

**Music as a promoter of phonological skills: an exploratory study with Uruguayan preschool children**  
**La Música como promotora de habilidades fonológicas: un estudio exploratorio con niños preescolares uruguayos**

**A música como promotora de habilidades fonológicas: um estudo exploratório com pré-escolares uruguaios**

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**Abstract:** In this study we describe the effects of a Music Intervention Program on the Phonological Awareness, PA, of a group of 21 5-year-old Uruguayan children. A quasi-experimental design of pre-post test group comparison was used. At the end of the pre-schooling period, children who participated in the Music Intervention Program performed better in Phonological Awareness tasks than those of the control group. Finally, in order to analyze the reading performance of the subjects, a word-reading test was administered at the end of the first year of school. The analysis showed statistically significant differences between the groups in reading efficiency. The discussion of the results is based on the characteristics of the stimulation program, which was focused on the development of skills related to rhythm, accuracy and duration. The discussion also takes into account reports from current international literature, which asserts that taking part in a Music Intervention Program stimulates the development of PA Skills.

**Keywords:** Phonological awareness; musical skills; reading acquisition; preschoolers; music intervention program; rhythm

**Resumen:** Este estudio presenta los resultados de un Programa de estimulación de la Conciencia Fonológica (CF), a través de la música en un grupo de 21 niños uruguayos de 5 años de edad. Se utilizó un diseño cuasiexperimental de comparación de grupos (pre-postest-seguimiento). Los niños que participaron del Programa de estimulación obtuvieron un puntaje mayor que los niños del grupo control en tareas de CF, al finalizar el periodo preescolar, y, además, se desempeñaron mejor en una tarea de lectura de palabras que se les administró al finalizar el primer año de escuela. Los resultados se discuten tomando en cuenta lo reportado por la literatura internacional que sostiene que participar de programas de entrenamiento musical favorece el desarrollo de las habilidades de CF, y en función de las características del programa de estimulación que estuvo centrado particularmente en el desarrollo de habilidades vinculadas con el ritmo, la precisión y la duración.

**Palabras clave:** conciencia fonológica; habilidades musicales; adquisición de la lectura; programa de estimulación musical; ritmo



**Resumo:** Este estudo apresenta os resultados de um Programa de Estimulação da Consciência Fonológica (CF), através da música em um grupo de 21 crianças uruguaias de 5 anos. Foi utilizado um desenho de comparação de grupos, quase experimental (pré-pós-follow-up). As crianças que participaram do programa de estimulação obtiveram uma pontuação maior do que as crianças do grupo controle nas tarefas de CF no final do período pré-escolar e, além disso, tiveram melhor desempenho em uma tarefa de leitura de palavras que foi administrada no final do primeiro período do ensino fundamental. Os resultados são discutidos levando em consideração o que foi relatado pela literatura internacional que sustenta que a participação em programas de treinamento em música favorece o desenvolvimento das habilidades da CF, e contemplando as características do programa de estimulação que foi particularmente focado no desenvolvimento de habilidades ligado ao ritmo, precisão e duração.

**Palavras-chave:** consciência fonológica; habilidades musicais; aquisição de leitura; programa de estimulação musical; ritmo

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It is well established that Phonological Awareness, PA, is a complex meta-linguistic skill and it refers to an individual's ability to reflect upon and manipulate the sound structure of spoken words. PA is a forerunner to learning to read in an alphabetic writing system (Alegría, 2006; Caravolas et al., 2012; Castles, Rastle, & Nation, 2018; Defior, 2014; Dehaene, 2017; Melby-Lervåg, Lyster, & Hulme, 2012).

Many have argued that the development of phonological awareness in children follows a hierarchical pattern, progressing from the ability to isolate large sound units (words) to small abstract units (phonemes); which conform oral language (Defior & Serrano, 2014; Melby-Lervåg et al., 2012; Nohales & Giménez, 2014).

Children's ability to analyse smaller and smaller parts of oral language depends on adequate cognitive development, as well as their social and home literacy environment. Early forms of PA development prior to literacy instruction, suggests that experiences with early oral language play an important role in evolving PA. Children's experiences with written language dramatically influence PA development, especially in the advancing of phoneme awareness (Defior, 2014; Defior & Serrano, 2014; Defior & Serrano, 2011; de la Calle Cabrera, Villagrán, & Guzmán, 2016; Domínguez, Nasini, & Teberosky, 2013; Melby-Lervåg et al., 2012; Nohales & Giménez, 2014; Villagrán, Consejero, Guzmán, Jiménez, & Cuevas, 2011). In this sense, 4 year-old children, who grow up in an auspicious home literacy environment, are able to identify words in which the final sounds are the same, for example "sopa vs pipa" ("soup" vs "pipe"). Rhyme awareness requires less conscious and deliberate manipulation of segments than the other

phonological levels, which makes it less cognitively demanding when compared to other phonological awareness skills. Therefore, in most cases, it does not depend on the explicit instruction.

Succeeding children can detect or manipulate syllables before they can detect or manipulate onset and rime. In addition, they are able to perform in initial-final sound word identification and isolation tasks. When children are exposed to formal learning of written language, they can detect or manipulate individual phonemes within intra-syllabic word units. Phonemic awareness includes the ability to separate a word into the sounds that make it up and blend single sounds into words. It also involves the ability to add, omit, or substitute new sounds in words (Cuadro, 2010; Defior & Serrano, 2014; Castles et al., 2018; Torres, 2014). Each one of these phonological tasks involve different levels of difficulties, it depends on their cognitive, linguistic and memory requirement.

The difficulty of a phonological awareness task depends on the size of the phonological unit and the nature of the manipulation that is required. Additionally, the complexity level is defined by unit positions in a word. Preliterate children recognize initial units easier than ending units (e.g., isolating initial sound *vs* isolating ending sound). On the contrary, if children must manipulate the units into a word, it will be easier to manipulate ending sound than initial sound (e.g., deleting ending sound *vs* deleting initial sound). Children's experiences with written language dramatically improve phonological awareness tasks performance, especially in phonological units deletion and addition tasks, as a consequence of a reciprocal relationship between reading and phonological awareness. The higher level of complexity of any phonological task is perceived in phonological units that are located in the middle of a word (Bravo, Villalón & Orellana, 2011; de la Calle Cabrera et al., 2016; Nohales & Giménez, 2014).

The positive effects of PA intervention programs are well established. Several studies have demonstrated that PA can be fostered through nursery rhymes, storytelling and oral languages activities. These studies have found that PA intervention programs are beneficial in terms of progress in reading abilities, both in infants with typically developing and young children who are at risk of literacy delay (Cuadro & Trías, 2008; Gordon, Fehd, & McCandliss, 2015; Jiménez & Ortiz, 2008; Kjeldsen, Karna, Niemi, Olofsson, & Witting, 2014).

Over the last few decades, a growing number of researchers have suggested that musical abilities play an important role in linguistics abilities development, particularly in PA. It is important to highlight that these studies have been done in a diversity of languages (Anvari, Trainor, Woodside, & Levy, 2002; Bolduc & Montésinos-Gelet, 2005; Gordon et al., 2015; Hansen, Bernstorff, & Stuber, 2014; Kraus & Chandrasekaran, 2010; Lamb & Gregory, 1993; Lucas & Gromko, 2007; Peynircioğlu, Durgunoglu, & ÜneyKüsefog˘lu, 2002; Tierney & Kraus, 2013). Several correlational studies have established a link between musical skills and PA, suggesting that music and speech may depend on many of the same basic auditory processes. Rhythmic and pitch patterns auditory analysis are similar to speech segmentation (Gordon et al., 2015; Goswami, 2012a; Kraus & Chandrasekaran, 2010; Patel, 2010; Tierney & Kraus, 2013).

Among the pioneers in this field were Lamb and Gregory (1993), who assessed 16 4 and 5-year-old children with pitch and timbre discrimination tasks, phonemic awareness, and a simple reading test. Results showed that phonemic awareness correlated with simple reading ability. They also reported that pitch discrimination was significantly correlated with phonemic awareness. Subsequently, Anvari et al. (2002) examined the relations among PA, music perception skills, and early reading skills in a population of 100 4 and 5-year-old children. Subjects were given a battery of music tasks and a set of phonemic awareness tasks. Regression analyses indicated that music perception skills contributed unique variance in predicting reading ability, even when variance due to phonological awareness and other cognitive abilities (math, digit span, and vocabulary) had been accounted for. Interestingly, in 4-year-old children both

rhythm production and rhythm discrimination predicted PA. In contrast, for the 5-year-old, only the pitch abilities were correlated with PA.

Peynircioğlu et al. (2002) carried out a study on Turkish and North American preschoolers. Their study showed that perceptive melodic and rhythmic abilities were correlated with PA and recognition of pseudowords abilities, regardless of the children's mother tongue. In a subsequent study, Bolduc and Montésinos-Gelet (2005) examined the performance between PA, melodic perception, and rhythmic perception tasks in a group of French speaking Canadian kindergartners. Results indicated a significant correlation between scores obtained in the perceptive melodic tasks and the syllables and rhymes identification tasks. More precisely, they noticed that melodic perceptive abilities were by far more correlated with syllabic and rhythmic identification tasks. Lucas and Gromko (2007) found a significant correlation between rhythmic and musical pattern discrimination skills and phonemic awareness in first-grade North American 6-year old children.

Furthermore, there is evidence that children who participate in musical training programs not only enhance their musical skills, but also extend to their language skills. In fact, musical activities promote the development of auditory perception, and involve manipulating temporal and nonlinguistic sound structures unfolding in time. A similar operation is required when a phonological task is solved. This implicates speech sound analysis, as well as handling efficiently the inherent temporal structures of the linguistic units. Therefore, some children who are reading disabled exhibit sensory deficits associated with poor temporal processing. In addition, they show difficulties with musical rhythmic skills (Bolduc, 2009; Degé & Schwarzer, 2011; Dellatolas et al., 2009; Flaugnacco et al., 2014; François, Chobert, Besson, & Schön, 2012; Goswami, 2012b; Gromko, 2005; Moritz, Yampolsky, Papadelis, Thomson, & Wolf, 2013; Peretz, 2018; Slater et al., 2014; Tierney & Kraus, 2013).

Herrera, Defior, and Lorenzo (2007), undertook a research to evaluate the effectiveness of two training programs on PA. One of the training programs included musical activities. Participants were divided into two groups. One group involved Spanish speaking preschoolers and the other Tamazight speaking children (a Berber dialect that is transmitted orally and is spoken in Morocco's Rif area). Overall, the results revealed that after the intervention phase the two experimental groups performed better than the control group on all phonological awareness tasks, regardless of their mother tongue. Moreover, the intervention combining phonological and musical activities was found to improve rhyme awareness.

Gromko (2005) conducted a study comparing two groups of preschoolers, before and after they participated in a sixteen-week music program. Children who were involved in the musical programs showed better performance in letter word recognition and segmentation phonological tasks than the control groups.

Bolduc (2009) analyzed the effect of a music training program on the development of PA in a group of French-Canadian kindergarten children. The treatment group participated in a specific musical training program, while the control group took part in the curricula music program. Results have shown that both music programs contributed similarly to the development of tonal and rhythmic perceptive skills. However, the experimental music training program proved to be more effective when it came to developing PA skills.

Degé & Schwarzer (2011) compared the effects of a music program and a phonological skills program on PA in a group of preschoolers. Children were randomly assigned to a phonological skills program, a music program, or a control group that received sports training. Participants in both the phonological skills group and the music group showed significant increases in PA after 20 weeks of training. On contrary, children in the sports group maintained their initial phonological awareness tasks performance.

Moritz et al., (2013), carried out a longitudinal study which analysed the relationship between kindergartners' music rhythm skills and their PA in kindergarten and second grade.

Children were assigned to different musical training programs that differed in range of activities administered, and workload. The experimental group received the *Kodaly* method, while the control group attended a musical workshop for singing nursery rhymes and learning basic musical vocabulary such as slow, fast, low and high, among others. Results indicated that children who received more music training during kindergarten showed improvement in a wider range of phonological awareness skills at the end of kindergarten. Twelve of them were followed up at the end of second grade. Results showed that rhythmic abilities developed in kindergarten were correlated with phonological skills in second grade.

Slater et al., (2014), using a longitudinal design, compared the reading ability of 42 low-income, Spanish-English bilingual children aged 6-to-9. Children from low-socioeconomic backgrounds tend to fall progressively further behind their higher-income peers over the course of their academic careers. In this study, control variables such as reading abilities, intelligence, gender, age at which English was acquired, as well as English reading abilities and educational level of their parents were assessed. The experimental group comprised 23 children, who immediately started the music program once they were assessed. The remaining subjects integrated the control group. Children who received music training maintained their age-normed performance on the composite reading measure after 1 year, whereas children in the matched control group deteriorated over the same period of time, consistent with expected declines in this population. Researchers argued that while the extent of change is modest, the outcomes nonetheless provide evidence that music programs may have value in helping to counteract the negative effects of low-socioeconomic status on child literacy development. Further, early bilingual experience might provide advantages in PA development.

For the most part, these researches have been pursued in languages other than Spanish. A considerably lesser number of studies about PA stimulation through music have been carried out with Spanish-speaking children. It is worth noting that these studies have seldom focused on the development of rhythmic skills. This is so, even when it has been suggested that speech rhythm perception facilitates the identification of spoken words and also prompts the broadening of vocabulary in children, thus promoting the development of PA (Holliman, Wood, & Sheehy, 2010; Wood, Wade-Woolley, & Holliman, 2009). In fact, children who exhibit low PA levels, or difficulties in the process of reading acquisition, also show difficulties in rhythmic skills and synchronization of musical tasks. (Goswami, 2012b; Goswami, Wang, Cruz, Fosker, Mead, & Huss, 2010; Flaugnacco et al., 2014; Lundetræ & Thomson, 2018; Moritz et al., 2013; Tierney & Kraus, 2013; Tierney, White-Schwoch, MacLean, & Kraus, 2017; Thomson, Huss & Goswami, 2006).

To our knowledge, there are no studies in Spanish language that assess the results of a Program of PA Stimulation through musical activities focused on rhythm in pre-school typically developing children. It is therefore of the utmost relevance to produce empirical evidence for this population. The main objective of this study was to analyze the effects of a Program of PA Stimulation through a musical intervention focused on the development of rhythmic skills in a group of 5-year old Uruguayan children, so as to provide some additional evidence to Uruguayan Spanish language.

## **Materials and Methods**

### ***Participants***

Children were recruited from a Public School in Montevideo. At the beginning of the experiment, the sample involved 26 preschoolers (10 girls and 16 boys). 5 children were excluded from the statistical analysis, due to various reasons: at the pretest phase 2 children were not able to complete the Linguistic Segmentation Task, LST (see description in instruments

section). Due to the complexity level of LST, it is administered in two separate sessions; a child who participated in less than 50% of stimulation activities; a child who faced familiar difficulties (this situation was informed by their professor) and another participant who was diagnosed with Asperger Syndrome at the end of kindergarten period. The remaining participants were 21 (8 girls), typically developing preschoolers who came from the same classroom. At the beginning of the study, the children ranged in age from 61 to 70 months ( $M=65.95$ ,  $SD= 2.97$ ). The children's mother tongue was Spanish, they had regular attendance at the school, and they were attending the expected educational level for their age. The participants had not music classes within the curricula program, nor did they attend extracurricular musical workshops.

This current research was approved by ethics committees of the University of the Republic Faculty of Psychology. Parental Permission and Child Assent to participate in this study were obtained.

### **Procedure**

A pretest (Time 1) children were given a test battery assessment:

1. *Raven Coloured Progressive Matrices, (RCPM)* (Raven & Court, 1993): It is a standardized test of abstract reasoning and regarded as a non-verbal estimate of fluid intelligence. This test contains sets A and B from the standard matrices, with a further set of 12 items inserted between the two, as set Ab. Each of these series implies different complexity levels. In this task children are presented with unfinished patterns. They are asked to point to the correct picture out of six pictures that would complete the presented figure.

2. *Peabody Picture Vocabulary Test (PPVT)* (Dunn & Dunn, 2006): It is a standardized test of receptive vocabulary. The test has a straightforward structure. Children see a page on an easel with four pictures. For each item, the examiner says a word, and the children responds by selecting one picture out of four that best illustrates that word's meaning.

3. *Linguistic Segmentation Test (LST)*, (Jiménez & Ortiz, 2008): This test was designed to assess phonological awareness in Spanish preschool children. It includes different tasks for the evaluation of sentence segmentation consciousness and syllabic awareness skills, such as recognition or rhyme, and deletion, counting, and isolation of minimal language units. These tasks are described below:

#### 3.1 *Sentence and syllable segmentation*

3.1.1 *Sentence segmentation*: in this task children were required to repeat orally presented phrases and had to segment these sentences into words.

3.1.2 *Word-syllable segmentation*: in this task, children were required to segment words into syllables in response to a word read aloud by the examiner.

#### 3.2 *Phoneme and Syllable isolation*

Children were presented a set of pictures and had to identify which picture begins with the target sound presented by the examiner.

#### 3.3. *Phoneme and Syllable deletion*

3.3.1 *Initial Phoneme deletion*: children were presented a set of pictures and had to name aloud each image deleting the initial phoneme.

3.3.2 *Syllable deletion*: children were presented a set of pictures and had to name aloud each image deleting the target syllable indicated by the examiner.

#### 3.4 *Recognize words with the same initial or final syllable sounds*

In this task, children were asked to match words that share its initial or final syllable sounds.

#### 3.5 *Syllable blending*

In this task, the examiner presented the syllables of a three-syllable word separately, and the child is asked to orally blend them into a word.

At the posttest (Time 2) and at the follow-up phase (Time 3) all subjects were assessed again with LST. In order to account for a reading measure, children were administered a reading word test (adapted from Serrano's task, 2005) one year after the music intervention program was finished (Time 4). This task comprises a total of 26 items (14 bisyllabic and 13 trisyllabic words), which contain a variety of levels of complexity in regard to word structure. Children were evaluated in an individual session, in a quiet salon at their school.

Subject groups were matched for dependent variable Phonological Awareness, PA ( $p=.605$ ), as well as, they were similar in their receptive vocabulary level ( $p=.809$ ), intelligence ( $p=.223$ ), month of age ( $p=.219$ ) and gender ( $p=.645$ ). Subsequently, participants were assigned to one of the two conditions of this study: Experimental Group (EG) and Control Group (CG): EG ( $n=11$ , four girls), and CG ( $n=10$ , four girls). This contributed to the internal validity of this study (Schaughnessy, Zechmeister & Zechmeister, 2007).

Children who integrated the EG ( $n=11$ ) participated in a musical intervention program based on rhythmic activities through musical games. All activities were highly demanding to manipulate the time structures of the sound events. Wooden hand percussion instruments and cups drumming rhythm were used to learn rhythmic accompaniment for African or Brazilian songs. Graphic notation was used to learn to read basic rhythmic patterns. Meanwhile, children from the CG, ( $n=10$ ) took part in a workshop. They did not receive formal training in music, and these sessions did not include playful musical activities whatsoever. For both groups a total of 32 sessions, two 30-minutes sessions per week, were completed.

### ***Music Intervention Program based on rhythmic activities***

The Music Intervention Program was designed to run over a 16-week period. It was structured in two 16-session modules. The Intervention Program was carried out by a team of three people: a Music Graduate and two undergraduate psychology Students. The first module was 16 sessions long. It comprised musical activities with percussion instruments, rhythmic accompaniment of songs, and rhythmic games with accessories. All activities were grupal.

The complexity of the tasks was gradually increased. In some of the sessions the level of difficulty was adjusted in response to the performance of the participants. The focus of musical activities was always on the rhythmic structure of the musical material, and in the perception and manipulation of the temporal features of sonic events, such as duration, sequence, and rhythm. In some activities, however, audio recordings were used to prop up the exercises and musical games. Most times, the repertory consisted of songs, rhymes, and games in languages other than Spanish. This selection prevented the musical activities from being interfered by the structure of the children's mother tongue. The participants were then able to focus chiefly on the rhythmic structure of the exercises. Thus, rhymes in Portuguese language or children's songs of African origin, in *Lingala* dialect, provided the material for rhythmic accompaniments, plays of hands, and rhythmic games with cups and other wooden hand percussion instruments. At the same time, different musical awakening activities were used in order to teach various musical concepts (*tempo*, pulse, metric accent, *accelerando*, *diminuendo*, *ritardando*, and silences). All games allowed for variations in performance, and were executed at different speeds and dynamics, so as to increase the complexity of the exercises. The second module (16 sessions) introduced activities that required the reproduction of 2-beat rhythmic patterns presented by the examiners. Exercises of rhythmic reading in 2, 3, and 4 beats, with optional use of silence in either the first or the fourth beat, were also introduced in this module. In this module, children were also taught how to read simple rhythmic patterns. Graphic music notation was used, since acquiring the knowledge and skills needed to operate with traditional music notation implies a considerable degree of difficulty for the age group we worked with. Graphic notation makes it simpler to

focus on the rhythmic aspects of a structure, since it is based on drawings and symbols, where each symbol represents a specific duration, attack, and timbre.

Children from the CG, under the guidance of participant adults, took part in a workshop where children songs were sung, the performances were assisted by audio recordings of the songs. These activities were carried out with the same period and frequency as the activities of children in the EG. Children from the CG did not receive formal training in music, and these sessions did not include playful musical activities whatsoever.

Before proceeding to analyze the effect of the stimulation, the researchers made sure that there was no difference in the attendance of children for each of the conditions ( $p=.918$ ).

## Results

Since the sample size was small, we used non-parametric techniques. This allows the groups to be compared without making the assumption that values are normally distributed. For comparisons between the groups Mann-Whitney  $U$  test and average ranges were used (Bologna, 2012). As a central tendency, median is reported due to it being less affected by outliers. Percentiles 25 and 75 are reported (Shaughnessy et al., 2007).

At the Time 2 (posttest), group comparisons were calculated using the gains in scores from LST (Linguistic Segmentation test) between T1-T2. Effect size from  $r$  de Rosenthal is reported.

Table 1 shows statistically significant differences between the groups in the gains in scores from LST ( $r= 0.69$ ;  $p=.001$ ). Significant differences in a set of phonological tasks were also observed: segmentation ( $r=0.80$ ;  $p=.001$ ); isolation ( $r=0.47$ ;  $p=.029$ ); deletion ( $r=.057$ ;  $p=.008$ ) and syllable blending ( $r=0.45$ ;  $p=.043$ ). No statistically significant differences were observed between the groups in recognizing words with the same final syllable sound ( $p=.085$ )

Table 1  
*Gains in scores from LST between T1-T2 and effect size*

Time 2	Experimental Group		Control Group		$U$	$Z$	$P$	$r$
	Median	P25-75	Median	P25-75				
LST	27	23-31	.50	-1.00-7.00	9.500	-3.206	.001	.69
Segmentation	6	5-7	.00	-3.00-3.00	3.000	-3.681	.000	.80
Isolation	2	.00- 4	.00	-1.00-1.00	24.500	-2.189	.029	.47
Deletion	12	10-18	1 .50	-1.00-7.00	18.000	-2.616	.008	.57
Recognize	4	2-4	2 .00	-3.00-2.00	30.500	-1.758	.085	_____
Blending	1	.00-2	-1 .00	-1.00-0.0	2.500	-2.064	.043	.45

Linguistic Segmentation Test, LST (Maximum score= 75): Segmentation (score=18); Isolation (score=6); Deletion (score=26); Recognize (score=20); Blending (score=5)

When children entered first grade, they were reassessed with the task. This allowed us to observe whether differences between groups held over the long-term (Time 3).

Tabla 2  
LST scores and phonological performance tasks

Time 3	Experimental Group		Control Group		<i>U</i>	<i>Z</i>	<i>p</i>
	Median	P25-75	Median	P25-75			
LST	70	60-72	55	49-62	14.000	-2.897	.003
Segmentation	17	16-18	13	9-16	13.500	-3.014	.002
Isolation	6	5-6	6	4-6	54.500	-0.42	.973
Deletion	24	21-25	20	16-22	14.500	-2.873	.003
Recognize	19	15-20	16	12-17	30.500	-1.749	.085
Blending	4	4-5	4	3-4	35.500	-1.482	.173

Linguistic Segmentation Test, LST (Maximum score= 75); Segmentation (score=18); Isolation (score=6); Deletion (score=26); Recognize (score=20); Blending (score=5)

As observed in Table 2 statistically significant differences between the groups remained intact in LST total score ( $p=.003$ ), segmentation ( $p=.002$ ) and deletion tasks ( $p=.003$ ). In this phase, there were no significant differences between the groups in isolation ( $p=.973$ ), and syllable blending tasks ( $p=.173$ ).

A year later the music program had finished (Time 4), 19 children (10 experimental group; 9 control group) were assessed with a reading word test (adapted from Serrano, 2005). Children were given 60s to read aloud as many words as possible from a list of 26 high-frequency words. The list began with words consisting of bisyllabic words and grew to include more complex words. At this time, a measure of word reading rate was obtained. Table 3 shows statistically significant differences between the groups in word reading rate ( $p=.035$ )

Table 3  
Word Reading Rate

Time 4	Grupo Experimental		Grupo Control		<i>U</i>	<i>Z</i>	<i>p</i>
	Median	P25-75	Median	P25-75			
Total of words read per minute (Maximum score= 26)	23	17-25	11	8-13	19.500	-2.095	.35

## Discussion

In this study we sought to analyze the effects of a program of PA Stimulation through a musical intervention centered on the development of rhythmic skills in a group of 5-year old Uruguayan children, for which we have no evidence for Uruguayan Spanish.

Assessments were implemented at four points in time; Time 1 just after the start of the first semester of the last year of initial education. Time 2 at the end of the last year of initial education; Time 3 at the entry of children to their first grade, and Time 4, at the end of the first grade.

Results from the data analysis of Time 2 showed that children who attended the Music Intervention Program during 4 months had gains in outcomes from LST higher than the CG. At the same time, the results sorted by type of phonological awareness task also showed that the EG obtained higher gains outcomes than the CG in 4 out of the 5 phonological awareness tasks that were evaluated (segmenting, isolating, deleting, and blending tasks). No statistically significant differences were observed between groups in recognizing words with the same final sounds.

A third evaluation was administered when children entered the first grade. Statistically significant differences between groups held for the LST, and for 2 out of 5 phonological awareness tasks that were assessed: segmenting and deleting tasks. This suggests that the effects of the program were long lasting and were not compensated by the spontaneous development of children in the CG.

In this phase, the improvement in scores observed in the CG in the tasks of isolating the initial and final sounds in a word and syllable blending task is consistent with the observations of Jiménez and Ortiz (2008). These authors point out that it would observe a great improvement in total score in LST between the first and second administration (at least 7 months), due to a PA developing quickly once literacy instruction begins. At the same time, when total scores for the isolating sounds and syllable blending tasks are considered, the differences could be explained by the total score of each one. The maximum score for the isolation task is 6 points, and the maximum score for the blending task is 5 points. This suggests that small progress of the CG in these tasks caused the significant differences observed between groups at Time 2 to disappear at Time 3.

Regarding the performance achieved for both groups in the task of recognizing similar unit sounds between words, two possible explanations exist that take into account the overall scores. As the first acquired phonological awareness skill, rhyme recognition is a simple phonological awareness task, in which the child requires just a certain degree of consciousness of the phonological structure of spoken language. The performance of this type of tasks does not reveal significant differences between age groups (Defior & Serrano, 2014).

On the other hand, the lack of differences in this task could also be credited to the characteristics of the Intervention Program. In it, the musical activities were not focused on tasks requiring judgments about the similarities or differences between melodic structures. Furthermore, the regularities of Spanish language were not exploited; rhythmic games in other languages or dialects were used, so that children did not focus on the phonological structure of their mother spoken language during training. Meanwhile, children of the CG were stimulated in this skill through nursery rhymes. This result is similar to the one reported in the study of Herrera et al (2007), in which only the group of children that participated in a PA Training Program which included the utilization of children songs experienced an improvement in the performance of tasks of identification of rhymes between two words.

As a whole, the results of this study are consistent in general with those of other investigations carried out with Spanish speaking preschoolers, which endorse the existence of a certain evolutive development in the tasks of PA, in increasing level of difficulty and different moments of emergence during development (counting, isolating, adding, deleting and

blending),(de la Calle et al., 2016; Defior & Serrano, 2014; Jiménez & Ortiz, 2008; Nohales & Giménez, 2014; Villagrán et al., 2011).

Moreover, the results of this study expand on previous reports suggesting that production and perception of rhythm are tightly linked to the ability of phonological segmentation and detection of syllables. Likewise, the ability to perceive and manipulate time intervals in a sequence of sounds is essential for an efficient performance in phonological tasks (Dellatolas, Watier, Le Normand, Lubart, & Chevrie-Muller, 2009; François et al., 2012; Moritz et al, 2013). At the same time, it can be observed that the superior performance achieved by the EG in the deleting of initial or final unit sound are in direct connection with the activities of reproduction and reading of rhythmic patterns with introduction of silences in the first or last beat, which were worked on during the second module of the specific training. Hence, it can be suggested that training in this kind of musical activities proved effective for one of the most challenging phonological awareness tasks for preschoolers. Deleting and manipulating initial or final sounds requires some degree of instruction.

A year after the training was completed, a word reading test was conducted to analyse the performance in reading accuracy. Data from 19 participants was obtained (10 from the EG and 9 from the CG). Statistical analysis showed that the word rate reading in children involved in EG was higher than the subjects of the CG. These results are consistent with a body of literature which asserts that PA is a key precursor for the acquisition of reading in languages that use an alphabetic writing system (Alegria, 2006; Bravo et al., 2011; Caravolas et al., 2012; Castles et al., 2018; Defior, 2014; Dehaene, 2017; Melby-Lervag et al., 2012; Morais, 2016).

However, it is necessary and pertinent to study in greater depth the influence that musical training could have had in attentiveness and concentration, as well as in the executive functions of children (Degé, Kubicek, & Schwarzer, 2011; Frischen, Schwarzer, & Degé, 2019; Kraus & Chandrasekaran 2010; Moreno et al., 2011). Given the characteristics of the activities of the program, and the difficulties of the musical activities that were implemented, it is necessary to enquire about the effects of the training in working memory, inhibitory control, cognitive flexibility, concentration and attention of children. This could have facilitated the resolution of phonological tasks of higher complexity (Thomas, 2016). Therefore, the mediation of executive functions between musical training and reading skills should be taken into account in future investigations.

The results of this investigation go in the same direction as current literature which asserts that PA can be stimulated through music in pre-readers. They provide additional evidence about rhythm as an important factor for the design of musical activities in the initial levels (Bolduc & Rondeau, 2015; Gordon et al., 2015; Hansen et al., 2014; Moritz et. al., 2013; Slater et al., 2014).

To date, this is the first study to deal with the relationship between rhythmic skills and PA development in Uruguayan Spanish speaking 5-year old typically developing children. It shows that musical training which explores the parameter of duration in the context of musical rhythm has beneficial and lasting effects on the development of PA as well as on word reading fluency one year after the beginning of formal instruction.

### ***Limitations and Future Directions***

The present study has some limitations that it should overcome in future research. The major limitation of this study is that the sample size is small. While the data is rich, the results need to be reinforced by additional research with a larger sample before large scale inferences can be made. It is worth noting that the results observed in this study must be accounted for due to its essentially exploratory value. Although the research design and statistical analyses used in this study enable us to argue that music intervention program was efficacious in PA skills

development, it would have been more suitable to account for some base line of rhythmic and musical abilities at the initial stage of this study. As already mentioned in the discussion section, it remains unclear to what extent executive functions were fostered through musical activities. The question must be posed, therefore, on to what extent executive functioning could have underpinned the PA improvement. Future researches would address and overcome all of these limitations.

To gain a more complete picture of the relationship between musical skills, and early reading abilities in Spanish, it is necessary for more academic research in this field. To conclude, the literature review and our findings suggest that music training, focused on rhythm, could be beneficial for developing PA in preschoolers. It might have practical implications for early education.

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