A new phonological discrimination test for children aged 48-72 months

The proposed research is part of a wider project aiming at the creation of a phonological discrimination test for pre-school subjects. More specifically, the test we describe is designed to evaluate the ability to discriminate stimuli pairs differing with respect to the consonant's phonological category representing the output of each of the simplification processes (the so called "phonological processes") that accompany the speech production of typical developing children.

We know from the literature that: i) a correct perception (and production) of the sound system of a language is the *sine qua non* condition to be able to access the other levels of the spoken language (Saffran, Werker, Werner, 2006); ii) speech disorders and language disorders with a phonetic-phonological component are an important, if not the main, portion of the caseloads of speech therapists who deal with voice-speech-language disorders in childhood (Law, Boyle, Harris, Harkness, Nye, 2000). Generally speaking, phonological discrimination refers to that process of categorical perception through which differences that unfold along a physical continuum (of frequency, intensity, duration) are traced to discrete categories. Phonological discrimination represents an essential part of a normal speech perception development. The phonological discrimination systematically improves till 10 years of age (Edwards, Fox & Rogers, 2002), although the cornerstones for a correct discrimination are already laid down by the age of 5 (Tamashige, Nishizawa, Itoda, Kasai, Igawa, Fukuda, 2009). The children's normal development can fortunately be tested starting from age 4-5 by using the same methods used for adults (Polka, Jusczyk, Rvachew, 1995). Phonological discrimination tests are an important procedure for assessing proficiency in speech acquisition, and any alteration in the ability to discriminate "similar" sounds could contribute to unveil the onset of speech and language disorders (Rvachew, Brosseau-Lapré, 2012; Freitas, Mezzomo, Marques, Vidor, 2014). Phonological discrimination tests may vary with respect to both the form and the content. Regarding the form, i.e. the procedural paradigm used to test the phonological discrimination skills, the AX or "same/different" paradigm is to be preferred, notwithstanding a possible bias towards a "same" judgment (Gerrits & Shouten, 2004, although their subjects were adults), because of less taxing the working-memory of the younger children in comparison to more sophisticated designs (Polka et al., 1995). Regarding the content, non-words (vs. words) stimuli are to be preferred because they are independent from previous lexical knowledge, thus engaging only the perceptual system and/or the phonological memory, but not the lexical/semantic system. From a developmental point of view, the perception of consonants is, generally speaking and until 5-6 years-of-age, less categorical in nature and more influenced by the context with respect to adults' perception. According to Walley (2005) all these outcomes are compatible with the hypothesis that 4-to-5-years-old children are more dependent from a global, syllabic representation than a segmental one. Anyway, according to McAllister-Byun (2015), by 5 years of age the children's discrimination skills are essentially adult-like. It is important to emphasize the distinction between the ability to discriminate two sounds (minimum pairs) from the ability to use this contrast in a phonologically relevant way (to learn new sounds), since the two skills can have different time courses. In fact, production errors in older children who have a speech disorder may reflect either motor problems, or an inadequate phonemic representation (Rvachew, Ohberg, Grawburg, Heyding 2003; Gierut, 1998). At present, the question of how linguistic perception and production are interrelated is still unresolved. During development, it is possible that the child perceives speech at almost the adult level, but that he does not yet have the motor skills to achieve a certain target (McAllister Byun, Tiede, 2017). On the other hand, it is possible that the child has adequate motor skills, but still a too wide auditory-perceptive representation of the target, with the consequence of not being able to receive the error feedback that would lead him to modify his motor planning (Shiller, Rochon, 2014). A more in-depth understanding of the relationships between perception and production in the course of development would help to better understand the enormous variability of production capacity observed in children. A logical way to investigate this relationship is to provide measures of speech perception and production within the same child, and we adopted this strategy. We started our endeavor in the creation of this test moving from the consideration that in Italy existing tests do

not evaluate the phonological discrimination of late preschoolers (48-72 months-olds) in a satisfactory way. To be precise, there is a unique norm-referenced test which makes use of pairs of non-words in an AX paradigm. This test is proposed as a part of a battery (BVN 5-11, Tressoldi et al., 2005; also in Pinton & Zanettin, 1998), but it presents a number of problems, among them: it does not test all the Italian consonants nor all the phonetic features, some of the tested consonants are proposed only once, there is no apparent attention to the phonetic context, the length opposition is not tested, it is not clear how the consonantal groups are evaluated, the administration procedure is neither automated nor randomized, it is not proposed in a playful way, the verbal stimuli have to be pronounced anew each time by the operator (i.e. they are not pre-recorded) and the list is written in orthography rather than in IPA. To begin with, we split the proposed test development in two sets: we first devised a set of stimuli based on contrasts involved in systemic phonological processes (mainly phones' substitution) and administered it to a group of children; we then devised a set of stimuli based on contrasts involving structural phonological processes (mainly phones' harmony or phones' addition/deletion). For each set, a number of control stimuli pairs have also been devised (with completely equal or completely different pair members), in order to individuate and exclude those children who are not able to accomplish the task. To this regard, a pretest session precedes both test sets with the aim of familiarizing the children with the task. The first set consists of 39 non words 'VCV minimal pairs, testing all the 10 distinctive features of the Italian phonological system (as exposed by Schmid, 1999: 134), representing as many systemic processes (stopping, backing, gliding etc.). Each distinctive feature is represented in two different pairs for each of the chosen vocalic contexts ('aCa, 'iCi) with each pair opposing a consonant (+ feature) against a consonant (-feature). Crucially, the two pairs make use of consonants which are different one from another but at the same time are sharing the same featural opposition, as in the example [+ continuous] VS [- continuous]. If we postulate the first consonant to be the target, and the second to be the output of a phonological process, the phonological process is called in this case "stopping": e.g. asa VS ata; isi VS iti; ava VS aba; ivi VS ibi. The second set consists of 68 minimal pairs, testing 12 structural processes (cluster reduction, consonant harmony, epenthesis etc.). Each distinctive process is represented in two different pairs for each of the chosen vocalic contexts ('aCa, 'iCi) with each pair opposing a target against the same target affected by a particular process. The structure of the test follows the AX paradigm and natural prerecorded stimuli are proposed after we verified their better perceptibility over synthetic stimuli (Gaiotto, 2016). The whole test administration procedure for both sets has been automated by means of a Praat script (XXX), and the randomized stimuli in each set were proposed to the children in a playful setting. The two sets of the test were administered by students graduating in speech therapy at the University of Padova to two groups of children (balanced per gender) recruited and tested in various kindergarten in the Veneto region (Italy): the first group (56 subjects) was assessed with the first set of the test (Bonato 2016); the second group (30 subjects) was assessed with the second set (Marchetti, 2017; Rossi 2017). According to their parents, who gave the informed consensus and compiled a questionnaire, all the children were normal under the psycho-physical profile. The children's audition, assessed through an audiometric screening, was within normal range. In a separate session all the children have also been tested with an articulation test (a modified version of TFPI, XXX, not published), in order to have the possibility to compare - in a separate study not addressed here - speech production and perception proficiency within each child. In the following analyses, we factorized ages (four groups spanning six months each) and gender (male and female). Dependent variable is the percentages of discrimination. Among the main results relative to the first set (systemic contrasts) there are the following: no significant differences by age groups or by gender; the discrimination percentages improve as the number of distinctive features that distinguish pairs' stimuli increases; discrimination is better in /a/ context than /i/ context; the distinctive feature causing more difficulty is the "voice" feature. Among the main results relative to the second set (structural contrasts), there are the following: neither significant difference for vocalic context, nor for gender, but a difference almost significant emerges as to the age variable (between the first and the fourth age group); by 5 years of age, there are still a number of contrasts characterized by "Degemination", "Cluster reduction 3-to-2 consonants" and "Consonant/vowel omission" that are not well discriminated by a consistent number of the children.