Effect of music instruction on phonological awareness and early literacy skills of five- to seven-year-old children

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Abstract

Multiple studies and systematic reviews have shown that music instruction improves phonological awareness (PA) and early literacy skills in children, although findings vary. In meta-analyses, the reliability and significance of the transfer effect are reduced. The study evaluated the effect of varying durations of music instruction exposure, over a single academic year, on PA and early literacy of young children. Based on the exposure to music instruction, participants were assigned to either a low- or high-exposure group. Additional analyses were conducted for 17 age-matched pairs and to compare participants that only received class music to those that received additional music instruction. Between-groups comparisons showed no significant difference after a single academic year of music instruction. Within-groups comparisons identified more PA improvements in the high-exposure group. Exposure to music instruction for no less than one academic year, is required to conclusively evaluate the effect on PA and early literacy.

Keywords

Phonological awareness, early literacy, music instruction, young children

Introduction

Formal music instruction is beneficial to overall development, including language, mathematics skills, self-confidence and interpersonal relationships (Bolduc, 2009; Hallam, 2010). Music instruction is not a foreign experience for most children as music is a global medium of communication and an important part of most cultures and religions (Cross, 2014). Children are often exposed to phonological awareness (PA) activities from a young age by engaging with music (Gan & Chong, 1998; Paquette & Rieg, 2008). Music, similar to and often in combination with play, is a medium of learning for children (Paquette & Rieg, 2008) and provides a natural, fun and engaging learning environment (Cross, 2014; Gan & Chong, 1998). This is important as PA does not mature naturally and must be stimulated directly (Goldstein et al., 2017).

PA refers to the auditory analysis and manipulation of language, through rhyme, segmentation, isolation, deletion, substitution and blending, on two levels. On word level, it refers to the ability to manipulate and analyse larger phonological units, including rhyming and blending syllables. On phoneme level, or phonemic awareness, PA refers to the ability to analyse and manipulate the individual sound units (phonemes) within a word (Degé & Schwarzer, 2011). The inclusion of PA in foundation phase learning to prevent later literacy difficulties is imperative (Moonsamy & Kathard, 2015). PA, including more intricate phonemic awareness abilities, form the basis of phonics knowledge. The early literacy skills of phoneme-grapheme correspondence and phonemic decoding depend on phonics and require the complex audio-visual integration of phonemes. Reading develops as a result of both PA and phonics knowledge (Kilpatrick, 2015).

Multiple studies and systematic reviews have shown that music instruction can improve PA and early literacy skills in young children (Bhide et al., 2013; Christiner & Reiterer, 2018; Hallam, 2010; Kraus et al., 2014a; Liebeskind et al., 2014; Moritz et al., 2013). When the outcomes of individual studies are, however, grouped in meta-analyses (Gordon et al., 2015; Sala & Gobet, 2017; Standley, 2008), the reliability and significance of the transfer effect from music to early literacy is reduced. Standley (2008) identified a moderately significant overall effect size when reading skills, such as phonological segmenting and blending, were incorporated into music education. This finding is supported by research studies and reviews (Bolduc, 2008, 2009; Gromko, 2005; Herrera et al., 2011). Another meta-analysis found that music instruction increased

PA, but no significant transfer was found for reading fluency (Gordon et al., 2015). A recent meta-analysis reported no reliable transfer from music instruction to cognitive and academic skills (Sala & Gobet, 2017). The transfer of skills arising from music instruction to foundational literacy is not yet fully understood. All three meta-analyses highlighted the need for longitudinal studies to contribute to the field (Gordon et al., 2015; Sala & Gobet, 2017; Standley, 2008).

Longitudinal investigations of the effect of musical skills on PA and early literacy need to consider multiple factors that can influence study outcomes. Influencing factors can include the demographics of participants, such as age, gender and language abilities, the academic curriculum in which literacy skills are taught, the duration of exposure to music instruction and the musical abilities targeted (Gordon et al., 2015; Hallam, 2010; Standley, 2008; Tierney & Kraus, 2013).

Musical abilities typically covered in music instruction include timbre, recognizing and producing melodies and harmonies, improvisation, singing, and pitch and rhythm discrimination (Cogo-Moreira et al., 2012; Kempe et al., 2015; Slater et al., 2014). Pitch and rhythm discrimination are the musical abilities most often targeted because they appear to have the greatest association with PA and emergent literacy (Benz et al., 2016; Flaugnacco et al., 2015; François et al., 2015; Patscheke et al., 2018). Pitch and rhythm processing may relate to PA and literacy skills because they are all dependent on auditory discrimination (Christiner & Reiterer, 2018; Flaugnacco et al., 2015; Kraus & Slater, 2015; Patel, 2014). Reciprocally, pitch and rhythm training have been shown to improve auditory discrimination of musical and speech stimuli (François et al., 2015; Kraus & Slater, 2015).

Children are expected to develop PA in the classroom by extracting speech-sounds from background noise. Sounds are then categorised using short timing differences (François et al., 2015; Ritter et al., 2013). Musical pitch and rhythm discrimination reportedly increase the auditory system's ability to overcome background noise and process speech (Patscheke et al., 2016, 2018; Strait et al., 2012; Tierney & Kraus, 2013) due to shared reliance on accurate timing and stress. Auditory discrimination of timing and stress features of speech are critical in PA tasks for the manipulation and analysis of words, syllables and phonemes (Thompson et al., 2013). Phonemic awareness, which relies heavily on auditory discrimination (Schellenberg, 2015), may help to

explain the relationship between music instruction and literacy development. Phonemic awareness requires the understanding that written words are encoded letters formed from the sound properties of a spoken word. Similarly, pitch and rhythm discrimination improve children's ability to process sound and associate visual symbols, notes, to specific tones (Gromko, 2005). Pitch discrimination may be particularly important for PA development as it has been shown to improve stress pattern recognition and assist in segmenting individual phonemes from continuous speech streams (Slater et al., 2014).

Findings describing the relationship between pitch and rhythm discrimination and PA and literacy abilities in young children have, however, shown varied results (Patscheke et al., 2018). In young school children, musical pitch discrimination was found to predict phonological and reading ability while rhythmic discrimination only predicted reading ability (Forgeard et al., 2008). Patel (2011) and Rautenberg (2015) also identified correlations between reading performance and rhythm discrimination, but not pitch discrimination. Longitudinally, children's rhythm performance in preschool significantly predicted their reading abilities at seven and eight years old (Dellatolas et al., 2009). Conversely, a significant correlation between preschool rhythm ability and Grade Two real-word segmenting, but not real-word reading effort and comprehension, has been identified (Moritz et al., 2013). In other studies, pitch perception was associated with phonemic awareness and reading skills in four- to five-year-old children (Anvari et al., 2002; Lamb & Gregory, 1993 in Gordon et al., 2015; Lambert, 2008). The diversity of results reflected in the literature warrants further investigation into the effect of music instruction on the PA and early literacy of the young school-going children (Gordon et al., 2015).

The effects regarding the duration and frequency, also termed exposure to music instruction, have been identified as influencing factors of phonological improvements (Schön & Tillmann, 2015). Some studies indicate that greater exposure to music instruction is associated with the greater improvements of PA and early literacy abilities (Gordon et al., 2015; Hallam, 2010; Heagy, 2018; Linnavalli et al., 2018). Although, a correlation between the duration of music instruction and reading comprehension was identified, no association was found between duration and word-segmenting abilities (Corrigall & Trainor, 2011), which rely on phonemic awareness - the most sophisticated PA ability (Paul & Norbury, 2012). Another study found no link between music

instruction and PA after a five-month programme, provided three times a week to nine-year-olds (Cogo-Moreira et al., 2013). Some studies support the notion that one year of exposure to music instruction is insufficient to improve PA (Chobert et al., 2014; Kraus et al., 2014b; Tierney et al., 2013). Studies examining speech-in-noise (SiN) discrimination have shown changes only after two years of music training and not before (Kraus et al., 2014b; Slater et al., 2014; Tierney et al., 2013). Conversely, other studies have demonstrated a positive effect of music instruction on PA and literacy abilities in one year or less (Bolduc, 2009; Moreno et al., 2009; Moritz et al., 2013). Music instruction lasting less than four weeks was found to be equally effective as instruction that ran for an academic year (Standley, 2008). Exploration of the effect concerning varying durations of music instruction exposure on PA and literacy skills would contribute to the field (Alemán et al., 2017; Piro & Ortiz, 2009).

Numerous studies have investigated the use of music instruction for PA development in additional language learners or sequential bilinguals (Christiner & Reiterer, 2018; Fonseca-Mora, 2013; Herrera et al., 2011; Patscheke et al., 2016; Slater et al., 2014). Limited literature is available regarding the effect on the PA of simultaneous multilingual children. The majority of children in South Africa, where the current study was conducted, are simultaneous multilinguals as they are exposed to multiple languages from a young age (Moonsamy & Kathard, 2015). English is, however, the primary language of education (Baker et al., 2011) regardless of language proficiency. Multilingual children are tasked with learning new academic information and developing literacy abilities with limited to no support from their other languages (Olivier et al., 2010). Phonological differences between languages can further challenge literacy development (Garcia-Lecumberri & Gallardo, 2003) especially if the phonological systems differ greatly. South African English has 19 vowels including diphthongs while African languages have between five and 11 vowels, and do not have diphthongs (le Roux et al., 2017). These differences can potentially impact both PA and phonics knowledge. The effect on early literacy abilities by music instruction in simultaneous multilingual learners should be explored.

There are differing findings in the literature concerning music instruction's effect on young children's foundational literacy abilities, such as PA (Hall et al., 2015). The most critical and recent meta-analysis (Sala & Gobet, 2017) called for future studies to investigate the effects of music

instruction on academic and cognitive skills. PA is not only a cognitive skill but is integral to academic performance (Rodriguez, 2015). After reviewing the existing literature, the following research question was posed: What is the effect of varying durations of music instruction exposure, presented over a single academic year, on the PA and early literacy abilities of young mono- and simultaneous multi-lingual children?

The Study

Participants

Children between five and seven years of age were recruited from two primary schools that follow the same curriculum and are classified as Quintile 5 schools, which indicates that children were from similar, high socio-economic statuses (SES). School One was a school for boys, therefore, only males were selected from School Two to avoid the possible influence of gender differences. Preschool girls have been shown to have more developed PA skills compared to boys (Lundberg et al., 2012) and the difference may increase up until the end of Grade One (Chatterji, 2006). The inclusion criteria were that participants be typically developing males with normal hearing and expressive language, to control for contributing factors. Participants had to be in Grade R, reception year, or Grade One (ages ranging 5.0–7.11) at an Independent Examinations Board (IEB) school and could not have previously repeated a grade. Home language and language of learning and teaching (LoLT) was English. Forty-four parents of children that met the inclusion criteria provided consent for their children to participate in the study, and the children also provided assent, as they were too young to provide legal consent. During the academic year, two children left the study: one withdrew before the completion of the baseline (T1) assessment and the other changed schools mid-year. The final sample included 42 participants, 24 from School One and 18 from School Two.

English was the home language and LoLT of all 42 participants, although many children also had additional home languages. Linguistic diversity is characteristic of South Africa's population where there are 11 official languages (Samuels et al., 2012). Of the 41 (98%) parents that reported on children's languages, 25 (61%) indicated the use of home languages additional to English, including at least one of the following: Afrikaans (36%), Setswana (20%), isiZulu (12%), isiXhosa

(8%), Northern Sotho (8%), Sesotho (4%), Tsonga (4%), Portuguese (4%), Greek (4%), Italian (4%) and Korean (4%).

Procedures

Ethical clearance to conduct the study was obtained from the Faculty of Humanities Research Ethics Committee, University of Pretoria. Permission to conduct the study was obtained from the two IEB schools in the Tshwane District, Gauteng Province of South Africa.

Participants that passed the screenings were assessed with a test battery including PA, phonics and pitch and rhythm discrimination at the beginning of the academic year (February to March) and again at the end of the year (October to November). Assessments were conducted by the first author and senior speech-language therapy undergraduate students after receiving training in administering the test battery from the first author (a qualified speech-language therapist). Assessments were conducted either at the selected schools or at the Department of Speech-Language Pathology and Audiology, University of Pretoria.

Measures

Screening measures for inclusion

Participants' hearing and expressive language abilities were screened to rule out any contributing hearing and language difficulties. Hearing was screened using a mobile audiometer (hearScreen^{TM}, hearX group, South Africa) with Sennheiser HD 280 Pro headphones, calibrated to ISO/ANSI standards. To pass the hearing screening, sounds must be detected at an intensity of 20 dB at 1000, 2000 or 4000 Hz in both ears. The Renfrew Action Picture Test (RAPT) (Renfrew, 2003) was used to screen the expressive language information or vocabulary and grammar skills of the participants when answering specific questions based on a picture card.

Biographical case history

Forty-one parents returned a comprehensive case history form compiled by the researchers regarding participants' biographical information. The case history collected information regarding family characteristics and participants' developmental, medical and educational history.

Phonological Awareness Test 2 Normative Update (PAT-2: NU) (Robertson & Salter, 2018)

The PAT-2: NU (5.0–9.11 years) evaluates children's phonological processing and phonics related early literacy skills of phoneme-grapheme correspondence and phonemic decoding. The PA subtest includes auditory-based tasks to assess rhyming (discrimination and production), segmentation (sentences, syllables and phonemes), isolation (initial, final and medial sounds), deletion (compounds, syllables and phonemes), phoneme substitution and blending (syllables and phonemes). The phonics subtest requires visual decoding of letter combinations shown to children. First, phoneme-grapheme correspondence is assessed in various contexts (consonants, long and short vowels, consonant blends, consonant digraphs, R-controlled vowels, vowel digraphs and diphthongs) and the application of phonemic decoding to nonsense words (vowel-consonant words, consonant-vowel-consonant words, consonant digraphs, consonant blends, vowel digraphs, R-controlled, long vowel words and diphthongs) is evaluated. Emergent English readers rely on word recognition due to the opaque orthographic nature of English (Probert & De Vos, 2016). Phonemic decoding of nonsense words was selected rather than individual reading tests to control for word recognition.

Primary Measures of Music Audiation (PMMA) (Gordon, 2002)

The PMMA (Kindergarten–Grade Three) is used to measure participants' ability to give syntactical meaning to music through pitch and rhythm discrimination and is widely used in research (Christiner & Reiterer, 2018). It consists of recordings of short musical phrases and is presented online via Gia Music Assessment along with an animation to encourage participation. The test consists of two subtests, tonal and rhythm, and in each subtest, participants are presented with example trials, followed by 40 pairs of sounds to discriminate. Half of the presented pairs differ either by one or more notes (tonal subtest) or in rhythm (rhythm subtest). Participants listened to the sound pairs on Sennheiser HD 280 Pro headphones and were asked to indicate whether they perceived the sounds in the pair to be the same or different.

Music instruction

Participants were exposed to various forms of school-based and private music instruction activities over the 38 weeks of the academic year. One music teacher from each school provided 30-minute weekly music classes, offered by the school as part of the curriculum, to the Grade R and One

classes. The music teacher from School One incorporated Kodály music education principles for the Grade R and One learners. The teacher at School Two made use of both Orff and Kodály music education approaches with a greater focus on Kodály principles with the Grade Ones. Grade R and One learners from School One also participated in weekly group recorder sessions (incorporating Orff principles) for 30-minutes presented by another music teacher consistently. Participants in Grade One from School One that elected to receive weekly half an hour individual music instrument lessons (n = 7) (violin or piano) also received additional weekly group music theory classes (30-minutes) from the class music teacher. Three participants from School Two received additional weekly individual music instrument lessons (guitar for 30-minutes, or piano for one hour) from teachers outside of the school. One participant from School Two attended weekly hour-long choir practice.

The participants were predominantly, but not exclusively, exposed to the Orff and Kodály approaches during music instruction. All music approaches cover the basic elements of music, such as rhythm, melody, harmony and timbre, and meet the standards of music education (National Association for Music Education, 2011). The Kodály approach encourages improvisation and singing with increased complexity through systematic sequences of set songs and games. Instruments are only introduced once musical literacy is first mastered vocally (Cogo-Moreira et al., 2012; Niland, 2009). Orff also only provides instruments after basic music skills have developed and encourages a play-based approach. Children learn through a kinaesthetic approach by using their bodies as instruments through movement, speech and clapping (Perlmutter, 2009). Any stimulation of PA and early literacy skills during the application of these approaches was incidental. Music instruction is subjective in application, and the same music educator may use different strategies depending on the class, learner or instrument (Isbell, 2012). Studies show that it is the exposure to music instruction, and not the particular approach, that results in the improvement of foundational literacy (Bolduc, 2009; Moritz et al., 2013; See & Kokotsaki, 2016; Standley, 2008).

Data analysis

Music instruction lasted a single academic year for all participants but differed in terms of exposure due to the various forms of music instruction activities as participants attending more music-related

activities had greater exposure to music instruction. At the end of the academic year and after data collection, information regarding participants' music instruction attendance was collected from participants' parents and the music teachers from each school. All forms of music instruction, school-based and private, were considered when determining the amount of music exposure in hours over the academic year. Consequently, participants were assigned to either a low- or high-exposure group using a median split according to the duration of music instruction, above or below 29 hours of exposure, received over the academic year. The low-exposure group (n = 21) received between 19 and 28.5 hours of exposure while the high-exposure group (n = 21) experienced between 29 and 61.5 hours of music instruction exposure.

Raw scores were used for all calculations as the tests included in the assessment battery were not normed for the South African population. Baseline (T1) ages of the participants from the low- and high-exposure groups were tested for normality using the Kolmogorov-Smirnov D statistic, the Anderson-Darling statistic and the Cramér–von Mises statistic. These three tests indicated that the ages and assessment scores of the participants did not follow a normal distribution across the two research groups. Therefore, the Wilcoxon Signed Rank Test, a non-parametric test, was applied to compare baseline (T1) assessment battery scores between the two groups. In order to control for the error that can occur in multiple comparison tests (11 comparisons were performed), the Bonferroni correction was applied to lower the critical value and hence the individual tests were deemed significant if $p < .0045$. The two-sided p-value was used to assess the significance in these baseline (T1) tests, to either accept or reject the null hypothesis, because one is testing for both low exposure > high exposure and low exposure < high exposure.

To measure the effect of the music instruction on PA and music abilities, the Wilcoxon Signed Rank Test was run on the differences between the baseline (T1) and post-music instruction (T2) scores of each participant in order to compare between the low- and high-exposure groups in terms of their magnitude of change in scores following the music instruction. The change in participants' difference scores from the PAT-2: NU (PA and phonics subtests) and PMMA (tonal, rhythm and composite scores) were analysed.

Within-groups comparisons (T1-T2) evaluated pre-music instruction (T1) versus post-music instruction scores (T2). The one-sided p-value from the Wilcoxon Signed Rank Test was used to evaluate possible changes within each research group after a single year of exposure to music instruction (i.e. testing only for pre-music instruction < post-music instruction).

PA and early literacy abilities experience the greatest amount of development between the ages of five and seven years (Horowitz-Kraus et al., 2017), which is the age range of the participants included in this study. Therefore, the baseline (T1) to post-music instruction scores (T2) of 17 age-matched pairs were compared to control for maturation over the academic year, using the Sign test. Pairs were identified from the low- and high -exposure groups and matched either exactly (n = 12) or within two months of their age (n = 5). Additional analysis was conducted, using the Wilcoxon Signed Rank Test, to compare participants that only received class music (n = 14) to those that received additional music instruction beyond class music instruction (n = 28).

Results

According to the duration of music instruction, the mean age of the low-exposure group was six years and three months (*SDmonths* = 6.83) and they received an average of 20 hours and 47 minutes (*SDhours* = 2.99) of music instruction over the academic year. The high-exposure group had a mean age of six years and two months (*SDmonths* = 5.82) and received on average 42 hours and seven minutes (*SDhours* = 12.34) of music instruction over the year.

Baseline (T1) assessment results indicated average and above average performances on all assessment measures and no significant differences between the two groups in age ($Z = 0.7306$, $p = .4651$), expressive language vocabulary ($Z = -0.6552$, $p = .5123$),grammar abilities ($Z = -0.3281$, $p = .7428$), number of hours spent reading per week ($Z = -0.5736$, $p = .5662$), PA i.e. rhyming ($Z = -0.5177$, $p = .6047$), segmentation ($Z = -0.3784$, $p = .7051$), phoneme isolation ($Z = -0.0756$, $p = .9397$), deletion ($Z = 0.4044$, $p = .6859$), substitution ($Z = -0.1898$, $p = .8495$), blending ($Z = 0.1267$, $p = .8992$) as well as phonics i.e. phoneme-grapheme correspondence ($Z = 0.4154$, $p = .6779$), phonemic decoding ($Z = -0.1674$, $p = .8670$), and music abilities i.e. pitch discrimination ($Z = 0.4164$, $p = .6771$), rhythm discrimination ($Z = 0.1640$, $p = .8697$). No differences between

the two groups in the various variables is an indication that both groups shared similar characteristics at baseline (T1) and were, thus, suitable for comparison purposes (see Table 1).

Table 1. ***Low- and High- Exposure Groups' Raw PAT-2: NU and PMMA Scores at Baseline (T1) and Post-Music Instruction (T2)***

Measure	Baseline (T1) Mean (standard deviation)		Post- music instruction (T2) Mean (standard deviation)	
	Low-exposure group	High-exposure group	Low-exposure group	High-exposure group
PAT-2: NU: Phonological awareness subtest				
Rhyme	13 (5.10)	14 (4.78)	18 (2.33)	18 (3.74)
Segmentation	18 (4.91)	18 (5.76)	21 (5.97)	22 (3.30)
Isolation	18 (9.16)	19 (8.93)	27 (3.25)	27 (3.73)
Deletion	12 (4.36)	12 (3.70)	15 (3.66)	15 (3.27)
Substitution	5 (3.52)	5 (3.02)	7 (2.89)	8 (2.87)
Blending	15 (5.17)	14 (5.86)	19 (2.14)	19 (1.30)
PAT-2: NU: Phonics subtest				
Phoneme-grapheme correspondence	26 (16.48)	24 (14.92)	47 (11.80)	46 (8.82)
Phonemic decoding	15 (13.41)	17 (20.50)	45 (25.84)	36 (24.37)
PMMA				
Tonal subtest	59 (24.26)	54 (32.59)	73 (25.55)	72 (25.68)
Rhythm subtest	60 (24.56)	57 (29.33)	57 (22.01)	53 (27.97)
Composite score	61 (18.72)	57 (26.97)	67 (17.93)	63 (22.88)

Between-groups comparisons (low- versus high-exposure) of PA post-music instruction (T2) scores showed no significant difference after a single academic year of music instruction (see Table 2). Within-groups comparisons (T1-T2) showed significant changes from baseline (T1) to post-music instruction (T2) in both groups (see Table 3). Bonferroni-adjusted levels of significance for post hoc comparison indicated that the low-exposure group improved significantly in two PA

subtests i.e. rhyming ($Z = 3.0324$, $p = .0012$),phoneme isolation ($Z = 3.1111$, $p = .0009$) and the two phonics subtests i.e. phoneme-grapheme correspondence ($Z = 3.6874$, $p = .0001$), phonemic decoding ($Z = 3.3044$, $p = .0005$). The high-exposure group improved significantly in five PA subtests i.e. rhyming ($Z = 3.1992$, $p = .0007$), phoneme isolation ($Z = 3.2890$, $p = .0005$), deletion ($Z = 2.8586$, $p = .0021$), substitution ($Z = 3.1538$, $p = .0008$), blending ($Z = 2.9944$, $p = .0014$) and in both phonics subtests i.e. phoneme-grapheme correspondence ($Z = 4.4544$, $p < .0001$), phonemic decoding ($Z = 2.8785$, $p = .0020$).

Table 2. ***Baseline (T1) to Post-Music Instruction (T2) Difference Score Comparison (Wilcoxon Signed Rank Test) Between Low-Exposure (n = 21) and High-Exposure (n = 21) Groups for PAT-2: NU and PMMA Scores***

Measure	p-Value
PAT-2: NU: Phonological awareness subtest	
Rhyme	0.6044
Segmentation	0.5961
Isolation	0.8300
Deletion	0.1760
Substitution	0.6667
Blending	0.6041
PAT-2: NU: Phonics subtest	
Phoneme-grapheme correspondence	0.8404
Phonemic decoding	0.2172
PMMA	
Tonal subtest	0.8102
Rhythm subtest	0.8797
Composite score	0.9598

* Statistical significance $p < 0.0045$ with Bonferroni correction applied

Table 3. ***Within-Groups Comparisons (T1-T2) (Wilcoxon Signed Rank Test) of Baseline (T1) to Post-Music Instruction (T2) PAT-2: NU and PMMA Scores***

Measure	Low-exposure group (n = 21)	High-exposure group (n = 21)
	PAT-2: NU: Phonological awareness subtest	
Rhyme	0.0012*	0.0007*
Segmentation	0.0583	0.0082
Isolation	0.0009*	0.0005*
Deletion	0.0641	0.0021*
Substitution	0.0152	0.0008*
Blending	0.0055	0.0014*
	PAT-2: NU: Phonics subtest	
Phoneme-grapheme correspondence	0.0001*	<0.0001*
Phonemic decoding	0.0005*	0.0020*
	PMMA	
Tonal subtest	0.0718	0.0768
Rhythm subtest	0.3292	0.2479
Composite score	0.145	0.2899

* Statistical significance $p < 0.0045$ with Bonferroni correction applied

None of the music ability scores showed significant between-groups or with-groups changes post-music instruction (T2). Indicating that neither groups' scores increased or decreased significantly over the academic year. When controlling for maturation by assessing 17 age-matched pairs, no significant between-groups differences were identified (see Table 4). Additional comparisons between participants that only received class music (n = 14) and those that received additional music instruction beyond class music instruction (n = 28) also indicated no significant between-groups differences after a single academic year of music instruction exposure (see Table 5).

Table 4. ***Age-Matched Pairs (n =17) Comparison (Sign Test) for PAT-2: NU and PMMA Scores***

Measure	p-Value
PAT-2: NU: Phonological awareness subtest	
Rhyme	0.1185
Segmentation	0.0213
Isolation	0.7905
Deletion	0.3018
Substitution	1.0000
Blending	0.0768
PAT-2: NU: Phonics subtest	
Phoneme-grapheme correspondence	0.8036
Phonemic decoding	0.6291
PMMA	
Tonal subtest	1.0000
Rhythm subtest	0.3018
Composite score	0.8036

* Statistical significance $p < 0.0045$ with Bonferroni correction applied

Table 5. Baseline (T1) to Post-Music Instruction (T2) Difference Score Comparison (Wilcoxon Signed Rank Test) Between Class Music (n = 14) and Class Music With Additional Music Instruction Activities (n = 21) Groups for PAT-2: NU and PMMA Scores

Measure	p-Value
PAT-2: NU: Phonological awareness subtest	
Rhyme	0.6012
Segmentation	0.2132
Isolation	0.3216
Deletion	0.1135
Substitution	0.8931
Blending	0.4445
PAT-2: NU: Phonics subtest	
Phoneme-grapheme correspondence	1.0000
Phonemic decoding	0.0194
PMMA	
Tonal subtest	0.9039
Rhythm subtest	0.9042
Composite score	0.8411

* Statistical significance $p < 0.0045$ with Bonferroni correction applied

Discussion

The post-music instruction (T2) PA, phonics and music ability scores showed no significant difference between low- and high-exposure groups after a single academic year of music instruction. Comparisons of participants receiving only music class to participants that received class music and additional music instruction also indicated that greater intensity of exposure did not significantly improve PA and early literacy outcomes. These results appear to align with the findings of the meta-analysis by Sala and Gobet (2017) which indicate no transfer effect from music to cognitive-related tasks. From the perspective of duration of music instruction exposure as an influencing factor, this study contributes to the evidence that one year, or less, of school-based and private music instruction activities may not be sufficient to improve PA, literacy and related auditory processing abilities, such as SiN discrimination in young mono- and simultaneous multi-lingual children (Kraus et al., 2014b; Moreno et al., 2011; Slater et al., 2015; Tierney et al., 2013). At least two years of music instruction may be needed to conclusively evaluate music exposure's effect on cognitive-related abilities, such as PA and SiN discrimination (Tierney et al., 2013). Differences between the exposure groups were, however, evident after a single academic year of music instruction exposure.

The within-groups (T1-T2) significant improvements only identified in the high-exposure group included deletion (compounds, syllables and phonemes), phoneme substitution and blending (syllables and phonemes) (see Table 3). These PA abilities are important for the development of phonic skills, such as phoneme-grapheme correspondence and phonemic decoding, in emergent readers (le Roux et al., 2017). Differences in within-groups (T1-T2) improvements between the low- and high-exposure groups could potentially be a result of the high-exposure group's greater exposure to music instruction, although changes were not enough to result in significant between-groups differences. Age-matched pair comparisons were investigated to control for maturation and showed no significant differences post-music instruction (T2). Maturation did not influence the findings of the current study.

Previous studies with various degrees of exposure have identified significant improvements in typically developing young monolingual and sequentially bilingual children's phonological deletion, phoneme substitution and blending after music instruction compared to non-music related

alternative activity control groups (Degé & Schwarzer, 2011; Moreno et al., 2009; Patscheke et al., 2016, 2018). The current study identified no significant differences in young mono- and simultaneous multi-lingual children exposed to varying durations of music instruction for a single academic year. Although a limitation, it was not possible in the current study to include a control group not exposed to music as South African school curricula mandate the inclusion of music classes. Comparisons between PA stimulation programmes and a specialised music intervention embedded with PA, phonemic awareness and phonics activities should, however, be considered with larger, multilingual samples of young male and female children in future studies.

Results from the current study outline potential educational implications for foundation phase (Grade R to Grade Three) educators. Educators are often tasked with managing the phonological and literacy difficulties of many multilingual children within the classroom setting (Moonsamy & Kathard, 2015) and the number of additional language learners in the classroom at-risk for literacy difficulties is growing (Master et al., 2016). The role of music within the school curriculum should be considered as a potential resource for the stimulation of other academic skills (Cloete & Delport, 2015) as creative arts, including music instruction, are noted to improve literacy outcomes (South African Department of Basic Education, 2017). Music is a valuable education tool because it is rewarding, emotionally engaging, indirect and holds young learners' attention (Gan & Chong, 1998; Tierney & Kraus, 2013). The potential benefit of incorporating long-term music programmes in foundation phase learning should continue to be probed in research. Foundation phase educators require support in providing literacy education to a diverse population of learners (Olivier et al., 2010).

The influence of music instruction on speech-processing abilities, such as PA and phonics, appears to be dependent on repetition over time (Patel, 2011; Slater et al., 2015). This study demonstrated that greater exposure to music instruction over an academic year did not result in significant PA and early literacy changes, but the high-exposure did demonstrate more within-groups (T1-T2) changes than the low-exposure group. A follow up study including the same cohort would be valuable to determine if the high-exposure group's within-groups (T1-T2) changes were indicative of a non-significant but small effect of music instruction on PA and early literacy and if the transfer effect is influenced by longer-term duration of instruction (Cogo-Moreira et al., 2013; Corrigall &

Trainor, 2011; Gordon et al., 2015). Delayed effects of music instruction on reading abilities have previously been demonstrated after no significant between-groups difference were identified immediately post- music instruction (Myant et al., 2008). The effect regarding two years or more of music instruction exposure should be compared to the effects described in the current study of a single year of music instruction exposure.

The current participant sample included typically developing males from high SES. Children from high SES typically demonstrate better literacy abilities than children from lower SES (Olivier et al., 2010). The application of the same test paradigm to multilingual male and female children from low SES, and thus at-risk for literacy difficulties, would be valuable. Vulnerable populations, such as children from low SES exposed to biological and environmental risk factors, have poorer literacy achievements and consequently poorer academic performance (Rowe et al., 2016). Innovative approaches to stimulating early literacy development, such as group music instruction, could be valuable and should be investigated (Vally et al., 2015).

Conclusions

The effect of music instruction on cognitive-related tasks, such as PA and early literacy, is an ongoing area of investigation (Gordon et al., 2015; Hall et al., 2015; Sala & Gobet, 2017; Slater et al., 2015). This study indicated that more music instruction did not result in a significant transfer effect on PA and early literacy in young mono- and simultaneous multi-lingual children within a single academic year. Within-groups comparisons (T1-T2), however, identified more PA improvements in the high-exposure group than in the low-exposure group, although not enough to indicate significant between-groups differences. Longer durations of exposure to music instruction, for no less than one academic year, are required to conclusively evaluate the effect on PA and early literacy developments.

Competing interests

The authors declare that there is no conflict of interest.

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