Early Education and Development

Language and executive function in the third year: the efficacy of the Drežančić method in preschool settings

--Manuscript Draft--

Manuscript Number:	
Full Title:	Language and executive function in the third year: the efficacy of the Drežančić method in preschool settings
Article Type:	Original Article
Corresponding Author:	Francesca Cozzani, Ph.D. University of Genoa Genoa, Genoa ITALY
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	University of Genoa
Corresponding Author's Secondary Institution:	
First Author:	Francesca Cozzani, Ph.D.
First Author Secondary Information:	
Order of Authors:	Francesca Cozzani, Ph.D.
	Mirella Zanobini
	Maria Carmen Usai, Ph.D.
Order of Authors Secondary Information:	
Abstract:	Abstract Research Findings: This study is aimed to evaluate the efficacy of linguistic training based on the Drežančić method in preschool settings. The hypothesis is that the peculiar characteristics of this method could influence language competence and executive function (EF). A pre-posttest treatment design with a control group was employed to evaluate the efficacy of the method for linguistic and EF skills. Forty-one children (ranging in age from 26 to 31 months) were recruited to participate in the study and were assigned to two groups: an experimental group that received training and a control group that participated in normal preschool activities. The participants were selected based on cutoff scores for linguistic skills (a vocabulary size score lower than the 50th percentile on the Italian version of the CDI). The results reveal an effect of the training. The experimental group produced a greater variety of words and more completed sentences, and moreover the linguistic training appeared to positively affect inhibitory processes. Practice or Policy: Registering significant differences following a limited intervention, that is applicable to educational contexts, offers cues for spreading. Furthermore, the confirmation of a rich interaction between language and EF even at such early ages provides important implications for clinical work.

Genoa, December 4th, 2014

Object: paper submission

Dear Editor,

Please, we ask the manuscript "Language and executive function in the third year: the efficacy of the Drežančić method in preschool settings" to be considered for publication in the Early Education and Development.

Yours sincerely

Francesca Cozzani

DISFOR, Department of Education Sciences
University of Genoa
Corso Podestà 2
16128 Genova
Italy

Phone: +39 010 20953705
Fax: +39 010 20953728
E-mail: francesca.cozzani@edu.unige.it

LANGUAGE AND EXECUTIVE FUNCTION IN THE THIRD YEAR: THE EFFICACY OF THE DREŽANČIĆ METHOD IN PRESCHOOL SETTINGS

Abstract

Research Findings: This study is aimed to evaluate the efficacy of linguistic training based on the Drežančić method in preschool settings. The hypothesis is that the peculiar characteristics of this method could influence language competence and executive function (EF). A pre-posttest treatment design with a control group was employed to evaluate the efficacy of the method for linguistic and EF skills. Forty-one children (ranging in age from 26 to 31 months) were recruited to participate in the study and were assigned to two groups: an experimental group that received training and a control group that participated in normal preschool activities. The participants were selected based on cutoff scores for linguistic skills (a vocabulary size score lower than the 50th percentile on the Italian version of the CDI). The results reveal an effect of the training. The experimental group produced a greater variety of words and more completed sentences, and moreover the linguistic training appeared to positively affect inhibitory processes.

Practice or Policy: Registering significant differences following a limited intervention, that is applicable to educational contexts, offers cues for spreading. Furthermore, the confirmation of a rich interaction between language and EF even at such early ages provides important implications for clinical work.

Keywords: language training, executive function, young preschool children, educational context.

Language and executive function in the third year: the efficacy of the Drežančić method in preschool settings

This study primarily aims to examine the effectiveness of an intervention conducted in preschool settings to promote language competence in early childhood. In recent decades, most efforts have been devoted to creating training that is effective in fostering children's development, especially when their educational environment is poor or inadequate for improving their abilities or for stimulating their potential development. In addition to reducing difficulties in individual development, such interventions could be important tools for reducing the achievement gap between more and less advantaged children.

A secondary aim of this study is to analyze the association between language development and other higher-order cognitive processes, such as executive functions (EF). The interest in the relationships between these domains has its origins in Vygotsky theory, but in recent years, the attention of researchers has also been focused on early childhood.

Effectiveness of language trainings

Research on the treatment efficacy for linguistic competence is primarily aimed at exploring the results of specific interventions targeting speech and language delays. Participants are typically children with various types of developmental language delays or impairments that involve expressive and/or receptive language skills and that may involve difficulty with one or more of the following: phonology, vocabulary, morphology and syntax.

Two meta-analyses (Law, Garrett & Nye, 2004; Law, Garrett & Nye, 2010) considering a number of studies with randomized control trials coded information relating to the characteristics of participants (age and type/severity of difficulty), designs, interventions (aims, intensity, duration, and administrators) and outcomes (expressive or receptive phonology, vocabulary or syntax). These

studies allowed us to draw some general conclusions: language therapy interventions typically show significant effects when children have phonology or expressive delay, where as there is mixed evidence for expressive syntax difficulties, and the effect of language therapy interventions on language output is smaller for groups with receptive language disorders; typically, no significant differences are found between the use of parents or clinicians as administrators or between group and individual interventions; trainings lasting longer than eight weeks may be more effective than those of shorter duration; and normal-language peers have a supportive role as language models for children with language impairment.

As noted by Robertson and Weismer in 1999, most treatment studies currently involve children in advanced preschool or school years. For example, Gierut, Morrisette, Hughes, and Rowland (1996) studied the positive effects of conducting phonological training with children with phonological disorders between the ages of three years and seven months and five years and six months. Other studies concern the application of language and literacy curricula for preschoolers with developmental speech/language impairment: for example, Wilcox, Gray, Guimond and Lafferty (2011) found significant effects of training based on children-teacher interaction, with teachers trained to use a program based on language and early literacy acquisition research consistent with typical early childhood standards.

Recently, the study conducted by Przybylski *et al*. (2013) tested the influence of a rhythmic auditory stimulation on syntax processing in twelve children with specific language impairment between the ages of 6 years 6 months to 12 years 11 months. The experimental material consisted of musical sequences of different levels of difficulty (regular vs. irregular rhythmic structures) and linguistic stimuli (96 French sentences: 48 correct and 48 incorrect sentences). The children made better grammatical judgments after the regular musical prime than after the irregular prime. Although the performance level of the children with language impairment was lower than that of control children of the same chronological age, both groups benefited from the regularity of the

musical prime. The authors concluded that "providing evidence for cross domain effects (from music to language) over time is encouraging and multiplies the possibilities of using rhythmic stimulation in training or remediation programs, in addition to accentuating rhythmic structures in linguistic material itself (at the same time, as in poetry)" (p. 129).

Several studies conducted in the later years of the last century considered the effect of early intervention on the development of young late talkers. Robertson and Weismer (1999) compared two groups of toddlers using different linguistic and social measures: the experimental group, which was composed of 11 participants, was involved in training twice a week for 12 weeks based on an interactive, child-centered intervention. The training was conducted in natural settings involving small groups of children and was conducted by speech-language pathologists experienced in intervention with infants and toddlers. Compared with the control group, the experimental group showed significantly greater improvements in the phonological, lexical and syntactic domains. Moreover, indirect measures of socialization and parental stress showed significantly greater improvements in the experimental group.

Girolametto, Pearce and Weizman (1996) demonstrated the effect of a parent-based intervention to promote language development in late talkers: children in the experimental group (25 late talkers between 23 and 33 months old) showed significant increases in their vocabulary size and better performance in the use of various target and control words in interactions compared with a paired sample of children in the delayed treatment group. In a subsequent study, the authors extended these results, showing that a focused stimulation centered on lexical training also had indirect effects on some of the children's phonological abilities (diversity in syllable shapes and consonant inventories) but did not affect the accuracy of consonant production (Girolametto, Pearce & Weizman, 1997).

Taken together, these results indicate the effectiveness of linguistic training for young late talkers, and the authors mentioned above generally have favorable views of precocious intervention.

A different opinion is expressed by other authors, who suggest caution in referring young children to speech therapists because objective language scores for toddlers are sometimes difficult to obtain. Moreover, at this age children are considered too young to be capable of cooperating in language tasks (Strong, Torgerson, Torgerson & Hulme, 2011).

In the debate between the interventionist and *wait-and-see* perspectives, a justification to support early intervention is the potential influence of language impairment on other aspects of child development. Girolametto *et al*. (1996) emphasized the negative effects of language problems on parental behavior and consequently on a child's potential for learning: indeed, the presence of language impairments is related to parental stress levels and, in turn, with children's social competences (Robertson & Weismer, 1999).

Speech and linguistic abilities are a useful indicator of a child's overall development, and the precocious identification of children at risk for developmental delays may lead to intervention services given at a young age, when the likelihood of improvement is best (Nelson, Nygren, Walker & Panoscha, 2006).

Such different opinions regarding the opportunity for precocious intervention may result from different considerations of what early intervention means: indeed, training involving children in their advanced preschool or school years typically requires some form of explicit teaching and the participation of children in well-crafted speech therapy sessions. Children under three years need to be stimulated naturally during spontaneous play and possibly in a group condition involving peers, and such natural stimulation is possible when the intervention occurs in a natural educational setting. Moreover, as shown in previous studies, it is important to choose a method of intervention that is consistent with the developmental characteristics of this age level.

To reduce the probability that a linguistic delay in young children will persist in their preschool years or negatively influence subsequent development in different areas, it is important to study the effect of intervention programs at a young age, also in children who are not identified as

language impaired but exhibit a low range of typical linguistic ability or in those who are identified as late talkers.

The Drežančić Method

The "Creative Rehabilitation Method of Oral and Written Communication with Musical Structures" was created by Zora Drežančić (1995) to enhance linguistic development in children with profound pre-lingual deafness and subsequently applied to children with different types of language impairment, and this method appears suitable for stimulating language in a natural setting (Zanobini, Basili & Lanzara, 2010).

The Drežančić Method (here after referred to as the Method) is composed of four different programs designed for children of different ages. The first program is designed for children from the first month of life to three years. In this phase, the proposed linguistic stimulation activities are aimed at enhancing the voicing and discrimination of linguistic sounds and the phono-motor control that is necessary to produce words and phrases.

The program for children between zero and three years is based on gaming activities in small groups in which interaction with an adult and peers is crucial to the success of the activity. The adult verbal inputs are based on the normal stages of linguistic and cognitive development, and the stimulation is based on the use of different simple objects combined with a linguistic sound (*giochi fonici*, from now phonic games, term created by Zora Drežančić). The stimuli used are intended to help with all the basic components of speech: voice, intonation, rhythm, and sounds of speech. The stimuli arise simultaneously on a multisensorial basis.

The main objectives of the training are to stimulate a good quality of voice, to support the discrimination of speech sounds and to promote lexical richness and the production of complete sentences with all necessary elements.

The use of multisensory stimuli (phonic games) combining auditory, visual, and motor elements encourages the processes of analyzing, integrating and coordinating sensory data and promotes the

development of mental functions connected to language skills, such as attention, memory and emotions.

The stimulation that is typical of the method, which uses a singing voice and musical rhythm, is consistent with studies that emphasize the relationship between music and language in children (Jentschke, Koelsch&Friederici, 2005) and the positive effect of music training on the pitch processing of language (Schön, Magne & Besson, 2004) and on the syntactic processing of children with language disorders (Przybylski *et al*., 2013).

The relationship between language and EF

EF is a set of higher-order cognitive processes that control and modulate cognition under multiple continuously changing task demands (Hughes & Graham, 2002). EF skills emerge early during children's development. Studies of the latent organization of EF in early childhood suggest that inhibition is one of the earliest executive skills that is separate from the other EF abilities at preschool age (Miller, Giesbrecht, Müller, McInerney, & Kerns, 2012; Usai,Viterbori, Traverso, & De Franchis, 2014) and that is in turn composed of separate dimensions already in the fourth year of life (Gandolfi, Viterbori, Traverso, & Usai, 2014).The term "inhibition" indicates a series of different processes; indeed, two separate dimensions are found in early childhood. The response inhibition refers to the ability to control impulsive behavior and to prevent prepotent motor or verbal responses, and the interference suppression involves more complex processes, such as mental set-shifting and working memory, and comprises the suppression of interfering information (Bunge, Dudukovic, Thomason, Vaidya, & Gabrieli, 2002; Gandolfi *et al*., 2014).

The majority of existing studies of the relationship between language and EF are found in the atypical language development literature (see, e.g., Dodd & McIntosh, 2008; Im-Bolter, Johnson & Pascual-Leone, 2006; Marton, 2008; Ullman & Pierpoint, 2005). In general, these studies

demonstrate that children with speech impairment perform more poorly than controls on EF, attention and working memory measures.

Recent research exploring the relationship between emerging EF skills and early language ability in typically developing children during the third year of life has shown that inhibitory control tasks are associated with various phonological measures, such as intelligibility and phonological accuracy (Viterbori, Gandolfi & Usai, 2012; Cozzani, Usai & Zanobini, 2013),morphological and syntactic abilities (Viterbori *et al*., 2012; Cozzani *et al*., 2013; Marano & Devescovi, 2014), and lexical competences (Cozzani *et al*., 2013; Marano & Devescovi, 2014),even when the level of general cognitive ability is controlled (Cozzani *et al*., 2013).As noted in other research (Wolf & Bell, 2004), inhibitory control is the executive dimension most strongly associated with linguistic abilities at this age.

The research generally documents the presence of strong relationships between certain aspects of executive functioning and different linguistic abilities during the early stage of development of these capacities. Nevertheless, the question remains as to whether an enhancement of linguistic abilities can be associated with improvements in the emergent EF.

Moreover, to the best of our knowledge, no studies have tested the effectiveness of interventions in promoting executive functions in typically developing children under the age of three years.

The present study

The aim of this study is to evaluate whether linguistic training based on the Drežančić method enhances the competence of children with a low-medium level of linguistic development in both the linguistic and EF domains. The characteristics of this method seem particularly suitable for fostering phonological, lexical and grammatical acquisition as well as encouraging children to pay attention to relevant stimuli and promoting the inhibition of prepotent uncontrolled responses.

In particular, after observing initial performance on various tasks, we hypothesize differences between the experimental and control groups with respect to the following aspects: different measures of language acquisition, namely, consonant inventories, intelligibility and the accuracy of verbal production; vocabulary richness; and the quantity and quality of sentence production.

We also predict that the experimental group would benefit from training and display an improvement in EF, particularly inhibitory control, which has been shown to be the most strongly connected to language in early childhood.

Method

Participants and sampling

The families of 67 children (with age range of 26-31 months, mean = 28.57,*SD*= 1.61) attending a preschool day-care center agreed to participate in the study. The children were enrolled in 5 different day-care centers. All participants were born in Italy and had attended the day-care centers for at least one year. Consent to participate was requested for each child. The following inclusion criteria were used in this study: having no diagnoses of any neurological, psychiatric, or developmental disorders; having a developmental quotient higher than 85 on the Bayley mental scale (BSID-III, Bayley, 2006); and having a vocabulary size score on the Italian version of MacArthur-Bates Communicative Development Inventories (CDI, Fenson *et al*., 1993) equal to or lower than 50th percentile scores (thus covering a range of competence levels, from late talkers to children whose lexical production is in the medium-low range for the corresponding age standard).

Of the 67 children initially recruited, 26 were excluded from the study for the following reasons: a developmental quotient lower than 85 on the Bayley mental scale (1), a level of vocabulary size higher than the 50th percentile on the Italian version of the CDI (17), unavailability

at the time of assessment because of prolonged illness or family transfers (6), or suspected or confirmed development delay (2).

The final sample was composed of 41 children (21 males and 20 females) from 26 to 31 months of age (M = 28.47 months, SD= 1.56 months): 20 children in the experimental group (M=28.01 months, SD=1.48, 12 males and 8 females) and 21 in the control group (M=28.76 months, SD=1.55, 9 males and 12 females). In the first evaluation, six children refused the test of spontaneous language, PFLI (four from the experimental sample and two from the control sample), and eight children (five from the experimental sample and three from the control sample) were excluded from the phonetic analyses because the number of different words in the first evaluation was small (fewer than 50 words).

The mother's education level ranged from 8 to 18 years (M=12.45 years), and the father's education level ranged from 8 to 18 years (M=11.57 years).

Graduate students trained in developmental psychology individually administered the EF tasks and the language assessment in two 20- to 30-minute sessions to the children while they were at the day-care center. The researchers transcribed the language produced by the children immediately after it was recorded.

Study design

This efficacy study aims to evaluate the efficacy of the Drežančić method on linguistic skills and EF with a control group (pre-posttest treatment design). The between-groups independent variable for the study was the participation in linguistic training.

Prior to training (Pre-intervention Baseline)	
Assessment of language and EF	
Assignment to one of the two groups by the cutoff 50th percentile score on the Italian version of CDI	
Experimental group	Control group
Training with the Drežančić method	Participation in standard education activities
Post-training	
Assessment of language and executive functions	

Training

The language training proposed for the experimental sample was based on the Creative Rehabilitation Method of Oral and Written Communication with Musical Structures by Zora Drežančić.

The training, which was conducted by an operator trained in language intervention, comprised 15 sessions of one hour each and was conducted over the course of ten weeks, with a frequency of three times in two weeks. The experimental sample participated in the training in groups of seven or eight children.

During each stimulation session, the children are seated in a circle with the operator in front of them. The adult begins stimulating the phonemes that are typically acquired early (i.e., vowels, anterior occlusive and nasals) and gradually introduces the first words and sentences, choosing utterances that are easy to pronounce and exemplifying the meaning with corresponding actions. The stimulation is based on the use of different simple objects combined with a linguistic sound (a phonic game); for example, spinning tops are used for the vowel /u/: the adult accompanies the rotary motion of the toy while pronouncing uuuuuuuuu u; a small jumping ball is used to pronounce ooooo (raising the ball) pa pa pa pa (for each contact of the ball on the floor or on the table, until it stops). The association between the object, movement and linguistic stimuliis stable over time.

Relevance is given to vowel sounds that are useful for establishing good pitch in one's voice and to promote intelligible production and all of the sounds of language are gradually introduced in association with a toy. These stimulations promote the possibility of evoking the proposed utterance in the presence of the corresponding object without the verbal model. In addition, longer utterances (words and simple sentences) are produced in association with different toys: proper names in association with dolls (Paolo, Anna, Emma, and Toni), common names with corresponding objects (la palla/the ball; il dado/the dice), and verbs and sentences with actions (metto/I put; butta/he throws; Paolo butta il dado/Paul throws the dice). The use of different examples for the same phonic toy in the stimulation materials allows the operator to maintain the children's attention and to reproduce the target utterance in different trials without the risk of tiring the children; moreover, each child learns to wait his own turn while the adult retrieves each new target toy from the bag. The time of presentation is modulated on the basis of the motivation of the children and follows their responses. The children are allowed to handle the toys, but the adult regulates the play activity to avoid providing too many stimuli simultaneously and to alternate different proposals. The method stimulates the production of every word category (nouns, verbs, adjectives, and function words) to stimulate the production of simple phrases complete with all fundamental elements. Children are never obliged to remain in a compulsory position or to imitate the proposal of the adult, but this type of situation encourages them to pay attention and wait their turn while preventing impulsive behavior.

Measures

A battery of tasks was employed to assess the participants' cognitive level, language development, and EF (response inhibition, interference suppression and working memory).

Cognitive level

Bayley mental scales (BSID-III, Bayley, 2006).

The Bayley-III consists of three scales: the Cognitive Scale, the Language Scale, and the Motor Scale. This study administered only the Cognitive Scale. The scale items include problem solving, a relational play task, object assembly, concept grouping and memory tasks.

Language

The *Italian version of the MacArthur Communicative Development Inventories* (CDI, Fenson *et al*., 1993; *Il Primo Vocabolario del Bambino*, PVB, Caselli, Pasqualetti & Stefanini, 2007), the "Words and Sentences" PVB version suitable for children aged 18–36 months, was used to evaluate the children and assess their expressive vocabulary and syntactic development. For this study, the following aspects were analyzed: (a) total words (vocabulary size) to assess lexical competences and (b) the number of nuclear, extended, coordinate and subordinate sentences as a variable to assess combinatory language.

The *Phonological Assessment of Child Language* (*Prove per la valutazione Fonologica del Linguaggio Infantile*, PFLI, Bortolini, 1995) is a measure that evaluates the phonetic characteristics of a child's language, the developmental level of phonological competence, and the phonetic and phonological similarities and differences between child and adult language. The test was designed for the clinical analysis of children with phonological disorders. This assessment may be used with all children aged two to five years, whether their language is normal or impaired. The test consists of a set of 90 pictures designed to obtain a spontaneous language sample. Seventy-four pictures show objects and events that the child must describe when encouraged by prompts, such as "Tell me what you can see in this picture." The remaining pictures represent three short stories (two short stories with six scenes and one short story with four scenes, for a total of 16 pictures). The pictures

are shown in sequence, and the child is asked to tell the story that the pictures show. This study used only the first 32 pictures, which the author deemed sufficient for an initial assessment.

EF: Response inhibition

The *Turtle and Rabbit* (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996) evaluates inhibitory motor control in an ongoing task. The child moves a doll (baseline), a fast rabbit, and a slow turtle along a curving path with two trials for each. The variables considered were the accuracy of the movements when following the path (scores ranged from zero to three) and the difference between the means of the turtle and rabbit trials, coded as the slow-down score and calculated as the proportion of the slowdown relative to the total time using the following formula: T_turtle-T_rabbit/ T_turtle+T_rabbit.

The *Head-to-toes* (Ponits, McClelland, Jewkes, Connor, Farris & Morrison, 2008) task is an adapted version of a task that taps complex inhibition in prepotent or automatic behavioral responses. This task requires the child to suppress a previously activated imitative response (the first trial of imitation), which is prepotent in early childhood (Carlson, 2005), and to provide an alternative response (when the adult touches his head, the child should touch his feet, and on the contrary, when the adult touches his feet, the child should touch his head). The variable considered was the proportion of correct items relative to the maximum score. Scores ranged from zero to one.

The *Gift Wrap* (Kochanska *et al*., 1996) is an emotional control task that taps the prepotent or automatic response inhibition necessary for delayed gratification. The child sits on a chair facing away from a table where the experimenter is noisily wrapping a gift for the child over a period of one minute. The child is asked to avoid looking while the experimenter is wrapping the gift. The variables considered were the latency before the first complete glance (Gift Wrap T) and a composite score (Gift Wrap CS) that accounts for the average quality (mV) and number (N) of

glances. This index is calculated using the formula mV-(N-1), where V ranges from one to five depending on the degree of rotation during the glance (see also Kochanska *et al*., 1996).

EF: Interference suppression

The *Fish task* (Viterbori *et al*., 2012, Cozzani *et al*., 2013; Gandolfi *et al*., 2014) is an experimental task to address visual interference using an adaptation of the flanker paradigm (Eriksen & Eriksen, 1974). In this forced-choice task, children are required to indicate where a centrally located target, a fish, "is going to eat his food" despite the presence of interfering stimuli. To facilitate task execution, the target was green, and the flanker stimuli were blue. There are 14 trials: two training trials, six congruent trials with the target and the interfering stimuli oriented in the same direction, and six incongruent trials with the target and the interfering stimuli oriented in the opposite directions. Congruent and incongruent trials are presented randomly. The accuracy observed in the incongruent trials is scored. The score in each trial ranged from zero to two: the score was two if the child answered correctly, one if the child performed correctly but needed help detecting the target, and zero if the wrong answer was given even with help from the experimenter. Total scores ranged from zero to twelve.

EF: Working Memory

The *Spin the Pots* (Hughes & Ensor, 2005) is a working memory and updating task. This multi-location search task includes eight visually distinct containers arranged on a circular tray. First, the child helps the experimenter to place six stickers in six of the eight containers. Before each trial, the tray is covered with a cloth and rotated, the cloth is removed, and the child then chooses a container to attempt to find a sticker. The task ends when all six stickers have been found, with a maximum of 16 guesses. The variable considered is the proportion of the number of correct responses among the total number of guesses. Scores range from zero to one.

Procedures for the transcription, coding and analysis of language

The language evaluations were performed individually for each child in a quiet room. The language production of each child was recorded using high-quality equipment (a Sharp portable minidisk recorder MT190H with a Sony ECM-MS907 microphone). One experienced transcriber broadly transcribed the recordings using the CHILDES system to identify the header, idiosyncratic words, omitted words, unintelligible speech, actions without speech, and pauses (Mac Whinney, 1997; Bortolini & Pizzuto, 1997). The length of these recordings ranged from 24'4" and to 31'1".Two independent judges transcribed 30% of the total corpus. The agreement index ranges from 87% to 99%. In the remaining part of the corpus, doubtful cases were resolved in a case-by-case discussion among the authors.

The analysis of the collected language sample targeted various aspects of linguistic skills: vocabulary, morphosyntax and phonology.

In the first phase of analysis, the following measures were extracted from the raw transcripts: the number of different words and the number of words on their first occurrence; the number of repeated words, i.e., words pronounced by the examiner during his/her turn; and the total number of words produced.

Two indices were calculated: the repetition index (n. repeated words)/(total words) and the diversity index (n. different words)/√(total words). This transformation allows us to adjust the number of different words based on the total number of words to compare children with different levels of lexical production (Rizzi, 1995; Zanobini & Viterbori, 2009).

To obtain the previous indices, certain rules were followed: all articles were counted as single words; interjections (e.g., oh!, eh!, mm) and onomatopoeia were not counted in the child's linguistic production; and productions with a consistent sound-meaning relationship and a clearly identifiable phonological form based on an adult model were considered words (Keren-Portnoy *et*

al., 2009), and each production for which the adult counterpart could not be determined was counted but catalogued as unintelligible.

We analyzed the morphosyntactic complexity of the productions recorded at the clause level. According to Berman and Slobin (1994), a clause is a syntactic construction with a single predicate (verbs of finite and non-finite form and past participles with adjectival value) that expresses a single situation (activity, state, or event). All cases containing an 'auxiliary' verb were included with the main verb in one clause. Reformulations and false starts were also coded as a single clause.

Two other categories that relate to linguistic expressions without verbs were included in the analysis of the complexity of statements: combinations of words and monorematic utterances. According to D'Odorico and Carrubbi (2001), sequences of two or more lexical and/or morphological elements (without a verb) were classified as combinations of words. Monorematic utterances consist of all single words (which are not predicates) that alone constitute a speech act. All free morphological elements, such as clitic pronouns and articles, were excluded from this category.

The third phase of analysis focused on the phonological encoding of each child's production. Two experienced transcribers transcribed the recordings using the International Phonetic Alphabet. For this analysis, we considered samples of language with at least fifty different words (Zmarich, Stocco, Minozzi & Bonifacio, 2005).

Subsequently, we performed an independent analysis (which evaluates the phonetic skills of the subject, regardless of whether a task is performed correctly as in the adult model) to compile the consonant inventory, i.e., the list of sounds classified by the mode and place of articulation and by their position within a word. Sounds that appear in at least three different words (types) in different positions (initial or median) were considered to be acquired. Phones that appear only once or twice

were considered only *occasionally present* and were therefore not considered for the purposes of this study.

Finally, a relational analysis was performed to examine the correspondences between words spoken by the child and the adult target, indicating the types of errors and strategies used to simplify the adult form. This analysis was conducted by two independent judges on 30% of the total corpus forthe first assessment and 20% for the second assessment. The index of agreement was between 88.34% and 100% for the first assessment and between 88.37% and 100% for the second assessment. Uncertain cases were discussed between the two examiners and, in cases of disagreement, were taken to a third judge to clarify the discrepancies (95% agreement).

On the basis of the classifications presented in the PFLI test manual (Bortolini, 1995), we assessed two simplification processes: processes that simplify the phonotactic structure (weak syllable deletion, consonant or vowel omission, metathesis, epenthesis, diphthong reduction, consonant or vowel harmony, and cluster reduction) and processes that simplify the system, i.e., substitution errors (stopping, affrication/frication, gliding, voicing/devoicing, vowel substitution, mutual replacement of the sounds /*r*/ and /*l*/, and phonologically plausible errors).

Statistical analysis

We conducted descriptive analyses and controlled for equality in the error variance between groups (Levene's Test of Equality of Error Variances, $p>.05$).

To control for any pre-intervention differences between the groups that may have affected the outcome of the analysis, an ANCOVA was conducted with the pre-training intervention baseline measurements incorporated as covariates. To assess the pre-posttest designs, the use of an analysis of covariance design with pre-test scores as a covariate is the preferred method over the use of repeated analysis design (Dimitrov & Rumrill, 2003) because it can afford greater power (Maxwell & Delaney, 2004). This choice of procedure is consistent with the recommendation of Vickers

(2001), who stated that ANCOVA has the greatest power in the analysis of controlled trials over the percentage of change and changes from pre-intervention baseline.

The *partial eta squared* value was considered in analyzing the comparisons. The partial eta squared (effect size), namely, the proportion of variance accounting for the effect, was obtained by dividing the between-groups deviation by the total deviation ($\eta p^2 = SSB/SST$). Values lower than .06 indicate a low effect size, values between .06 and .14 reveal a moderate effect size, and values higher than .14 correspond to a large effect size. For the comments, we also considered the results near to significance (α>=.05) when the effect size was high or moderate.

We also calculated the U3 statistic for each effect size. The U3 is a measure of overlap that refers to the percentage of scores in a group that are exceeded by the average score for another group (Cohen, 1988).

Results

Pre-intervention equivalence of the two groups

A series of analyses were conducted to identify any significant differences between the two groups. The experimental and control groups are equivalent at the cognitive level according to the Bayley scales: M=103.25, SD=8.78 and M=98.81, SD=6.10, respectively, t(39)=1.88,p>.05. Moreover, no significant differences were found between the two groups in terms of age, F(2,39)=0.11, p>.05, orgender, $\chi^2(2)=0.02$, p>.05. Finally, the mother's education level didnot differ between the groups: M=12.12 SD=2.64for the experimental group, M=12.09 SD=3.75for the control group, t(36)=.022, p>.05.

Post-training group differences in language

Descriptive statistics for the linguistic and EF measures at Time 1 and 2 are shown in Tables 1 and 2, respectively. A high level of inter-individual variability in the language measures was detected.

TABLES 1 and 2

Effects of training were observed for different aspects of language competence (vocabulary, morphosyntactic, and phonology; see Table 3).

TABLE 3

At Time 2, the Diversity Index was higher and the Repetition Index was lower in the experimental group than in the control group (6.33 vs. 5.72 and .03 vs. 0.5, respectively).

Spontaneous, richer and more diversified productions and a reduced tendency to repeat the language used by the experimenter were found in the experimental group compared with the control group. Estimates for the U3 statistics were 0.67 for both lexical measures (Table 3).

With regard to the development of morphosyntactic abilities emerging from parents' observation (PVB), the number of nuclear (9.37 vs. 8.62) and extended (8.11 vs. 7.38) sentences tended to increase more in the experimental group than in the control group, but the differences were not significant.

Among the direct measures of language, clause production was significantly better in the experimental group than in the control group (Table 3).

With respect to phonology competences, at Time 2, the experimental group tended to produce more consonants in general (19.27 vs. 17.69) and more consonants in the initial positions (12.64 vs. 11.50) than the control group; the differences are almost statistically significant with moderate effect sizes and a U3value of .56.

Regarding system errors, the experimental group tended to produce fewer simplifications than the control group (42.18 vs. 62.88). Although the difference between the groups was almost

statistically significant, the U3 value was high (.75), indicating that a large majority of the experimental sample produced fewer system errors than the children in the control group.

Post-training group differences in EF

With regard to the effects of training on executive abilities, both groups improved their Turtle & Rabbit task performance in the accuracy of the path at Time 2 (accuracy of path at Time 1= 1.11±.75 and at Time 2= 1.65±.74), but the children in the experimental group showed a greater slowdown than those in the control group (Table 4).

TABLE 4

Nevertheless, the control group improved the accuracy of the path, which actually led to a decrease in speed in the "fast" (rabbit) tests, thus producing negative performance in the variable proportion of slowing down. The experimental group was indeed able to improve its accuracy while modulating their motor responses according to external requests.

At Time 2, the children in the experimental group also obtained better scores in the Gift Wrap task: they significantly outperformed the control group in their composite scores and tended to show greater latencies before the first glance (49.58" vs. 31.00", Table 4).

The children in the experimental group were able to more effectively inhibit the impulse to turn around and see the gift that had been promised.

Discussion

The main aim of this study was to evaluate the efficacy of linguistic training based on the Drežančić method in fostering competences in both the linguistic and EF domains.

With regard to the first hypothesis, the training succeeded in improving the experimental group's linguistic abilities, particularly in the lexical and morphological domains, as indicated by the results of the direct measures of language development.

Children who received the training showed a significant improvement in their lexical abilities: at Time 2, the experimental group exhibited a broader and more diversified vocabulary characterized by fewer repetitions of the adult utterances. The lower tendency to repeat words that the children had just heard pronounced from the adults can be considered a sign of a more mature level of communicative competence. Indeed, the repetition of the interlocutor's preceding utterance is a well-known phenomenon in the verbal production of young children (Bates, 1979) and is primarily used to engage or maintain interaction with the adult.

In the syntactic domain, the introduction of words that belong to different grammatical categories enhanced the children's capacity to form complete sentences. Moreover, training on phonological and prosodic aspects likely facilitated the individuation and subsequent production of every element of the sentence, including grammatical morphemes, which are typically weak syllables with lesser prominence (Bortolini & Leonard, 1996), as suggested by theories on the interaction of different types of information in the acquisition of language (Tommasello, 2003).

A reason for the efficacy of the training on linguistic competences can likely be found in the analogy between musical and linguistic rhythm, which is one of the underlying principles of the Drežančić method (Drežančić, 1978; 1995). In particular, rhythmic auditory stimulation can influence syntactic processing in children, as shown by Przybylski *et al*. (2013) for children with developmental language disorders. The authors investigated the potential effect of a musical rhythmic prime on children's performance in a subsequent language task and observed better performance in syntax processing after a regular prime than after an irregular prime. The researchers concluded that remediation based on rhythm and music can positively influence

remedial training, both through a cross-domain effect (from music to language) and through an accentuation of the linguistic structures in the linguistic material.

The training had a smaller effect on phonological abilities because most children at this age level have not acquired the full phonetic inventory and exhibit the use of several simplification processes. Moreover, the relatively small size of our sample may not allow us to highlight the differences between groups. Nevertheless, the results showed a trend toward the reduction of phonological system errors in the group of children who participated in the training: although the differences were almost statistically significant, inspection of the other statistical indices (the partial eta square and U3) suggests that most children in the experimental group did make fewer errors than their peers in the control group. The literature shows that phonological ability is associated with lexical development, both in typically developing young children with average or advanced vocabulary size (Smith, McGregor & Demille, 2006) and in late talkers (Fasolo, Majorano & D'Odorico, 2008). On the one hand, a stimulation that aims to foster phonological discrimination reduces the need to replace phones difficult to articulate with other phones that are easier to pronounce and provides the opportunity to accurately produce a greater number of tokens. On the other hand, the gradual introduction of lexical items can consolidate and stimulate the production of linguistic sounds, emphasizing the bidirectional nature of the interaction between lexical and phonological acquisition (Smith *et al*., 2006). Our results primarily support this second possibility, with significant effects on lexical and morphological competences and weaker effects (possibly secondary to those of other language abilities) on phonological competences. More specifically, by offering rich stimulation that simultaneously considers different aspects of language and by emphasizing processes that frequently occur in natural contexts, the Drežančić Method helped children with typical (not high) levels of linguistic competence to progressively build their language system and to improve their verbal communication. However, further research is needed to understand whether, to what extent and in what respects (e.g., consonant inventory, percentage of

correct consonants, types of simplifications) the training is also effective in improving phonological skills.

With regard to the second hypothesis, linguistic training positively affected the efficiency of inhibitory processes. Children trained with the Creative Rehabilitation Method of Oral and Written Communication with Musical Structures (Drežančić, 1995) showed a more effective ability to modulate the speed of motor responses and to suppress the impulse to obtain gratification. Both of these abilities involve inhibitory processes, particularly the response inhibition, namely, "inhibition at the level of behavior" (Diamond, 2013, p. 152; see also Gandolfi *et al*., 2014). The response inhibition implies the regulation of one's own behavior and control over one's emotions to facilitate behavior regulation. This ability can involve avoiding impulsive behavior or continuing to perform a task despite distractions or other competing urges.

Our results may lead to different interpretations. One interpretation may focus on the processes stimulated by the training. Indeed, this training uses complex stimuli that engages children's attention and active participation: the children did not simply repeat sounds or words correctly, but they would actually combine actions with sounds or with utterances. Furthermore, the situations stimulated the children to pay attention, to wait for their turn and to avoid impulsive behavior. Moreover, activities punctuated by the rhythm of music may have positive effects on EF, as shown by Moreno, Bialystok, Barac, Schellenberg, Cepeda and Chau (2011), who observed that a short-term music training increased verbal intelligence in children ages four to six and that this change was positively correlated with changes in functional brain plasticity during a go/no-go task. It is reasonable that such compound stimulation also simultaneously influenced language and other abilities, particularly EF, which are by definition complex abilities that could be enhanced by exposure to complex experiences. However, research has shown that the paucity of environmental stimuli that is often associated with low socioeconomic status influences both language and

executive function systems, which suggests that the characteristics of the educational environment may directly or indirectly affect language and EF (Noble, Norman & Farah, 2005).

An alternative explanation involves the potential influence of language competences on EF. According to the Vygotskian approach, our results indicate that improving verbal ability enhances skills that useful for regulating children's own behavior (Fuhs & Day, 2011; Vallotton & Ayoub, 2011), which suggests that language may also may be used as a regulation tool in early childhood.

However, our experimental design does not allow us to distinguish between these two interpretations. In addition, a third hypothesis is also plausible: both the complex stimulation and the linguistic improvement together produced an increase in inhibitory control.

From a theoretical perspective, an important limitation of this study relates to the relatively small sample size and the inability to use randomized controlled trial procedures. Nevertheless, this difficulty is common to most studies of typically developing children attending preschool that are based on spontaneous participation. To overcome this obstacle and to provide greater generalization of the results, it would be desirable to replicate the research on children of different ages and with varying levels of language skills.

Finally, this study offers several important clinical implications. For the first result, we observed a significant effect of the training in a typically developing population.

The finding of significant effects for non-clinical populations means that the training was effective in strengthening children's areas of weakness and allowing for a more harmonious development of skills, which is in accordance with the stages of children's development and motivation to learn.

This consideration highlights the potential preventive value of this training with respect to subsequent developmental difficulties. In addition, evidence of improvements in inhibitory processes extends the preventive potential of the method to different domains of development.

Finally, this training may also be applicable to educational settings: the use of this method may be more likely to spread while maintaining lower costs, and it may also take advantage of the involvement of educators, who could become active proponents of the training exploiting the beneficial effects of the relationship between educators and children (Schmitt, Pentimonti, & Justice, 2012).

References

Bates, E. (1979). *The emergence of symbols*. New York, NY: Academic Press.

Baumeister, R.F., &Vohs, K.D. (2007). Self-Regulation, Ego Depletion, and Motivation. *Social and Personality Psychology, 1*, 1-14.

Bayley, N. (2006). *Bayley Scales of Infant and Toddler Development – Third edition* (3th ed), ed. San Antonio, TX: The Psychological Corporation.

Behrend, D. A., Rosengren, K., & Perlmutter, M. (1989). A new look at children's private speech: The effects of age, task difficulty, and parent presence. *International Journal of Behavioral Development*, *12*(3), 305-320.

Benigno, J. P., Byrd, D. L., McNamara, J. PH., Berg, W. K., & Farrar, M. J. (2011). Talking through transitions: Microgenetic changes in preschoolers' private speech and executive functioning. *Child Language Teaching and Therapy, 27*(3), 269-285.

Bergman Nutley, S., Söderqvist, S., Bryde, S., Thorell, L. B., Humphreys, K., & Klingberg, T. (2011). Gains in fluid intelligence after training non‐verbal reasoning in 4‐year‐old children: a controlled, randomized study. *Developmental science*, *14*(3), 591-601.

Berman, R. A., & Slobin, D. I. (1994). Becoming a proficient speaker. In: R. A. Berman, & D. I. Slobin,(Eds.), *Relating events in narrative. A crosslinguistic developmental study* (pp. 597-610). Hillsdale, NJ: Lawrence Erlbaum.

Bird, G., & Heyes, C. M. (2007). Imitation: Thoughts and theories. In K. Dautenhahn & C. Nehaniv (Eds.), *Models and mechanisms of imitation and social learning in robots, humans, and animals* (pp. 23–25). Cambridge, UK: Cambridge University Press.

Blair, C., & Ursache, A. (2011). A bidirectional theory of executive functions and self-regulation. In: R. Baumeister, & K. Vohs, (Eds.), *Handbook of self-regulation* (2nd ed., pp. 300–320). New York, NY: Guilford.

Bodrova, E., & Leong, D. J. (2007). Play and early literacy: A Vygotskian approach. In K. A. Roskos & J.F. Christie (Eds.), *Play and literacy in early childhood: Research from multiple perspectives* (2nd ed.; pp. 185-200). Mahwah, NJ: Lawrence Erlbaum Associates.

Bortolini, U. (1995). *Prove per la valutazione fonologica del linguaggio infantile [Phonological Assessment of Child Language]*. Padova, PD: Edit Master.

Bortolini, U., & Leonard, L. B. (2000). Phonology and children with Specific Language Impairment: status of structural constraints in two languages. *Journal Communication Disorders, 33,* 131-150.

Bortolini, U., & Pizzuto, E. (1997). *Il Progetto CHILDES Italia [The CHILDES Project Ital]*. Tirrenia, (PI): Edizioni Del Cerro.

Bronson, M.B. (2000). Recognizing and supporting the development of self-regulation in young children. *Young Children*, *55*, 32–37.

Bunge, S.A., Dudukovic, N.M., Thomason, M.E., Vaidya, C.J., & Gabrieli, J.D.E. (2002). Immature frontal lobe contributions to cognitive control in children: evidence from fMRI. Neuron *33*, 301–311, doi:10.1016/S0896-6273(01)00583-9

Carlson, S. M. (2005), Developmentally Sensitive Measures of Executive Function in Preschool Children, *Developmental Neuropsychology*, *28*(2), 595-616.

Carlson, S. M., & Beck, D. M. (2009). Symbols as tools in the development of executive function. In A. Winsler, C. Fernyhough, & I. Montero (Eds.), *Private speech, Executive Functioning, and the Development of Verbal Self-regulation*, (pp. 163-175). New York: Cambridge University Press.

Caselli, M.C., Pasqualetti, P. & Stefanini, S. (2007). *Parole e frasi nel "Primo vocabolario del bambino". Nuovi dati normativi fra i 18 e 36 mesi e forma breve del questionario [Words and sentences in the "MaCArthur Communicative Inventory, Italian Version". New normative data for children between 18 and 36 month and short form of the questionnaire]*. (Vol. 83). Milano: Franco Angeli.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Cole, P. M., Armstrong, L. M., & Pemberton, C. K. (2010). The role of language in the development of emotion regulation. In S. D. Calkins, & M. A. Bell (Eds.), *Child development at the intersection of emotion and cognition* (pp. 59-77). Washington, DC: American Psychological Association.

Cozzani, F., Usai, M.C., & Zanobini, M. (2013). Early language development and executive skills, *Rivista di Psicolinguistica Applicata/Journal of Applied Psycholinguistics*, *13*(1), 25-43.

Cragg, L., & Nation, K. (2010). Language and the development of cognitive control. *Topics in Cognitive Science*, *2*(4), 631-642.

D'Odorico, L., & Carubbi, S. (2001). Early multi-word utterances in Italian-speaking children. In M. Almgrem, A. Barrena, M.J. Ezeizabarrena, I. Idiazabal & B. MacWhinney (Eds.): *Research on child language acquisition* (pp. 1124-1142). Sommerville, MA: Cascadilla Press.

Diamond, A. (2013). Executive Functions. *Annual Review of Psychology*, *64*, 135-168.

Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, *333*(6045), 959-964.

Diamond, A., Barnett, W. S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science*, *318*(5855), 1387.

Dimitrov, D. M., & Rumrill, Jr, P. D. (2003). Pretest-posttest designs and measurement of change. *Work: A Journal of Prevention, Assessment and Rehabilitation*, *20*(2), 159-165.

Dixon, J. A., & Marchman, V. A. (2007). Grammar and the lexicon: developmental ordering in language acquisition. *Child Development*, *78*(1), 190-212.

Dodd, B., McIntosh, B. (2008). The input processing, cognitive linguistic and oro-motor skills of children with speech difficulty. *International Journal of Speech-Language Pathology*, *10*, 169-178.

Dowsett, S. M., & Livesey, D. J. (2000). The development of inhibitory control in preschool children: Effects of "executive skills" training. *Developmental psychobiology*, *36*(2), 161-174.

Drežančić, Z., (1978). Rythme musical et son aide pour un langage intelligible, *Rééducation ortophonique*, *103*, 411-423.

Drežančić, Z., (1995). A Creative Rehabilitation Method of Oral and Written Communication with Musical Structures: A General Survey of Method. *Bulletin of the Council for Research in Music Education*, *127*, 45-49.

Eriksen, B.A., & Eriksen, C.W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task, *Attention, Perception & Psychophysics*, *16*(1), 143-149.

Ezrine, G. A. (2010). Effects of Language on the Development of Executive Functions in Preschool Children. United States, Geogia: Georgia State Univesity.

Fasolo, M., Majorano, M., & D'Odorico, L. (2008). Babbling and first words in children with slow expressive development. *Clinical linguistics & phonetics*, *22*(2), 83-94.

Fenson, L., Dale, S. P., Reznick, J. S., Thal, D., Bates, E., Hartung, J. P., … Reilly, J. S. (1993). *The MacArthur Communicative Development Inventory: User's guide and technical manual*. San Diego: Singular Publishing Company.

Fernyhough, C., & Fradley, E. (2005). Private speech on an executive task: Relations with task difficulty and task performance. *Cognitive Development, 20*, 103-120.

Fuhs, M.W., & Day, J.D. (2011). Verbal ability and executive functioning development in preschoolers at Head Start, *Developmental Psychology*, *47*, 404–416.

Gandolfi, E., Viterbori, P., Traverso, L. & Usai, M.C. (2014). Inhibitory processes in toddlers: a latent –variable approach, *Front*. *Psychol*. 5:381. doi: 10.3389/fpsyg. 2014.00381

Gierut, J. A. (1998). Treatment efficacy: Functional phonological disorders in children. *Journal of Speech, Language, and Hearing Research*, *41*, 85-100.

Gierut, J. A., Morrisette, M. L., Hughes, M. T., & Rowland, S. (1996). Phonological treatment efficacy and developmental norms. *Language, Speech, and Hearing Services in Schools*, *27*(3), 215-230.

Girolametto, L., Pearce, P. S., & Weitzman, E. (1996). Interactive focused stimulation for toddlers with expressive vocabulary delays. *Journal of Speech, Language and Hearing Research*, *39*(6), 1274-1283.

Girolametto, L., Pearce, P. S., & Weitzman, E. (1997). Effects of lexical intervention on the phonology of late talkers. *Journal of Speech, Language and Hearing Research*, *40*(2), 338-348.

Hughes, C., & Ensor, R. (2005). Executive function and theory of mind in 2 year olds: A family affair? *Developmental neuropsychology*, *28*(2), 645-668.

Hughes, C., & Graham, A. (2002). Measuring executive functions in childhood: Problems and solutions? *Child and Adolescent Mental Health*, *7*(3), 131-142.

Im-Bolter, N., Johnson, J., & Pascual-Leone, J. (2006). Processing limitations in children with specific language impairment: The role of executive function. *Child Development*, *77*, 1822-1841.

Jentschke, S., Koelsch, S., & Friederici, A. D. (2005). Investigating the relationship of music and language in children. *Annals of the New York Academy of Sciences*, *1060*(1), 231-242.

Jones, P. E. (2009). From 'external speech' to 'inner speech' in Vygotskij: A critical appraisal and fresh perspectives. *Language & Communication, 29,* 166-181.

Keren-Portnoy, T., Majorano, M., & Vihman, M. M. (2009). From phonetics to phonology: The emergence of first words in Italian. *Journal of child language*, *36*(2), 235.

Kloo, D., & Perner, J. (2003). Training transfer between card sorting and false belief understanding: Helping children apply conflicting descriptions. *Child development*, *74*(6), 1823-1839.

Kochanska, G., Murray, K., Jacques, T.Y., Koenig, A.L., & Vandegeest, K.A. (1996). Inhibitory control in young children and its role in emerging internalization. *Child Development*, *67*, 490-507

Law, J., Garrett, Z., & Nye, C. (2004). The efficacy of treatment for children with developmental speech and language delay/disorder: A meta-analysis. *Journal of Speech, Language and Hearing Research*, *47*(4), 924-943.

Law, J., Garrett, Z., & Nye, C. (2010). Speech and language therapy interventions for children with primary speech and language delay or disorder (Review). *The Cochrane Collaboration*. doi: 10.1002/14651858.CD004110.

MacWhinney, B. (1997). *Strumenti per L'analisi del Linguaggio Parlato [Tools for the analisys of spoken language]*. Tirrenia: Ed. Del Cerro.

Marano, A., & Devescovi, A. (2014). Le parole per dirlo: sviluppo del linguaggio e funzioni esecutive in bambini tra i 24 e 30 mesi. *Rivista di psicolinguistica applicata*, 14(1), 9-24.

Marton, K. (2008). Visuo-spatial processing and executive functions in children with specific language impairment. *International Journal of Language & Communication Disorders*, *43*(2), 181-200.

Maxwell, S. E., & Delaney, H. D. (2004). *Designing experiments and analyzing data: A model comparison perspective* (Vol. 1). Psychology Press.

Miller, M.R., Giesbrecht, G.F., Müller, U., McInerney, R.J., & Kerns, K. (2012). A latent variable approach to determining the structure of executive function in preschool children. *Cognitive Development 13*, 395–423. doi: 10.1080/15248372.2011.585478.

Moreno, S., Bialystok, E., Barac, R., Schellenberg, E. G., Cepeda, N. J., & Chau, T. (2011). Short-term music training enhances verbal intelligence and executive function. *Psychological science*, *22*(11), 1425-1433.

Muller, U., Jacques, S., Brocki, K., & Zelazo, P.D. (2009). The executive functions of language in preschool children. In: A.Winsler, C. Fernyhough, I. Montero, (Eds.)ed. *Private Speech, Executive Functioning, and the Development of Verbal Thought* (pp. 53-68). New York: Cambridge University Press.

Murray, K. T., & Kochanska, G. (2002). Effortful control: Factor structure and relation to externalizing and internalizing behaviors. *Journal of abnormal child psychology*, *30*(5), 503-514.

Nelson, H.D., Nygren, P., Walker, M., Panoscha, R. (2006). Screening for speech and language delay in preschool children: systematic evidence review for the US Preventive Services Task Force. *Pediatrics*, *117*(2), 298-319.

Noble, K.G., Norman, M.F., & Farah, M.J. (2005). Neurocognitive correlates of socioeconomic status in kindergarten children. *Developmental Science*, 8(1), 74–87.

Ponitz, C. C. E., McClelland, M. M., Jewkes, A. M., McDonald Connor, C., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly, 23*, 141–158.

Przybylski, L., Bedoin, N., Krifi-Papoz, S., Herbillon, V., Roch, D., Léculier, L., ... & Tillmann, B. (2013). Rhythmic auditory stimulation influences syntactic processing in children with developmental language disorders. *Neuropsychology*, *27*(1), 121.

Robertson, S. B., & Weismer, S. E. (1999). Effects of treatment on linguistic and social skills in toddlers with delayed language development. *Journal of Speech, Language and Hearing Research*, *42*(5), 1234.

Röthlisberger, M., Neuenschwander, R., Cimeli, P., Michel, E., & Roebers, C. M. (2012). Improving executive functions in 5 ‐ and 6 ‐ year ‐ olds: Evaluation of a small group intervention in prekindergarten and kindergarten children. *Infant and Child Development*, *21*(4), 411-429.

Schön, D., Magne, C., & Besson, M. (2004). The music of speech: Music training facilitates pitch processing in both music and language. *Psychophysiology*, *41*(3), 341-349.

Smith, B. L., McGregor, K. K., & Demille, D. (2006). Phonological development in lexically precocious 2-year-olds. *Applied Psycholinguistics*, *27*(03), 355-375.

Schmitt, M. B., Pentimonti, J. M., & Justice, L. M. (2012). Teacher–child relationships, behavior regulation, and language gain among at-risk preschoolers. *Journal of school psychology*, *50*(5), 681-699.

Stoel-Gammon, C., & Cooper, J. A. (1984). Patterns of early lexical and phonological development. *Journal of Child Language*, *11*(2), 247-271.

Strong, G. K., Torgerson, C. J., Torgerson, D., & Hulme, C. (2011). A systematic meta‐analytic review of evidence for the effectiveness of the 'Fast ForWord' language intervention program. *Journal of Child Psychology and Psychiatry*, *52*(3), 224-235.

Thorell, L. B., Lindqvist, S., Bergman Nutley, S., Bohlin, G., & Klingberg, T. (2009). Training and transfer effects of executive functions in preschool children. *Developmental science*, *12*(1), 106-113.

Tomasello, M. (2003). *Constructing a language*. *A usage-based theory of acquisition*. Cambridge, MA: Harvard University Press.

Ullman, M. T., & Pierpont, E. I. (2005). Specific language impairment is not specific to language: The procedural deficit hypothesis. *Cortex*, *41*(3), 399-433.

Usai, M.C., Viterbori, P., Traverso, L., & De Franchis V. (2014). Latent structure of executive function in five- and six-year-old children: A longitudinal study. *European Journal of Developmental Psychology*, 11(4), 447-462. doi:10.1080/17405629.2013.840578.

Vallotton, C., & Ayoub, C. (2011). Use your words: The role of language in the development of toddlers' self-regulation. *Early Childhood Research Quarterly, 26,* 169–181.

Vickers, A. J. (2001). The use of percentage change from baseline as an outcome in a controlled trial is statistically inefficient: a simulation study. *BMC medical research methodology*, *1*(1), 6.

Vihman, M. M., Macken, M. A., Miller, R., Simmons, H., & Miller, J. (1985). From babbling to speech: A re-assessment of the continuity issue. *Language*, *61*, 397-446.

Viterbori, P., Gandolfi, E., & Usai, M.C.(2012). Executive skills and early language development. *Rivista italiana di Psicolinguistica applicata/Journal of Applied Psycholinguistics, special issue on language development and executive function*, *13,* 17-32

Wagner Fuhs, M., & Day, J. D. (2011). Verbal Ability and Executive Functioning Development in Preschoolers at Head Start. *Developmental Psychology*, *47(2*), 404–416.

Wilcox, M. J., Gray, S. I., Guimond, A. B., & Lafferty, A. E. (2011). Efficacy of the TELL language and literacy curriculum for preschoolers with developmental speech and/or language impairment. *Early Childhood Research Quarterly*, *26*(3), 278-294.

Wolfe, C. D., & Bell, M. A. (2004). Working memory and inhibitory control in early childhood: Contributions from physiology, temperament, and language. *Developmental Psychobiology, 44*, 68–83.

Ye, Z., & Zhou, X. (2009). Executive control in language processing. *Neuroscience and Biobehavioral Reviews, 33,* 1168–1177.

Zanobini, M. &Viterbori, P. (2009). La relazione fra sviluppo fonologico e lessicale nel terzo anno di vita [The relation between phonological and lexical development in the third year of life]. *Rivista di psicolinguistica applicata [Journal of AppliedPsycholinguistic]*, *9*(1), 9-24.

Zanobini, M., Basili, A., & Lanzara, C., (2010). Il Metodo creativo, stimolativo e riabilitativo della comunicazione orale e scritta con le strutture musicali di Zora Drežančić [Creative Rehabilitation Method of oral and written communication with Musical Structures of Zora Drežančić], *Logopedia e comunicazione [Speech Therapy and Communication], 6*(1), 23-47.

Zanobini, M., Saraceno, F., & Lanzara, C. (2008). La stimolazione linguistica al nido con i giochi fonici del metodo Drežančić [Linguisticstimulation in nursery schoolthrough the phonictoys of the Drežančić Method], *XVII Congresso Nazionale AIRIPA [17th AIRIPA Italian Conference]*, Piacenza 17-18 Ottobre.

Zanobini, M., Viterbori, P., & Saraceno, F. (2012). Phonology and Language Development in Italian Children: An Analysis of Production and Accuracy. *Journal of Speech, Language and Hearing Research*, *55*(1), 16.-31.

Zelazo, P. D., & Frye, D. (1998). Cognitive complexity and control: The development of executive function. *Current Directions in Psychological Science, 7,* 121–126.

Zmarich, C., Stocco, D., Minozzi, M. & Bonifacio, S. (2005). La frequenza di occorrenza di consonanti e vocali e delle loro combinazioni nelle sillabe del babbling e delle prime parole dai 10 ai 27 mesi di età. [The frequency of consonants and vowels occurrence and their combinations in babbling's and first words syllables between 10 and 27 months of age]. In P. Cosi (Eds.), Misura dei parametri [Measurement of Parameters], *Atti del I Convegno Nazionale dell'Associazione Italiana Scienze della Voce (AISV);Padova, 2-4 dicembre, 2004, Proceedings of the 1st National Congress of Italian Speech Sciences Association* held in Torriana (RN): EDK Editore.

Tables

Table 1

Descriptive statistics for EF and linguistic measures at the first assessment

	Time 1									
	Experimental Group					Control Group				
Language	**N**	**Min**	**Max**	**Mean**	**SD**	**N**	**Min**	**Max**	**Mean**	**SD**
PVB										
Total words	20	8	420	235	131.3	21	34	430	262.90	117.9
Nuclear sentences	20	0	10	5.55	4.38	21	0	10	6.43	3.74
Extended sentences	20	0	9	3.75	3.58	21	0	9	4.95	3.57
Coordinate sentences	20	0	9	4.05	3.59	21	0	9	4.67	3.75
Subordinate sentences	20	0	9	3.75	3.38	21	0	9	4.29	3.62
PFLI										
Diversity Index	16	.67	5.71	3.73	1.11	19	.70	7.50	4.46	1.69
Unintelligibility Index	16	.006	.818	.18	.22	19	.02	.50	.17	.14
Repetition Index	16	.007	.15	.04	.05	19	.003	.19	.05	.05
Clauses	16	.11	.37	.23	.08	19	.12	.35	.24	.08
System errors	11	23	256	93.64	85.12	16	10	120	53.19	33.26
Structure errors	11	34	362	154.18	129.67	16	22	273	129.38	66.43
N. initial consonants	11	6	13	8.64	2.01	16	5	14	9.25	3.36
N. median consonants	11	8	17	12.00	2.53	16	5	20	11.50	5.11
N. total consonants	11	14	19	16.00	1.61	16	8	21	14.81	4.46
Executive function	**N**	**Min**	**Max**	**Mean**	**SD**	**N**	**Min**	**Max**	**Mean**	**SD**
Turtle & Rabbit	16	-.13	.53	.23	.18	18	.029	.500	.26	.13
Fish Task	14	0	10.5	5.03	3.45	11	0	12	5.14	3.37
Head to Toes	10	8	36	21.20	11.42	13	8	36	17.31	8.87
Gift wrap CS[a]	14	15	30	22.64	4.51	15	6	30	19.70	6.89
Gift wrap T[b]	14	3.52	60.00	30.81	21.84	15	1	60	17.93	23.2
Spin the Pots	17	.250	1.00	.60	.25	19	.250	1	.61	.20

[a] Gift wrap CS: composite score which takes into account the number and type of glances

[b] Gift wrap T: time at the first complete glance

Table 2

Descriptive statistics for EF and linguistic measures at the second assessment

	Time 2									
	Experimental Group					Control Group				
Language	**N**	**Min**	**Max**	**Mean**	**SD**	**N**	**Min**	**Max**	**Mean**	**SD**
PVB										
Total words	19	137	661	479.47	131	21	242	659	455.24	145
Nuclear sentences	19	5	10	9.37	1.38	21	4	10	8.62	1.98
Extended sentences	19	4	9	8.11	1.66	21	2	9	7.38	2.5
Coordinate sentences	19	3	9	8.11	1.76	21	1	9	7.52	2.27
Subordinate sentences	19	3	9	7.53	1.92	21	0	9	7.14	3.05
PFLI										
Diversity Index	19	3.25	9.02	6.03	1.57	19	2.60	10.38	5.88	1.77
Unintelligibility Index	19	.002	.218	.06	.07	19	.00	.39	.08	.10
Repetition Index	19	.009	.07	.03	.02	19	.008	.09	.05	.03
Clauses	19	.18	.69	.47	.15	19	.09	.72	.34	.19
System errors	11	8	85	42.18	25.53	16	23	119	62.88	30.8
Structure errors	11	27	321	132.55	90.01	16	38	255	137.69	60.58
N. initial consonants	11	9	15	12.64	1.63	16	8	15	11.50	2.37
N. median consonants	11	12	21	17.73	2.76	16	9	21	16.00	3.81
N. total consonants	11	15	21	19.27	1.74	16	14	21	17.69	2.33
Executive function	**N**	**Min**	**Max**	**Mean**	**SD**	**N**	**Min**	**Max**	**Mean**	**SD**
Turtle & Rabbit	20	-.09	.72	.27	.22	21	-.43	.31	.05	.18
Fish Task	19	0	11	4.61	3.33	18	0	12	5.50	3.45
Head to Toes	15	8	34	22.23	8.58	18	8	36	19.92	9.04
Gift wrap CS[a]	18	11	30	24.97	5.55	20	9	30	20.44	6.79
Gift wrap T[b]	18	3	60	48.50	19.74	20	2	60	33.90	24.3
Spin the Pots	20	.25	1	.74	.25	21	.25	1	.69	.25

[a] Gift wrap CS: composite score which takes into account the number and type of glances

[b] Gift wrap T: time at the first complete glance

Table 3

ANCOVA Controlling for the performance at the first assessment (put as covariate) for linguistics measures. Comparisons between experimental and control group.

		Experimental Group			Control Group			Univariate analysis		Effect size	U_3[a]
	Language	N	M	SD	N	M	SD	F	*p*	ηp^2	
Vocabulary	Diversity Index	16	6.33	1.49	18	5.98	1.77	5.72	*.02*	.16	0.67
	Repetition Index	16	.03	.02	18	.05	.03	5.19	*.03*	.15	0.67
Morphosyntax	Nuclear sentences	19	9.37	1.38	21	8.62	1.98	3.22	*.08*	.08	0.48
	Extended sentences	19	8.11	1.66	21	7.38	2.5	3.15	*.08*	.08	0.38
	Clauses	16	.48	.14	18	.35	.19	5.97	*.02*	.16	0.71
Phonology	System errors	11	42.18	24.53	16	62.88	30.81	3.98	*.058*	.14	0.75
	N. initial consonants	11	12.64	1.62	16	11.50	2.36	3.82	*.06*	.14	0.56
	N. total consonants	11	19.27	1.74	16	17.69	2.33	3.42	*.07*	.12	0.56

[a] U_3: percentage of individuals within control group with scores that are exceeded by the average score in the experimental condition (Cohen, 1988).

Table 4

ANCOVA Controlling for the performance at the first assessment (put as covariate) for EF measures. Comparisons between experimental and control group.

	Experimental Group			Control Group			Univariate analysis		Effect size	U_3[c]
Executive function	N	M	SD	N	M	SD	F	*p*	ηp^2	
Turtle & Rabbit	16	.26	.24	18	.07	.16	7.14	*.01*	.19	0.83
Gift wrap CS[a]	12	25.46	4.91	14	19.05	7.16	4.76	*.04*	.17	0.64
Gift wrap T[b]	12	49.58	18.80	14	31.00	23.15	3.83	*.06*	.14	0.71

[a] Gift wrap CS: composite score which takes into account the number and type of glances

[b] Gift wrap T: time at the first complete glance

[c] U_3:percentage of individuals within control group with scores that are exceeded by the average score in the experimental condition (Cohen, 1988).