

Babbling and first words in children with slow expressive development

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Abstract

This study examined early vocal production to assess whether it is possible to identify predictors of vocabulary development prior to the age point at which lexical delay is usually identified. Characteristics of babbling and first words in 12 Italian children with slow expressive development (late talkers; LT) were compared with those of 12 typically developing (TD) peers. Syllable structure and phonetic characteristics of babbling and first words produced by both groups of children at 20 months were analysed during mother-child play sessions. Results indicated that phonetic complexity and number of consonantal types were lower in the LT group. The two groups also differed in their use of sound classes and their syllable structure. Overall, it can be said that LTs development is similar to (but slower than) TDs, as opposed to having an atypical pattern of phonological development.

Keywords: *Late talkers, babbling, phonological development*

Introduction

Over the last 20 years, several studies have focused on the linguistic development of children defined as “late talkers”, i.e. children who fail to produce at least 50 words or a two-word combination of any kind by age two (Rescorla, 1989; Rescorla & Schwartz, 1990; Scarborough & Dobrich, 1990). These studies did not provide clear indications regarding deficits in hearing, intelligence or receptive language ability, although many did attempt to identify predictor variables to assist in distinguishing children who will catch up through their own efforts from those who will require special assistance. There have been studies that implicated the role of comprehension (Thal, Tobias, & Morrison, 1991), gestural ability (Fasolo & D’Odorico, 2002a), age of diagnosis (Rescorla & Schwartz, 1990; Paul, 1993), and combined delays in comprehension and non-verbal ability (Rescorla, Roberts, & Dahlsgaard, 1997).

Recently, many studies have focused on prelinguistic vocal patterns and their relation to later speech development. It has often been hypothesized that the initial speech-like articulation and babbling stage, which occur at approximately 10 months of age, allows infants to develop a link between articulatory settings and the resulting auditory consequences, thus

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laying down the basis for the development of the phonetic inventory and adaptation to the ambient language (Westermann & Miranda, 2004). Several longitudinal studies, conducted on different populations and using different modes of analysis, indicated a continuity between prelinguistic production (babbling) and first words both in typically developing children (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Locke, 1989; Vihman & McCune, 1994; Leonard & Bortolini, 1998; Oller, Eilers, Neal, & Schwartz, 1999) and in children with language delay (Stoel-Gammon, 1989; Oller, Eilers, Neal, & Cobo-Lewis, 1998; D'Odorico, Bortolini, De Gasperi, & Assanelli, 1999; Rescorla, Dahlsgaard, & Roberts, 2000).

Although many studies (e.g. Paul, 1991; Rescorla et al., 1997) have indicated that approximately 50% of toddlers with slow expressive speech development at age two have good vocal output at age 3, only a few have attempted to make a distinction between delayed and deviant phonological development. As Locke (1989) reported, there are both theoretical and practical reasons for investigating whether prelexical vocal behaviour is an accurate predictor of later speech and language development. On the theoretical side, the ability to predict with accuracy would contribute to making a more precise characterization of infant vocalization with regards the child's motor, perceptual, social and linguistic development. In practical terms, early recognition that an infant is unlikely to develop speech and language normally was (and still is) considered valuable, as it indicates which children are capable of catching up with their peers and those who, on the other hand, are not able to do so without assistance.

In the last 20 years, two types of studies have been conducted to investigate the phonetic characteristics of speech produced by late talkers (hereafter, LT). Longitudinal analyses have been carried out on children with slow expressive development, whereas group comparisons have been made between children with language delay and typically developing children. One of the first studies in this area was done by Stoel-Gammon (1989) on two LTs from age 9 to 21 months, nested in a larger sample of 34 children. Her analysis of pre-speech utterances revealed that one child produced only a few canonical babbles from 9 to 21 months of age, while the other displayed an unusual pattern of sound preference in his babbles. At 24 months of age, both children showed a simpler syllable structure and more limited phonetic repertoires compared to the peer group. Scarborough and Dobrich (1990), in a study of four LT children conducted at 30, 36, and 42 months of age, also found a significant difference in the total number of errors on consonants in comparison with a group of 12 typically developing (TD) peers. In recent years Williams and Elbert (2003) collected and analysed longitudinal data from five children with slow expressive development. Their results indicated that, in addition to quantitative factors (limited phonetic inventories, lower percentage of correct consonants, and more sound errors), qualitative variables (atypical error patterns, greater sound variability and slower rate of resolution) can be potential predictors of phonological delay.

While limited numbers of children were involved in the analyses described above, other studies compared large groups of LTs and TDs. Whitehurst and his colleagues (Whitehurst, Smith, Fishel, Arnold, & Lonigan, 1991) analysed babble in the spontaneous speech of 37 2-year-olds. The variables derived from this sample were then used to predict individual differences in expressive language scores at 30 months of age. The rate of word use was positively related to language outcome, whereas the rate of vowel babble was negatively related. Together, these two variables accounted for 41% of the variance in language outcome test scores. The single strongest correlate of language outcome was the proportion of consonantal to vocalic babble, whereas the degree of social responsiveness of babble and the length of babble were not related to later language scores.

Paul and Jennings (1992), in contrast, divided 28 toddlers into two age groups to examine phonological development in a slow expressive development scenario compared to a control group of normally developing children. The authors used three global measures of phonological development: the average level of complexity of syllable structure, the number of different consonant types produced, and the percentage of consonants correctly produced in intelligible utterances. The two groups differed significantly on all three measures. Compared to the control group, both groups of late talkers produced fewer consonants correctly, had smaller phonetic inventories, and produced less complex syllable structures. They displayed a delayed, rather than a deviant, pattern of phonological development.

Similar results were reported by Rescorla and Ratner (1996) in a study that analysed the phonological development of 30 children with specific language impairment (SLI) and 30 TDs. The SLI group showed a delay in phonetic development; these children produced fewer vocalizations, displaying reduced phonetic inventories and syllable structure patterns. Later, Pharr, Ratner and Rescorla (2000) conducted a longitudinal study of 20 LTs and 15 TD peers at 24 and 36 months of age, focusing on the production of syllable shapes. The authors found that the LTs produced fewer syllable shapes containing final consonants, more than one consonant type, and consonant clusters; this group vocalized less often than their TD peers.

Oller and colleagues (Oller et al., 1998) found that infants who began to babble after 10 to 12 months of age showed a greater number of developmental problems (including sensory, cognitive, and linguistic disorders), than infants who babbled earlier. Late babblers had significantly lower expressive vocabulary scores at 18, 24, and 30 months of age than those who began to babble at the normal age. Receptive vocabulary scores were slightly lower at 18 months of age than those of the TD group, but had recovered at 24 months, suggesting that late babbling may be more closely related to production than to perception.

The relationship between poor phonological skills and slow expressive language development, however, is not straightforward in regard to the direction of influence. One may hypothesize that children with little experience producing syllables on their own were less sensitive to similar patterns in their ambient language. Perhaps, the phonemes were not well represented in the phonological memory; therefore, they would not be available as building blocks for the construction of lexical representations. On the other hand, a low vocabulary acquisition impeded the use of words acquired as models to attain new words, phonetics rules and contrasts (Ganger & Brent, 2004). The role of phonology in the development of other domains, such as the lexicon and bound morphology, can be identified only through analyses of the phonological characteristics of early utterances of children at the same stage of lexical development.

It should be noted that most of the research aimed at verifying the predictive value of the characteristics of phonological development on subsequent language development has been conducted on infants learning to speak the English language. Exceptions to this pattern may be found in research on the relationships between lexical immaturity and limited phonetic abilities in a sample of Cantonese children (Fletcher, Chan, Wong, Stokes, Tardif, & Leung, 2004) and in two Italian late talkers (Bortolini, 1991).

The aim of the present study is to analyse the production of babbling and first words in LTs and TDs at an early stage of language development, i.e. before delay of vocabulary acquisition is manifest. More specifically, a comparison will be made of the characteristics of babbling and first words in 20-month-olds with a similar vocabulary size and the value of babbling measures as a predictor for linguistic development in the following months will be

verified. Given the scarcity of phonological studies conducted on non-English LTs, the data from this study will permit a comparison of the similarities and differences in early phonological development in English and Italian children, and will provide a useful contribution to the cross-linguistic perspective of language acquisition.

As reported by Bortolini and Leonard (2000), Italian differs from English in several ways that are likely to influence the pattern of phonological acquisition in children. The Italian phonetic inventory contains 27 consonant sounds and, in Italian, the most frequent sounds in children's first words are stops and nasals (Bortolini, 1995). The most common words have two or three syllables (e.g. CVCV; CVCVCV, VCVCV); monosyllabic words and words with a final consonant (e.g. CVC) are uncommon. As in English, feet are usually trochaic (e.g. *cane* (dog); *topo* (mouse)); however, Italian has many words with an initial weak unfooted syllable (e.g. *matita* (pencil), *martello* (hammer)) and with an unfooted weak syllable in the final position (e.g. *albero* (tree), *pecora* (sheep)). Word-initial and word-final consonant clusters are uncommon (Barca, Burani, & Arduino, 2002).

Data from 11 TDs, reported in Majorano and D'Odorico (2006), showed that the children's first words were in the CVCV format (e.g. /mam:a/, /papa/, /tato/, /momo/, /mimi/, /tete/). From 18–20 months (from the 10- to 50-word point) the children began to produce words with consonantal variations (e.g. /kadi/; /tap:o/), and longer, trisyllabic and quadrisyllabic words (e.g. /banana/, /majone/, /pikolo/, /pekolozo/); the number of words containing consonant clusters also increased (e.g. /bimba/, /pendi/, /ande/).

Method

Participants

The children under study were a subset of the groups who had previously participated in several epidemiological longitudinal studies on language acquisition in Italian children (D'Odorico & Carubbi, 2001, 2003; D'Odorico, Carubbi, Salerno, & Calvo, 2001; D'Odorico, Salerno, Carubbi, & Calvo, 2001; D'Odorico, 2002; Fasolo & D'Odorico, 2002a, b; D'Odorico & Jacob, 2006; D'Odorico & Fasolo, in press; Salerno, Assanelli, & D'Odorico, 2007). A subset of 12 children (eight males, four females) identified as late talkers (LT) at 24 months of age (i.e. failing to produce at least 50 words or any two-word combinations) were selected from the corpus. The control group was composed of 12 typically developing (TD) children who were matched for gender (see Table I). All the

Table I. Parity and education of mothers of late talkers (LT) and typically developing children (TD).

	LT		TD	
	male	female	male	Female
Parity				
First-born	2	1	3	0
Second-born	5	3	5	4
Third-born	1	0	0	0
Mothers' education ³				
18 years of education	2	0	4	1
13 years of education	4	3	3	2
8 years of education	2	1	1	1

children participating in the study came from monolingual Italian-speaking families of average social-economic status.

The vocabulary development of all the children participating in the study was assessed monthly on the basis of their mothers' responses to the Italian version of the MacArthur Communicative Development Inventory (Caselli & Casadio, 1995); none of the children demonstrated any deficits in hearing, intelligence or receptive language ability. When they were approximately 18–20-months-old, all the children participated in 30-minute play sessions with their mothers. These sessions were video-recorded and subsequently transcribed. The children's spontaneous vocal productions during these sessions were analyzed for the purposes of present study.

At 24 months of age, the mean vocabulary size of the two groups differed dramatically (LT: M=32; SD=14.410; TD: M=230; SD=161.721), but when the spontaneous vocal production data were collected during the play sessions, vocabulary size alone would not have been sufficient to predict which children would exhibit a slowing down of vocabulary development in the following months (see Table II). Specifically, all children at that age had a vocabulary size of fewer than 60 words and some children, subsequently classified as LT, had a higher vocabulary size than some TD.

Table II. Vocabulary size and age at the time of the play-sessions; mean and (standard deviation).

	Subjects	Video-recorded play session	
		Age	Vocabulary
LT	B.G.	20;07	4
	C.S.	22;03	13
	C.M.	20;24	27
	D.M.F.	19;14	13
	F.S.	20;06	14
	G.G.	18;10	2
	G.A.	20;05	33
	R.J.	20;07	26
	S.L.	20;08	11
	S.A.I	21;29	10
	S.A.II	20;08	14
V.N.	18;01	12	
TD	A.S.	18;02	57
	A.A.	20;07	26
	B.M.	19;29	30
	B.E.	20;05	14
	F.T.	20;02	22
	F.G.	20;07	51
	F.C.	20;21	42
	N.M.	20;02	26
	P.A.	20;26	58
	S.S.	20;02	26
	T.M.M.	19;22	48
V.M.	20;10	31	
LT Mean (SD)		20;05	14.92 (9.239)
TD Mean (SD)		20;04	35.92 (14.681)

Procedure

During play sessions, five different sets of toys were used to give the children the opportunity to exhibit their naming competence. These materials included a farm, a “nurturing” set (a doll with bed, mattress, and a telephone), a “dining” set (plastic fruits and vegetables with dishes and cutlery), and some illustrated books. Mothers were instructed to play normally with the children, but to try to draw their attention to each set of toys; the experimenter attended each play-session and could participate if they were directly invited to do so by the children or the mothers.

The observer transcribed each child’s vocal or verbal production, noting the duration and contextual elements. These observations included the children’s interaction with the objects, their communicative gestures and gaze direction, and the mothers’ verbal production immediately preceding and following that of the children. Two trained transcribers, working independently from one another, transcribed all the vocalizations directly from the mother-child play session videotapes. Broad phonetic transcription were prepared using IPA (International Phonetic Association, 1999) symbols. The first transcriber was not informed of the subject’s group assignment until the transcription had been completed. Laughing and singing were not included in the transcripts. Any vocalization that could not be confidently transcribed after four listenings was eliminated. The guidelines for the transcription process were analogous to those used by other authors (Stoel-Gammon, 1989, 2002; Paul & Jennings, 1992; Pharr et al., 2000). The completed transcriptions were entered into individual CHAT files (Codes for the Human Analysis of Transcripts; MacWhinney, 1997).

Coding and data reduction

The utterances produced by the children during the play sessions were coded into two main categories: single-word utterances and babbling vocalizations. The latter were identified according to Stoel-Gammon’s criteria (1989):

- the vocalization was judged to be non-meaningful;
- the vocalization contained at least one voiced vocalic element or a voiced syllabic consonant;
- the vocalization was produced with an egressive airstream;
- babbled and non-interpretible utterances were bounded by one second of silence, breath, noise, or maternal speech;
- the vocalization was judged to be “speechlike”.

Words were identified on the basis of Vihman’s procedure (Vihman, 1991; Vihman & McCune, 1994).

The babbling utterances were then classified into the following three categories as established by Paul and Jennings (1992):

Level I: vocalization containing a vowel (e.g. [o]) or a syllable containing a glottal stop (e.g. [ʔ]) or glide (Wulbert, Inglis, Kriegsmann, & Mills, 1975);

Level II: vocalizations containing one true consonant or a replicated true consonant (e.g. [ba], [dada]), or sounds that differed only in voicing (e.g. [data]);

Level III: vocalization containing two or more different consonants (e.g. [bati]).

The Mean Babbling Level was also computed in reference to Stoel-Gammon’s criteria (1989) and was calculated by multiplying the number of Level I utterances by 1, the

number of Level II utterances by 2, the number of Level III utterances by 3, and then dividing the total by the number of babbled utterances.¹

Applying Ingram’s criteria (2002), we computed the Proportion of Whole-word Correctness (PWC), i.e. a measure that determines which proportion of the child’s words of his/her entire vocabulary are produced correctly.

The syllable structure of babbling and first words was analysed, calculating the proportion of the following types of structure: (a) CV; (b) VC; (c) CVV1; (d) CVCV; (e) ≥ three syllables with one consonant type; (f) ≥ two syllables with two consonant types; (g) other. The mean syllabic length of babbling and word utterances was also calculated, dividing the total number of syllables produced by the total number of babblings and word utterances.

Finally, the consonant inventory for each speech sample was calculated on the basis of Stoel-Gammon’s criteria (1989). The number of different consonants produced by each child during babbling and producing interpretable words was computed.

All the consonant types for each subject were grouped into classes, roughly corresponding to the developmental order of acquisition (Paul & Jennings, 1992; Stoel-Gammon & Dunn, 1985): glides and glottals ([w, j, ʔ]), front stops and nasals ([p, b, t, d, m, n]), back stops and nasals ([k, g, ŋ, ŋ]), fricatives ([f, v, s, z, ʃ, ʒ]), affricates ([tʃ, dʒ]) and liquids ([l, ʎ]).

Reliability

Transcription reliability was calculated on 42% of the total transcriptions; 10 children (five from each group) were randomly selected for this purpose. Point-by-point consonant comparisons were made and the interjudge reliability ranged from .80 to .95. To maintain data consistency, only the material produced by the first transcriber was used for the final analysis.

Results

The spontaneous vocal productions of the two groups during the play sessions were similar insofar as there were no significant differences in the total number of utterances produced (no distinction being made between babbling and single-word utterances; see Table III). Even if the TDs produced more words (phonetic tokens) and a wider variety of words (phonetic types) than the LTs, the two groups did not differ in the proportion of whole-word correctness, i.e. the LTs showed a good level of phonological accuracy in producing the words they have acquired.

Table III. Utterance production of late talkers and typically developing children.

	LT		TD		t-value	p
	M	SD	M	SD		
Total utterances	100.42	89.838	152.25	74.614	-1.538	.138
Babbling utterances (%)	73.99	26.277	44.11	20.640	3.106	.005
Word utterances (%)	26.01	26.277	55.89	20.640	-3.106	.005
Phonetic Tokens	30.33	32.267	81.17	41.111	-3.369	.003
Phonetic Types	5.33	4.735	20.75	10.270	-4.722	.001
Phonetic correct production (%)	23.50	28.257	34.58	13.494	-1.226	.233

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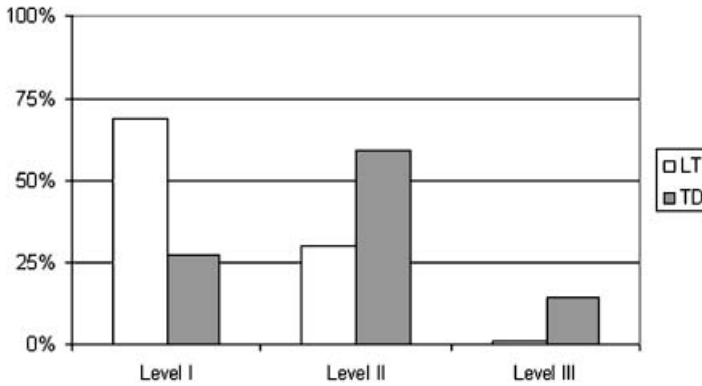


Figure 1. Percentages of different babbling and word syllabic structures levels of LT and TD.

A more in-depth analysis of prelinguistic behaviour (see Figure 1) revealed that babbling produced by TDs showed a higher phonetic complexity than that produced by the LT group; more specifically, the TD group produced a significantly lower proportion of Level I babbling than did the LT group ($t=3.258$; $p=.004$; $d=1.52$)² and a higher proportion of Level II ($t=-2.474$; $p=.022$; $d=1.36$) and Level III babbling ($t=-2.858$; $p=.009$; $d=1.36$); besides, 75% of the TD group produced Level III babbling at least once, compared to a mere only 25% of the LT group.

The same pattern of results is obtained considering Mean Babbling Level (LT: $M=1.22$; $SD=.187$; TD: $M=1.50$; $SD=.312$), which is significantly higher for the TD group than for the LT group ($t=-3.444$; $p=.002$; $d=1.08$).

LT children produced shorter utterances than TD's (LT: $M=1.134$; $SD=.529$; TD: $M=1.546$; $SD=1.636$) even if the difference does not reach a statistical significance ($t=-.580$; $p=.568$; $d=1.08$). Moreover the syllable structures used more frequently by the two groups were quite different too (see Figure 2). The most striking differences were in the high proportion of the simplest syllable structure, i.e. CV, and in the very low proportion of syllables containing two different consonants (i.e. CVC_1V) in LT production compared to TD. This result can be explained by LT's limited consonant inventory which was on average 4.42 consonants (range: 1–11), while that of the TD group was 10.50 (range 7–18); the difference is statistically significant ($t=-4.962$; $p=.001$; $d=1.91$; see table IV for

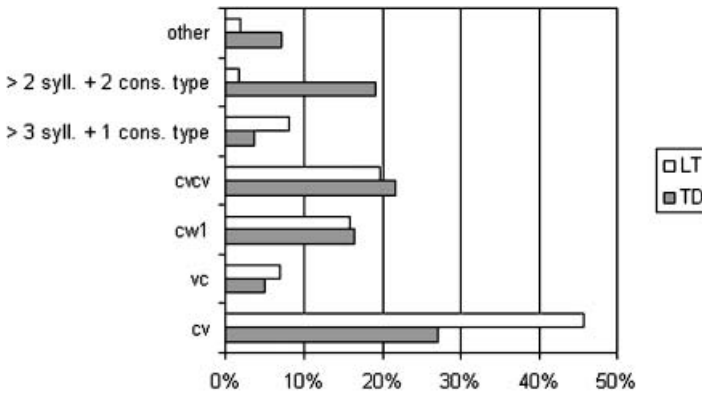


Figure 2. Percentage of different syllable structures produced by LT and TD.

Table IV. Consonant sound inventory of late talkers and typically developing children.

LT	p, b, t, k, m, n, w
TD	p, b, t, d, k, m, n, ʃ, l, w, j

the consonants found in the phonetic inventories of 50% or more of the children in each of the two groups).

As can be seen from Table V, front stops and nasals were the most prevalent class for both groups, whereas LTs displayed a higher percentage of glides/glottals ($t=1.95$; $p=.06$; $d=1.09$) and a lower percentage of fricatives ($t=2.20$; $p=.03$; $d=.89$); affricates and liquids were less frequent for both groups, depending on the age of the participants.

Predictive value of babbling measures on language acquisition

The last group analysis considered the value of babbling measures collected at 18–20 months of age to predict vocabulary development at 24 months. Results showed that the Mean Level of Babbling is significantly related to vocabulary size at 24 months of age, even controlling the number of words already acquired at the earlier age ($r=.580$; $p=.003$); the same predictive value has to be assigned to the percentage of babbling classified at level III ($r=.740$; $p=.001$).

Discussion

The aim of this study was to compare the phonetic characteristics of babbling and early words in children showing slow expressive development at 24 months of age with those of a group of typically developing peers. In particular, the study sought to identify early differences in syllable structure and phonetic characteristics of babbling and first words between the two groups in order to identify reliable indicators of language development. Our data, collected on a sample of Italian children, are consistent with those reported by previous studies (Stoel-Gammon, 1989; Paul & Jennings, 1992; Thal, Oroz, & McCaw, 1995; Rescorla & Ratner, 1996; Mirak & Rescorla, 1998; Roberts, Rescorla, Giroux, & Stevens, 1998; McCathren, Yoder, & Warren, 1999; Pharr et al., 2000): children with a low expressive language development at 24 months exhibited significantly different babbling patterns and syllable structures than those of their TD peers at 18–20 months of age. Many authors posited the predictive value of babbling characteristics with regard to subsequent speech and language ability (Stoel-Gammon, 1989; Davis & MacNeilage, 1995; Vihman, 1996), in so far as the experience of frequent CV syllable production made infants more aware of similar patterns in their ambient language, rendering these forms more salient as potential building blocks for word representations.

Table V. Percentages of different consonant types used by late talkers and typically developing children; mean and (standard deviation).

	Glides and Glottals	Front stops and Nasals	Back stops and Nasals	Fricatives	Affricates	Liquids
LT	17.82 (20.75)	57.34 (29.24)	17.08 (24.53)	.32 (0.79)	.98 (2.45)	6.46 (16.35)
TD	5.81 (4.95)	65.06 (16.85)	19.98 (10.66)	3.70 (5.26)	1.47 (2.04)	3.98 (6.66)

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Moreover, children who produced a lower number of sound variegations (as our LT children) are not in a position to use these as a filter for lexical acquisition (Vihman, 1993), while some studies have demonstrated that TD appear to learn words that are consistent with phonotactic constraints observed in their babbling and first words (e.g. Velleman & Vihman, 2002).

According to some authors, these results could be explained considering the relationship existing between phonology and lexicon. Several longitudinal studies showed how children tend to use the same favourite sounds in prelinguistic production and in their first words (Bortolini, 1991; Vihman, 1992; Fletcher et al., 2004) and to acquire words containing sounds which are already present in their phonetic inventory with greater ease (Schwartz & Leonard, 1982). On the other hand, lexical development can influence phonological development by allowing children to experience new articulatory schemata. As suggested by Paul and Jennings (1992), it is often difficult to establish if a slowing down in the linguistic production is to be attributed to reduced phonological abilities or if the cause is to be found in the paucity of lexical items acquired, which negatively influences the possibility to develop a rich phonological inventory.

Our results, derived from data collected when the two groups of children had similar vocabulary sizes, can be interpreted as evidence of the influence of phonological capacity on the process of word acquisition. Our data are consistent with the literature reporting that children who suffer from slow expressive development have a limited phonetic inventory, prefer to use glides and glottals in substitution of true consonants and use vocalization as a form of expression in substitution for words (Stoel-Gammon, 1987; Rescorla & Ratner, 1996; Williams & Elbert, 2003). The use of stops and nasals by LTs, however, did not differ from typically developing peers. According to some authors (e.g. Vihman, 1996) the fact that stops and nasals are the earliest true consonants to be produced by all children may be related to the natural perceptual salience of syllables with a stop onset. Stops present the sharpest possible contrast with vowels and provide the most obtrusive break in the acoustic stream of speech sounds. In particular, children not only hear, but *see* bilabial stops in adult speech, and so produce such sounds themselves and engage in repetitive vocal production or sound play, recreating their impressions of adult speech.

In conclusion, our data on early phonological development in children acquiring Italian show that it is possible to identify valuable predictors of lexical development predictors before the age of 24 months, the age-point at which lexical delay is usually identified.

Notes

1. For example: Level I: 35 utterances \times 1=35 syllables; Level II: 21 utterances \times 2 syllables =42; Level III: 6 utterances \times 3=18 syllables; total number of utterances =62; total number of syllables =95; Mean Babbling Level =95/62=1.532.
2. We calculated effect size following Kramer and Rosenthal (1999). They suggest that considering effect size is possible to uncover potentially interesting relationships, even when the statistical analysis of differences between groups does not reach the conventional level of significance.
3. Eighteen years of education corresponds to graduate school; 13 years of education corresponds to high school; 8 years of education corresponds to elementary and junior school.

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