilingualism. Subsequently, correlational analyses, partial correlations, and regression analyses were conducted. As expected, correlational analyses revealed that all variables under consideration were significantly associated with the degree of multilingualism. Building on these correlational findings, we further explored the predictive relationships by conducting two regression models. The first followed the conventional approach by treating the degree of multilingualism as the dependent variable. This model demonstrated that multilingualism could be predicted by education level, musicality, and foreign language imitation skills – predictors validated by numerous prior studies as relevant for foreign language proficiency (Christiner et al. 2022b; Christiner et al. 2023, 2). We performed this approach for reasons of transparency but will not discuss the results in detail, as they have been addressed in multiple previous investigations (Slevc and Miyake 2006; Wong et al. 2007; Anvari et al. 2002).

Reversing this approach, we used musicality as the dependent variable. The results showed that both the degree of multilingualism and STM capacity significantly predicted musical ability (see Table 4), suggesting a potential bidirectional positive transfer between music and language faculties. To further confirm this relationship beyond the preceding analyses, partial correlation analyses were conducted controlling for educational attainment as a potential confounding factor in the multilingualism–musicality link. These analyses indicated that the strength of the association slightly decreased but remained statistically significant, suggesting that the capacity to speak multiple languages independently contributes to musical ability. In light of these findings, the roles of multilingualism degree and STM capacity as predictors of musicality are discussed.

WM encompasses Baddeley's multicomponent model – including the phonological loop, visuospatial sketchpad, central executive, and episodic buffer – that combines storage with active manipulation and attentional control (Cowan 2008, 326), whereas STM represents simple temporary storage without these processing elements (Baddeley 2012, 4). STM capacity is one of the most extensively studied predictors of individual differences in language ability (Dörnyei 2005; Wen and Skehan 2011; Wen et al. 2017). In contrast, the relationship between musicality and STM capacity remains less well studied. Same studies suggest that auditory STM processing of musical and verbal sounds overlaps only minimally (Williamson et al. 2010, 172), while more recently evidence has been provided for the relationship between musical training and improved STM and WM capacity (Groussard et al. 2020). In this study, we found that STM capacity also predicts variance in musical ability performance. The reasons why STM and the degree of foreign language capacity predict musical ability could be a result of different mechanisms. First, STM capacity is trained by language learning and may enhance sequence memory in music, while musical training likely boosts STM capacity in return – suggesting bidirectional pathways across these auditory domains rather than a unidirectional model.

Second, the relationships between musicality, STM, and multilingual proficiency may stem from their shared perceptual-cognitive nature. STM capacity is closely associated with the ability to recall larger phonological units and emerges as a key cognitive predictor of advanced language skills in multilinguals (Christiner 2020, 80). Research shows that auditory phonological pattern recognition of unfamiliar languages correlates with both the number of foreign languages spoken and musical ability (Christiner and Groß 2025). Common to all three – STM (measured via increasing digit spans in this study), musicality tests (short musical sequences), and larger auditory phonological patterns (multi-syllabic stimuli) – is the core demand of retaining and repeating increasingly complex auditory sequences.

Third, memory is central to auditory processing: when listeners encode unintelligible utterances they rely chiefly on phonological features rather than semantic content (Baddeley 2003, 832). Musical experience bolsters this phonological/auditory coding and retention, with research showing that musicians outperform non-musicians on STM tasks (Tierney et al. 2008 Christiner and Reiterer 2013).

Multilingual exposure and musical training likely enhance this shared sequence retention capacity, facilitating bidirectional transfer across domains: prosodic patterns from diverse languages generalize to melodic structures and digit strings, rather than unidirectional effects. This mechanism accounts for the observed predictive relationships, where STM capacity and degree of multilingualism jointly explain variance in musicality performance.

Our findings contribute to the existing body of literature on multilingualism and musical abilities by illustrating the interplay between productive musical skills and foreign language proficiency. Unlike the majority of previous studies, which primarily explore the influence of musicality on linguistic skills, our research emphasizes the impact of linguistic capabilities on musical competencies. This study provides preliminary evidence for bidirectional associations between linguistic and musical abilities.

The results of our study suggest that research should move beyond unidirectional models when addressing overlaps between musicality and language ability. Similarly, given evidence of bidirectional training effects between these faculties, music and language education warrant integration to maximize cognitive transfer benefits.

However, the exclusively German-native sample limits generalizability. Future studies should test whether these bidirectional relationships hold across typologically diverse populations while controlling for language-specific influences (e.g., tonal vs. non-tonal systems). Future studies should test whether these bidirectional relationships between degree of multilingualism, STM capacity, and musicality hold across typologically diverse populations while controlling for language-specific influences (e.g., tonal vs. non-tonal systems).

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