NORMATIVE AND VALIDATION DATA OF AN ARTICULATION TEST FOR ITALIAN-SPEAKING CHILDREN

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Abstract

Objectives. As a standardized instrument to assess speech sound skills in Italian-speaking children is currently lacking, norms used to diagnose speech sound disorders (SSD) are mainly based on studies including English-speaking participants. This application may result in misidentification of SSD due to linguistic differences. The aims of the study were to establish normative data on speech sound development of Italian-speaking children and to evaluate psychometric properties of Rossi's articulation test, the picture-naming test selected to assess speech sound skills.

Methods. A cross-sectional study including 694 normally-developing Italian-speaking children aged from 3 to 7 years was conducted. Children were administered Rossi's articulation test and percentages of speech sound correct production were calculated. To evaluate inter-rater reliability of the test audio-recordings of 50 children were scored by an additional examiner. To assess intra-rater reliability, the rater who administered the test re-scored the audio-recordings of 50 children with an interval of at least a week. To evaluate test-retest reliability, 144 participants were re-tested after 1-3 weeks by the same assessor. Scores were compared through Intraclass Correlation Coefficient (ICC). To assess construct validity, the developmental progression of total scores across age groups was verified by the estimation of the reference range for the test, using a Beta inflated distribution with inflation in 1.

Results. Almost all Italian children in the sample produced vowels and approximants correctly. Single consonants were acquired before consonant clusters. Ages of acquisition of each consonant were presented: plosives and nasals were early mastered by Italian children, while dental affricates, alveolar fricatives and the palatal lateral were the latest acquired segments. All ICCs were superior to 0.9 (reliability). The Beta regression showed a significant improvement in test score with age (construct validity).

Conclusions. The paper provides normative data for speech sound development of Italian-speaking children and additional validation of the psychometric properties of Rossi's articulation test. Findings are discussed in relation to normative data from other languages: children seem to follow both cross-linguistic and language-specific trends. Clinicians are recommended to use Rossi's articulation test to improve the diagnostic accuracy of SSD in Italian children.

1. Introduction

1.1. Background

Children with speech sound disorder (SSD) represent a large proportion of the caseloads of pediatric speech and language therapy services, considering that SSD estimated prevalence ranges from 2% to 25% of the population aged from 5 to 7 years [1]. In clinical practice, it results in an increasing request for early assessment and management of children with SSD, to avoid SSD communicative and social consequences [2]. The availability of normative data is essential for the clinical assessment of children with speech sound difficulties, to properly differentiate children with delay or disorder from normally-developing children [3]. Several normative studies have been carried out on speech sound development of English-speaking children from the 1930s [4], while relatively few studies analysed children acquiring languages other than English, including Italian. English norms may provide general guidelines, according to the theory of the existence of a universal trend in speech sound development [5], but they are not sensitive to linguistic differences. Each language exhibits different rules for consonant and vowel phonemes in different word positions, the complexity of word and syllable shapes, as well as prosody [6]. Direct application of English norms to non-English children may result in misidentification of disorder and inappropriate selection of treatment target [7]. Language specific norms are critical for assessing children with speech difficulties and making clinical decisions [8]. Therefore, research focused on speech sound development of non-English speaking children was more recently implemented, e.g. [8, 9, 10, 11, 12], also including Italian-speaking children, but with some limitations. First, most studies with Italian children focused on earlier stages of language acquisition and analyzed the relationship between phonological skills and early lexical acquisition [13]. In addition, in Italian clinical practice, there is a lack of a large-scale standardized instrument to assess children with suspected SSD [14]. A recent standardized test battery for language and speech assessment [15] provides normative data on language and speech development of Italian-speaking children aged from 4 to 12 years, but the articulation subtest shows some limitations. Indeed, it is composed by a picture naming task, standardized for children aged from 4 to 6 years, that aims to assess both articulation and lexical abilities. This method involves a less specific speech sound evaluation, providing a numeric total score for articulation subtest to compare to age norms, but not providing normative data specifically for each Italian phoneme or consonant cluster. In addition, children with

lexical impairment are penalized by the assignment of a lower score when correct production are elicited under repetition (1 instead of 2). Lastly, because of a limited number of items, the production of Italian phonemes is not studied in all word-position, and the production of consonant clusters is not extensively analysed.

1.2. ***Objectives***

The aims of the study were: 1. to establish normative data on speech sound development of Italian-speaking children and 2. to evaluate psychometric properties (inta-rater, inter-rater, test-retest reliability and construct validity) of Rossi's articulation Test, the picture-naming test selected to assess speech sound skill of Italian-speaking children.
Based on the data available in English and from previous Italian studies, almost all children in the sample were expected to have already master vowels and approximants, and that single consonant would be acquired before consonant clusters, with an early acquisition for plosives and nasals and later for fricative and affricates. However, also the presence of a linguistic specific pattern of acquisition was expected, related to structural linguistic differences, for example in speech sound system, consonant frequencies, preferred syllable structure and stress system. In addition, Rossi's articulation test was expected to be a reliable and valid tool to assess speech sound skills in Italian-speaking pre-schoolers. Because of the lack of assessment tools standardized on a large sample of Italian-speaking children, findings would be relevant and useful in clinical practice.

2. Material and Methods

2.1. Study design

The study design is a cross-sectional study among typically-developing children.

2.2. Participants

The normative sample included 694 Italian-speaking children aged from 3 to 7 years, gender-balanced (347 males and 347 females). Participants were distributed into 10 age groups, each representing a 6-months interval. Children were recruited in Italian nurseries and schools from different geographical areas; 203 children lived in an urban area in the South of Italy (city of Naples), 191 children lived in an urban area in the North of Italy (city of Milan), 300 children lived in smaller towns in the district of Bergamo and Varese. Demographic characteristics of the sample are summarized in Table 1.

➔ Table 1

Exclusion criteria were: the first language of one or both parents other than Italian, walking age >18 months, physical malformation of articulators (e.g., cleft lip/palate), hearing loss, cerebral palsy, mental retardation, autistic spectrum disorders, history of speech difficulties and expressive vocabulary at 24 months <50 words. Parents were given an information letter and a consent form, to be signed. In addition, they were asked to fill a brief questionnaire to check that children did not match the exclusion criteria and to collect information on socioeconomic status (SES). SES measures were based on parents' education and occupation [4, 16, 17]. Educational level was measured in years of education. Parents' occupation was classified into 4 groups: unemployed, manual worker (e.g., workman, farmer), office worker and knowledge worker (e.g., medical doctor, lawyer). All parents returned consent forms signed, but only 577 parents agreed to fill the questionnaire concerning SES. Socioeconomic characteristics of the sample are summarized in table 2.

➔ Table 2

Data on SES were similar to a recent Italian study on the role of SES on narrative abilities in normally developing children [18]. Data from 2011 Italian census, reported that approximately 30% of the Italian population referred 8 years of education, 25% 13 years,

2.5 15 years and 8.5% 18 years and 2.5% 15 years of education [19]. Therefore, parents of the normative sample referred SES comparable to the whole Italian population.

2.3. Rossi's Articulation Test

The most comprehensive published Italian picture naming test, Rossi's Articulation Test [20], was used in the present investigation to assess children's phonetic abilities. During its administration, the production of 180 words is elicited, to evaluate the production of all Italian phonemes in different word position (initial, medial and geminate) and of the most frequent consonant clusters and diphthongs. The 180 words target are: 6 plosives ([p] [b] [t] [d] [k] [g]), 5 fricatives ([f] [v] [s] [z] [ʃ]), 4 affricates ([ʦ] [ʣ] [ʧ] [ʤ]), 3 nasals ([m] [n] [ɲ]), 3 liquids ([l] [r] [ʎ]), 62 bi-consonants clusters, 22 tri-consonants clusters, 9 vowels and approximants ([a] [e] [ɛ] [i] [o] [ɔ] [u] [j] [w]), 11 diphthongs ([au] [ao] [ae] [ai] [eu] [eo] [ɛi] [ea] [ɔa] [ɔu] [ɔi][oɛ]). At present, although this instrument is frequently used in clinical practice, there are no available normative data and information about its psychometric properties.

2.4. Procedures

2.4.1. Normative data. After receiving parents' informed consent, all children were individually tested in a quiet room of their nursery or school. The assessors were six speech pathologists with over 5 years of experience in child language assessment and rehabilitation, previously trained on Rossi's Articulation Test administration procedure and scoring. Children were presented the stimulus book and were asked to name each item (drawings of common objects/actions). A semantic cue was given if they couldn't identify the picture. If they failed in producing the target phoneme or cluster according to this elicitation procedure, the examiner finally asked to repeat the target word. Imitated sounds were accepted as evidence of articulatory competence [3]. The examiner recorded the production of every target phoneme or cluster in each word-position, awarding a score of 1 to every correct production and a score of 0 to inaccurate production (substitution, omission or distortion). Dialect features were not scored as errors [16]. The test score ranged from 0 to 180, subdivided into 9 subscales (plosives, fricatives, affricates, nasals, liquids, bi-consonants clusters, tri-consonants clusters, vowels, diphthongs). Administration time ranged from 30 to 60 minutes. The examiner transcribed the child's responses online but also audio-recorded the assessment with a high fidelity recording

equipment (Digital voice recorder, VN-6500PC, Olympus), to analyse test reliability. The microphone was built into the recorder, and the typical microphone to mouth distance was 8-10 inches. During test administration children, especially the younger, were allowed to pause based on examiner's judgment briefly. The frequency of pauses was not recorded and analysed because influence on articulation performance was not expected.

2.4.2. Psychometric properties. To evaluate inter-rater reliability of Rossi's Articulation Test, audio-recordings of 50 children, selected randomly from the normative sample, were scored by an additional examiner. To assess intra-rater reliability, the rater who administered the test re-scored the audio-recordings of 50 children, selected randomly from the normative sample, with an interval of at least a week. In order to evaluate test-retest reliability, 144 participants, randomly selected from the normative sample, were re-tested after 1-3 weeks by the same assessor under similar circumstances.
To assess construct validity, the developmental progression of total scores across age groups was verified, as Lousada and colleagues in Portuguese children [16].

2.5. Statistical Analyses

Statistical tests were performed using SPSS 19.0 statistical software (SPSS, Inc., Chicago, IL) and R software (R Core Team 2014).

2.5.1. Normative data. **The Kolmogorov-Smirnov test was applied to test the normality of the data (total and subscale score) for each age group. To establish normative data, percentages of correct production for target** phoneme or cluster and percentile ranks for total and section scores were calculated for each age group. The percentages of accuracy for each consonant were examined to determine *mastery* (at least 90% of children in an age group produced the sound correctly in all word-position tested), *acquisition age* (at least 75%) and *age of customary production* (at least 50%) [21].

2.5.2. Psychometric properties. To assess inter-, intra- and test-retest reliability, data from different measures were compared using two-way random Intraclass Correlation Coefficient (ICC). To study construct validity, the association of age with the total score was evaluated using a Beta inflated distribution with sigma and tau modeled as a function of age. Such regression is needed as the total score is not normally distributed but has a

limited range (0-180). The Beta inflated model also allows for the estimation of the reference range for the test. The R package GAMLSS [22] was used for model fitting.

3. Results

3.1. Normative data. The Kolmogorov-Smirnov test results showed that for most age groups the sample was not normally distributed, but only for the youngest ones (3;0-3;5 and 3;6-4;0). Percentages of correct target production across age groups were calculated, according to Rossi's articulation test performances. Almost all children in the sample produced vowels, approximants and diphthongs correctly. Single consonants were generally acquired by younger children in comparison to consonant clusters. Ages of acquisition of each Italian consonant were calculated and reported in Table 3. Italian-speaking children aged from 3;0 to 3;5 mastered voiceless plosives [p] [t] and nasals [m] [n] in all word positions. Age of mastery of the voiced plosive [b], the lateral [l], the velar plosive [k] and the labiodental fricatives [f] was 4;0 years. In the next age band (4;0-4;5 years) children showed acquisition also of the voiced counterparts [g] [v]. Age of mastery of the nasal [ɲ], the palato-alveolar fricative [ʃ], the palate-alveolar affricates [dʒ] [ʧ] and the vibrant [r] was 6;0 years. Late consonants, acquired by children of at least 7;0 years, were dental affricates [dz] [ts], alveolar fricatives [s] [z] (frequently distorted) and the palatal lateral [ʎ]. The acquisition of consonant cluster was characterized by early mastery of bi-consonant cluster that consists of nasal + stop (e.g. [mp]) and stop + liquid element (e.g. [pl]), mastered by 4-year-old children. Bi-consonant clusters that include a liquid or fricative as first consonant (e.g. [lp] [st]) were mastered generally by 6-year-old children. Lastly, 7-year-old children produced more accurately tri-consonant cluster, with a preference for nasal as the first consonant. Both the acquisition of consonants and clusters appears to be characterized by reversals and revisions: in some cases, children from older age group produced correctly target sound in a lower percentage of children from the younger adjacent group. Percentile ranks of test total score are presented in Table 4 for each age group; data are available also for section scores, not presented here, for brevity.

3.2. Psychometric properties. Inter-rater reliability of the sample was ICC=0.92 (95% CI: 0.86–0.95), intra-rater reliability was ICC=0.98 (95% CI: 0.97-0.99) and test-retest reliability was ICC = 0.99 (95% CI: 0.98-0.99). Test scores increased with age. The association of age with the total score (construct validity) was significant ($p<0.001$), as reported in Figure 1. In Figure 1 are also reported the 10^{th} and 90^{th} percentiles of the total

score distribution for the different ages (reference range).

4. Discussion

In the present cross-sectional study, the acquisition of Italian consonants was investigated through the administration of Rossi's articulation test to a sample of 694 typically developing children. Specific language norms in speech sound development were defined. In addition, psychometric properties of the test (reliability and validity) were confirmed.

4.1. Normative data. Norms established in the study partly confirm findings of earlier research, both in Italian language and in other languages. Two previous Italian studies [13, 14], that reported some of the selected measures and targeted children within the same age range can be compared to the present study. Zanobini and colleagues [13] studied consonant inventories of 30 Italian children between 36 and 42 months. Their assessment included a set of 90 pictured designed to collect a spontaneous language sample. A phone was considered part of the child's consonant inventory if the child produced it in three different words (types), regardless the position. Compared to results of the present study, there is concordance on early acquisition of plosives (except [g]), nasals [m] [n], lateral [l] and labiodental fricatives [f] [v]. Zanobini and colleagues reported that more than 80% of their sample produced fricatives [s] [z], affricate [ʧ] and vibrant [r] in initial or medial position, while in the present study these sounds seem to be acquired lately by Italian children. This discrepancy can be explained by the selection of more stringent acquisition criteria: in this work, a consonant was considered acquired when correctly produced in all word position and not in just one position. In the area of speech sound development research, differences, especially in the criteria used, resulted in differences in the age of sound acquisition [3].
In previous research [14] a sample of 649 Italian-speaking children aged from 3 to 6 years was administered a repetition test to establish normative data on speech sound development. Compared to present study results, the order of consonant acquisition appears similar, but for most sounds ages of acquisition are reported as earlier. This discrepancy might be related to characteristics of the speech sample elicited and analysed. In addition, the task was different: a repetition task in the previous study, a picture naming task in the present study.

To explore similarities and differences in cross-language speech sound development, results of the study can also be compared to studies in different languages. Consistently

with results of international researchers, 3-years-old children produced vowels correctly, and single consonants were generally acquired before consonant clusters [3, 5]. Moreover, speech sound acquisition was marked by reversals and revisions [4, 23]. To compare specifically ages of mastery for consonant acquisition, two studies were selected from the international background presenting a similar methodology [4,24]. To compare data from the speech sound development of the Italian and English children, a recent Dodd's study was selected because it was based on a large sample of English-speaking children aged from 3;0 to 7;0 [3]. An additional study on American English-speaking children was added [25]. To compare Italian data to a more similar language (a romance language), a study including 156 Quebecois French-speaking children aged 20-53 months [7] was selected, despite this variety of French shows also influences from English and Native American. The comparison of the consonant age of acquisition in these two studies is summarized in Table 5. In all language voiceless plosive [p] [t] and nasals [m] [n] are mastered early, already by 3-year-old children. In addition, Italian- , Quebecois French- and English-speaking participants mastered the lateral [l] by the age of 4 and the sibilant [ʃ] later, after 4;6 years. For other speech sound acquisition, there is less correspondence between languages. Similarities appear to be more evident between Italian and Quebecois French than between Italian and English: mastery of the velar plosive [k] and voiced plosive [d] by the 4;0-4;5 age group and acquisition of sibilant [s] after 4;6 years. Data from the speech sound development of Italian, English and Quebecois French were compared and show some similar tendencies. An additional study analysing age of mastery on American English-speaking children was considered, but not included in the table because of differences in reporting the data [25]. Also in Smit et al study nasals, glides and stops reached high levels of accuracy at young ages (generally mastered by 4 years), while fricatives, affricates and liquids reached comparable levels of accuracy at later ages (until 9 years for phonemes frequently distorted such as /s z/), and clusters still later. Other studies focused on age of acquisition, rather that of age of mastery in speech sound development [16, 26, 27, 28]. As can be expected age of acquisition is younger compared to age of mastery: however, when comparing Portuguese and English data, similarities can be found for phonemes in common. At least 75% of Portuguese-speaking children aged from 3;0 to 3;5 correctly produced almost all singleton consonants. Later ages of acquisition were reported for consonants [ʃ][l][ʎ] (3;6 years), for consonants [z][ʒ] (4;0 years) and finally [r] (4;6 years) [16]. Also different studies on English-speaking children [27, 28] reported early ages of acquisition for

nasals, stops and almost all fricatives, generally acquired by 3-years-old children and later ages of acquisition for laterals [l] [r] and fricatives [s] [z] [ʃ] [ʒ].

Discrepancies in order and rate of acquisition are probably related to differences between languages: perceptual and motor details of phonemes, the frequency of occurrence of phonemes and stress system [7], but also to preferred syllable structure and morphologic system [13]. As both similarities and discrepancies were found, it can be questioned if there is a universal trend, based on the gradual growth of speech motor abilities [5]. Data also showed some differences in speech sound development, that can support the need for language specific norms, considered the speech sound specificity of each language [7]. Indeed, children seem to follow both cross-linguistic and language-specific trends.

4.2. Psychometric properties. The study demonstrated strong inter-rater, intra-rater, and test–retest reliability of Rossi's articulation test: all ICCs were superior to 0.9, values that are considered acceptable for group comparison and for individual measurements over time **[29]**. Furthermore, the study reported the analysis of construct validity of Rossi's articulation test. The results of Beta inflated regression showed a significant improvement in test score with age, to reflect the improvement that occurs during normal development of children, as demonstrated in other studies [16].

4.3. Methodological limitations and future directions

Several methodological factors may have influenced results and require consideration. The analysis of psychometric properties of Rossi's articulation test included only the study of construct validity, not comparing results obtained by normally-developing children with a group of children with SSD (clinical validity) and with scores obtained through other assessment instrument (concurrent validity). In addition, the assessment of inter-rater reliability of Rossi's articulation test based on judgments of only two examiners can be considered a limitation of the study. Another study limitation was the absence of the analysis of the association between children's speech sound articulation and factors discussed in the literature, such as gender, SES, geographical area of residence, speech perception abilities, swallowing and praxis skills. Future research may focus on these aspects. Finally, Rossi's articulation test length represented a limitation for children with limited concentration and particularly for the youngest. Clinicians may

decide to pause the test or to administer just a few sub-test in a first evaluation (e.g., excluding consonant clusters' subtests).

5. Conclusions

In conclusion, normative data on speech sound development of Italian-speaking children were presented, based on a large sample of 694 participants aged from 3 to 7 years and representative of different geographical areas. Results of this investigation have significant clinical implications for the assessment of Italian-speaking children with suspected speech sound disorder. Data established to allow the clinician to avoid clinical decisions making about children from the Italian language based on comparison to norms for children learning English and to avoid misidentification of disorders.

Norms were derived specifically from Rossi's articulation test's items, whose psychometric proprieties were verified (reliability and construct validity). Rossi's articulation test provides a full picture of Italian-children speech sound skill and its application in clinical practice can be recommended, both in diagnosis phase and in the selection of treatment target. Although the 10^{th} percentile is not a legally mandated cut-off in Italy, a total score below the 10^{th} percentile on Rossi's articulation test can be considered highly suggestive of the performance below the normal range. Finally, a qualitative analysis, comparing ages of acquisition of each Italian phoneme, can help clinicians to choose appropriate treatment targets.

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Tables and Figures

Table 1. Distribution and characteristics of the normative sample

Age group *(years; months)*	**N**	**%**	**Gender**		**Geographical area of residence**		
			Female	**Male**	**Milan**	**Bergamo and Varese**	**Naples**
3;0-3;5	51	**7.3**	21	30	16	23	12
3;6-3;11	75	10.8	32	43	31	24	20
4;0-4;5	82	11.8	41	41	34	31	17
4;6-4;11	74	10.7	39	35	28	28	18
5;0-5;5	103	14.8	58	45	40	41	22
5;6-5;11	116	16.7	58	58	32	57	27
6;0-6;5	87	12.5	39	48	10	47	30
6;6-6;11	68	9.8	37	31	0	48	20
7;0-7;5	16	2.3	9	7	0	1	15
7;6-7;11	22	3.2	13	9	0	0	22
Total	694	100.0	347	347	191	300	203

Table 2. Socio-economic characteristics of the sample (higher-educated parent)

Age group *(years; months)*	**N**	**Years of education**	**Occupation**			
			0	**1**	**2**	**3**
3;0-3;5	39	15.5±3.7	0%	25.6%	20.5%	53.9%
3;6-3;11	54	16.5±3.6	0%	9.2%	27.8%	63%
4;0-4;5	64	15.4±2.9	0%	14%	29.7%	56.3%
4;6-4;11	53	15.4±3.4	0%	17%	34%	49%
5;0-5;5	81	15.8±3.9	0%	19.8%	25.9%	54.3%
5;6-5;11	98	14.9±3.8	2%	19.4%	30.6%	48%
6;0-6;5	86	13.6±3.3	3.5%	27.9%	40.7%	27.9%
6;6-6;11	67	14.7±3.4	0%	20.9%	35.8%	43.3%
7;0-7;5	15	14.0±2.8	6.6%	40%	26.7%	26.7%
7;6-7;11	20	14.1±4.7	0%	15%	45%	40%
Total	577	15.1±3.6	1%	20%	31.7%	47.3%

0 = unemployed

1 = manual worker (e.g. workman, farmer),

2 = office worker

3 = knowledge worker (e.g. medical doctor, lawyer)

Table 3. Ages of acquisition of Italian phonemes (years; months)

Italian phonemes	Age of customary production ≥ 50%	Acquisition age ≥ 75%	Mastery ≥ 90%
p			≤ 3;0
t			≤ 3;0
m			≤ 3;0
n			≤ 3;0
b		≤ 3;0	3;6
l		≤ 3;0	3;6
k		3;6	4;0
d		≤ 3;0	4;0
f		≤ 3;0	4;0
v	3;6	4;0	4;6
g	≤ 3;0	4;0	4;6
ɲ	3;6	4;0	5;6
dʒ	≤ 3;0	4;0	5;6
ʃ	≤ 3;0	4;6	5;6
tʃ	≤ 3;0	4;0	6;0
r	4;0	4;6	6;0
z	≤ 3;0	3;6	6;6
ts		6;0	6;6
dz	3;6	5;6	7;0
ʎ	5;0	6;0	7;0
s	≤ 3;0	5;6	7;6

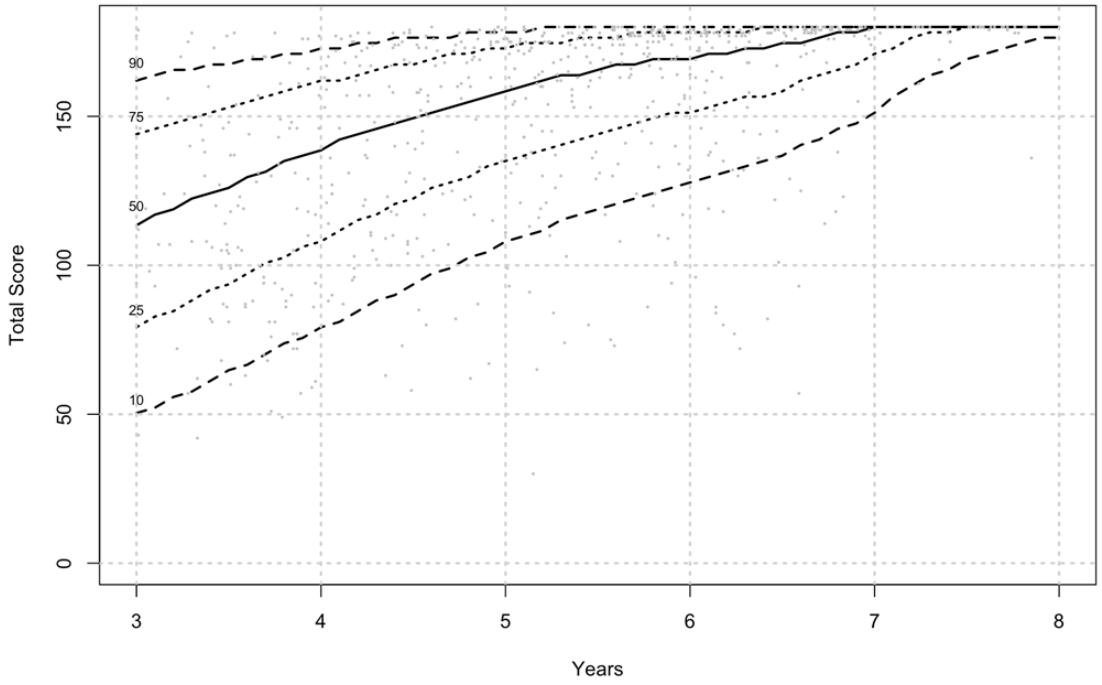
Table 4. Percentile ranks for test total score

Age group (years; months)	N	Percentile ranks						
		1°	5°	25°	50°	75°	95°	99°
3;0-3;5	51	42	57	68	94	112	146	173
3;6-3;11	75	49	59	68	86	117	146	170
4;0-4;5	82	58	88	99	111	147	170	176
4;6-4;11	74	62	82	103	129	160.5	174	178
5;0-5;5	103	65	91	111	137	163	175	178
5;6-5;11	116	75	108	124	156.5	174	178	180
6;0-6;5	87	72	84	118	145	175	178	179
6;6-6;11	68	57	118	129	175.5	179	179.5	180
7;0-7;5	16	161	161	169	176.5	180	180	180
7;6-7;11	22	136	178	178	180	180	180	180

Table 5. Age of acquisition for mastered consonants (> 90%) across different languages

Age group	Italian *Present study*	English *Dodd et al, 2003*	Quebecois French *McLeod et al, 2011*
3;0-3;5	p, t, m, n	p, t, m, n, f, z, b, d, k, g, v, s, ŋ, h	p, t, m, n, f, z
3;6-3;11	l, b	l-, w, j	l, w
4;0-4;5	**k, d, f**	**tʒ, ʒ, dʒ**	k, d, b, g, v, ɲ, ʏ, ʁ
4;6-4;11	**v, g**		ʃ, s, ʒ, j (4;6 above)
5;0-5;5		**ʃ**	
5;6-5;11	**ɲ, dʒ, ʃ**		
6;0-6;5	**tʃ, r,**	**ɹ**	
6;6-6;11	**z, ts**		
7;0 above	**s, dz, ʎ**	**ɵ, ð**	

Figure 1. The figure reports the 10th and 90th percentiles of the total score together with the median and quartiles. The effect of age on the mean of the distribution was significant ($p<0.001$). Estimates were obtained using a Beta inflated regression with sigma and tau modeled as a function of age using GAMLSS package in R software.



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