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Research Article

Language Profiles and Their Relation to Cognitive and Motor Skills at 30 Months of Age: An Online Investigation of Low-Risk Preterm and Full-Term Children

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Purpose: Wide interindividual variability characterizes language development in the general and at-risk populations of up to 3 years of age. We adopted a complex approach that considers multiple aspects of lexical and grammatical skills to identify language profiles in low-risk preterm and full-term children. We also investigated biological and environmental predictors and relations between language profiles and cognitive and motor skills.
Method: We enrolled 200 thirty-month-old Italian-speaking children—consisting of 100 low-risk preterm and 100 comparable full-term children. Parents filled out the Italian version of the MacArthur–Bates Communicative Development Inventories Infant and Toddler Short Forms (word comprehension, word production, and incomplete and complete sentence production), Parent Report of Children's Abilities–Revised (cognitive score), and Early Motor Questionnaire (fine motor, gross motor, perception–action, and total motor scores) questionnaires.
Results: A latent profile analysis identified four profiles: *poor* (21%), with lowest receptive and expressive vocabulary and absent or limited word combination and phonological accuracy; *weak* (22.5%), with average receptive but limited expressive vocabulary, incomplete sentences, and absent or limited phonological accuracy; *average* (25%), with average receptive and expressive vocabulary, use of incomplete and complete sentences, and partial phonological accuracy; and *advanced* (31.5%), with highest expressive vocabulary, complete sentence production, and phonological accuracy. Lower cognitive and motor scores characterized the *poor* profile, and lower cognitive and perception–action scores characterized the *weak* profile. Having a nonworking mother and a father with lower education increased the probability of a child's assignment to the *poor* profile, whereas being small for gestational age at birth increased it for the *weak* profile.
Conclusions: These findings suggest a need for a person-centered and cross-domain approach to identifying children with language weaknesses and implementing timely interventions. An online procedure for data collection and data-driven analyses based on multiple lexical and grammatical skills appear to be promising methodological innovations.
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Language development up to 3 years of age is characterized by a wide interindividual variability, with some children reaching language milestones earlier than others. The majority of children present with a significant vocabulary increase, first in word comprehension and then in word production, between the second and the third year of life (Bates, 1993; Bavin et al., 2008; Caselli et al., 2012; Fenson et al., 2007; Sansavini, Bello, et al., 2010). This lexical increase drives grammatical development, allowing the emergence of word combinations with a gradual shift from incomplete to complete sentences (Bates & Goodman, 1997; Fenson et al., 2007). However, some children show a delay in their language development that can be transient between 2 and 3 years of age

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or persistent after 3 years of age (Bishop et al., 2003, 2016).

This wide heterogeneity in developmental language profiles and outcomes may depend on weaknesses in expressive or also receptive skills (Bello et al., 2018; Chilosi et al., 2019; Desmarais et al., 2010; Thal et al., 2013). In addition, it may be related to cognitive and motor skills (Desmarais et al., 2010; Zubrick et al., 2007) and to several biological and environmental risk factors (Bishop et al., 2017; Law et al., 2000; Marini et al., 2017; Sansavini, Guarini, et al., 2010; Zambrana et al., 2014). Among biological risk factors, preterm birth (i.e., a gestational age of < 37 weeks at birth) has been widely recognized, but fewer and discordant findings are available for low-risk preterm children (i.e., those not having brain injuries or severe perinatal complications, being usually less immature and hospitalized for a shorter time compared to high-risk preterm children; Loeb et al., 2020; Perez-Pereira et al., 2014; Suttora et al., 2020; Zambrana et al., 2020).

This study intends to address this issue by adopting a complex approach that considers multiple aspects of lexical and grammatical skills to identify language profiles in low-risk preterm and full-term children. We also investigated biological and environmental predictors and relations between language profiles and cognitive and motor skills. This multifactorial model will contribute to identify children with language weaknesses and implement timely interventions.

Expressive Language Delay and Its Relation With Linguistic, Cognitive, and Motor Skills

Expressive language delay is the most common developmental difficulty among preschoolers and a recurrent reason for parents to consult clinicians about preschool-age children as it might be an index of different developmental problems, such as developmental language disorder, hearing loss, intellectual disability, or autism spectrum disorders (Bishop et al., 2016; Buschmann et al., 2008; Rescorla, 2011; Rescorla & Dale, 2013). The term “late talkers” refers to children showing late language emergence in the absence of neurological, sensory, cognitive, or socioemotional deficits between 18 and 35 months of age (Fisher, 2017; Hawa & Spanoudis, 2014; Rescorla, 2011; Rescorla & Dale, 2013). Late talkers are characterized by a delayed expressive vocabulary, defined as a vocabulary size at or below the 10th percentile when assessed with parental reports, such as the MacArthur–Bates Communicative Development Inventories (CDI; Dale et al., 2003; Desmarais et al., 2008; Fenson et al., 2007), or as a measure of expressive language lower than 1 *SD* below the mean when assessed with direct tools (Rescorla, 2011). Other widely used criteria to define late talkers are a vocabulary size lower than 50 words at 24 months of age and/or the absence of word combination between 24 and 30 months (Rescorla, 1989; Zubrick et al., 2007).

The prevalence of late talkers is rather high between 2 and 3 years of age, ranging from 9% to 20% in population-based studies, depending on the criteria chosen to identify late talkers and the age of assessment (Bello et al., 2014; Collisson et al., 2016; Korpilahti et al., 2016b; Reilly et al., 2010; Zubrick et al., 2007). The majority of late talkers catch up with their peers on language development by preschool age, being by age of 3 years recognized as “late bloomers”; however, about one third of them, corresponding to 5%–7% of all preschoolers, end up with a developmental language disorder that can be diagnosed around 4 years of age (Dale et al., 2003; Reilly et al., 2010).

Late talkers are heterogeneous and often have weaknesses in other linguistic skills. Some late talkers have also a poor receptive vocabulary (Bello et al., 2018; Dale et al., 2003; Desmarais et al., 2008; Horwitz et al., 2003) that increases the risk of an outcome of developmental language disorder (Chilosi et al., 2019; Desmarais et al., 2010; Thal et al., 2013). Late talkers often lack phonological accuracy, showing a small phonological inventory and simple syllabic structures (Bello et al., 2018; Carson et al., 2003; Desmarais et al., 2010; Mirak & Rescorla, 1998). They also show delays in morphosyntactic skills up to 4 years of age with respect to their peers who are not late talkers (Moyle et al., 2007; Rescorla, 2011; Rescorla et al., 2000) and a lower level of responsiveness and communicative initiative (Bello et al., 2018; Vuksanovic, 2015).

Late talkers are also heterogeneous in relation to cognitive and motor skills. Less advanced symbolic play abilities, in terms of complexity, richness, and variety, were found in 24-month-old late talkers characterized by an expressive language delay (Rescorla & Goossens, 1992) and in 29-month-old ones who persisted in their late-talking status up to 34 months, showing a positive relation between lexical comprehension and cognitive skills (Bello et al., 2018). Furthermore, late talkers with both receptive and expressive delays exhibited significantly lower nonverbal cognitive scores than late talkers with only an expressive delay and typically developing children (Buschmann et al., 2008). These findings suggest that cognitive functions are related to language development, with language production appearing related to symbolic play and language comprehension to global cognitive skills. The association with delays in cognitive functions increases the severity and risk of persistence of language delay (Desmarais et al., 2010).

Motor skills appear also vulnerable in late talkers, suggesting the existence of tight links between the language and motor domains. Zubrick et al. (2007) found that a significant number of 24-month-old late talkers obtained low scores in gross motor and fine motor domains. Iverson and Braddock (2011) found that children with language impairment, ranging from 31 to 73 months of age, exhibited poorer performances in gross and fine motor abilities relative to their typically developing peers. This association has recently also been confirmed by two studies on preterm children documenting a risk in the gross and fine motor functions in 24-month-old preterm children with a vocabulary size below the 10th percentile (Charkaluk et al., 2019) and a significant likelihood of motor, cognitive, or both delays in 30-month-old preterm children exhibiting language delay in at least one receptive or expressive measure (Loeb et al., 2020). The studies reported above suggest the relevance of examining variations across language dimensions and their relations with the cognitive and motor domains in order to better understand interindividual variability across the entire language ability spectrum.

The Role of Biological and Environmental Factors in Language Delay

The wide heterogeneity in developmental language profiles and outcomes has been further investigated by examining the relations between biological and environmental risk factors and language delay (Collisson et al., 2016; Korpilahti et al., 2016a, 2016b; Zambrana et al., 2014). Male sex, a family history of speech and language impairments, and pre- or perinatal factors, such as being born preterm or with low birth weight, have been investigated as the main biological risk factors, whereas parental characteristics, such as a low level of education, socioeconomic status, and parental linguistic input, have been targeted as the main environmental risk factors (Bishop et al., 2017; Law et al., 2000; Marini et al., 2017; Sansavini, Guarini, et al., 2010).

Among biological risk factors, male sex increases the risk of an expressive language delay at 24 months. Specifically, most (62%–86%) late talkers are males (Collisson et al., 2016; Sanchez et al., 2019; Sansavini, Guarini, Savini, et al., 2011; Zubrick et al., 2007), and male sex is a significant predictive factor of language impairment at 4 years of age (Reilly et al., 2010). A family history of language disorders—that is, having at least one biological relative with current or past language delays or disorders—also increases the risk of an expressive language delay, affecting approximately 12%–20% of late talkers at 24–30 months (Collisson et al., 2016; Suttora et al., 2020; Zubrick et al., 2007) and up to 63% of those with a persistent language delay at 36 months (Korpilahti et al., 2016b) and showing a significant predictive value of language impairment at 4 years (Reilly et al., 2010).

Preterm birth has been also widely recognized as a risk factor for language delays with cascading effects on later development in several domains, depending on neonatal immaturity; pre-, peri-, and postnatal complications; neurological alterations; and the association with other biological and environmental factors (Sansavini, Guarini, & Caselli, 2011). Lower gestational ages are associated with poorer language skills and a higher risk of exhibiting a language delay (Charkaluk et al., 2019; Loeb et al., 2020; Sanchez et al., 2019; Sansavini, Guarini, Savini, et al., 2011; Sansavini et al., 2014; Sentenac et al., 2020; Zambrana et al., 2020).

Less concordant findings, however, are available for low-risk preterm children (Loeb et al., 2020; Perez-Pereira et al., 2014; Suttora et al., 2020; Zambrana et al., 2020). Some researchers have found that low-risk preterm children are at risk for poorer language performance compared to children born at term (Cheong et al., 2017) and for developmental disorders, including language disorders (Palumbi et al., 2018). In contrast, Perez-Pereira et al. (2014) did not find delays in communicative, lexical, and grammatical development in low-risk preterm children between 10 and 30 months of age. Interestingly, a very recent study showed that low-risk preterm children, born between 34 and 36 weeks of gestational age, are at risk for language delays at 18 months, but this risk decreases from 18 months to 3–5 years of age, whereas it persists in preterm children with lower gestational ages (Zambrana et al., 2020).

Noteworthily, the impact of biological risk factors on language delays is also highly related to that of environmental risk factors. Among environmental factors, a low maternal education level, socioeconomic status, and parental occupation were found to be strong predictors of adverse language outcomes in several studies both in the general population (Collisson et al., 2016; Hawa & Spanoudis, 2014; Horwitz et al., 2003; Reilly et al., 2010) and in the preterm population (Loeb et al., 2020; Patra et al., 2016; Sansavini, Guarini, Savini, et al., 2011). The above factors appear as conditions that poorly affect language development rather than encouraging educational practices, such as reading and sharing books and participating in informal play, that support language development (Collisson et al., 2016). Interestingly, Korpilahti et al. (2016a) found that fathers having a low social class and working full time also predicted children's language delays at 36 months of age, suggesting that both parents' social status plays a role in predicting language delays. The above findings support the need for a multifactorial model considering multiple biological and environmental factors to explain interindividual variability in language developmental profiles and outcomes (Desmarais et al., 2008).

Aims of the Study

Several screening studies have been conducted on heterogeneous populations of children to identify late talkers between 2 and 3 years of age based on a limited vocabulary size and/or the absence of word combination criteria, highlighting interindividual variability in language development (Bello et al., 2014; Eriksson et al., 2002; Heilmann et al., 2005; Horwitz et al., 2003; Kristoffersen et al., 2013; Law & Roy, 2008; Reilly et al., 2007), even wider in populations at risk for language delays, such as the preterm population (Charkaluk et al., 2019; Loeb et al., 2020; Perez-Pereira et al., 2014; Sanchez et al., 2019; Sansavini, Guarini, Savini, et al., 2011; Sansavini et al., 2014; Sentenac et al., 2020; Suttora et al., 2020; Zambrana et al., 2020). In the current study, we focused on low-risk preterm children and a control sample of full-term children in order to (a) describe their different linguistic profiles at 30 months of age, (b) examine biological factors and environmental factors predictive of language profiles, and (c) understand how language profiles are related to cognitive and motor skills. To this aim, we employed an online procedure for data collection and a data-driven analysis with a complex approach considering multiple lexical (word comprehension and word production) and grammatical (incomplete and complete sentence production) skills in the same model. Additional communicative-linguistic measures (i.e., gesture production, decontextualized comprehension, verbal imitation, phonological accuracy, and symbolic play) were also considered to describe language profiles.

Method

Participants

We enrolled 200 thirty-month-old Italian-speaking children—consisting of 100 low-risk preterm and 100 comparable full-term children—with an online investigation. All children were born at the S. Orsola-Malpighi Hospital of the University of Bologna between May 2015 and July 2016. To be included in the investigation, children had to be monolingual (Italian) or exposed mainly to the Italian language since birth (i.e., weekly exposure to Italian of > 65%; see Onofrio et al., 2012). Children with a history of major cerebral damage (i.e., periventricular leukomalacia, intraventricular hemorrhage > Grade II, hydrocephalus) and/or congenital malformations, sensory (retinopathy of prematurity > Grade II, blindness, mono- or bilateral hearing loss) or motor impairments, or severe cognitive deficits were not included in the investigation. According to these criteria, 180 low-risk preterm children (with a gestational age of < 37 weeks) were eligible for the study (see Supplemental Material S4).

The parents of 31 children (17%) declined to participate in the investigation. The parents of 49 children (27%), although they had agreed to participate and had been contacted up to 2 times by the researchers, did not fill out the online survey. As a result, the parents of 100 preterm children participated in the investigation. No significant differences in gestational age, sex, and parents' nationality were found between low-risk preterm children participating in the investigation and those whose parents declined to participate or did not fill out the online survey. A significant difference emerged only in birth weight, with children not participating in the investigation (M = 2,322 g, SD = 615) having a slightly higher birth weight than those participating in the investigation (M = 2,086 g, SD = 660, t = 2.44, p = .016).

The parents of 169 full-term children, with a gestational age of ≥ 37 weeks and comparable to the low-risk preterm sample in sex and parents' nationality, were contacted to participate in the investigation as a comparison group. Among them, the parents of 24 children (14%) declined to participate in the investigation. The parents of 45 children (27%), although they had agreed to participate and had been contacted up to 2 times by the researchers, did not fill out the online survey. As a result, a comparison sample of 100 full-term children participated in the investigation.

Biological, medical, and sociodemographic data of the low-risk preterm and full-term children participating in the study were obtained from the database of the University of Bologna S. Orsola-Malpighi Hospital (i.e., gestational age, birth weight, sex, parents' nationality, birth order, multiple birth, type of delivery, length of stay in the hospital neonatal ward, and perinatal complications—being small for gestational age, respiratory distress syndrome, mechanical ventilation, apnea, bronchopulmonary dysplasia, intraventricular hemorrhage Grade I/II, sepsis, retinopathy of prematurity Grade I/II; for details, see Table 1 and the first section of the parental questionnaire).

Several children's biological and medical characteristics (see Table 1) did not differ significantly between the low-risk preterm and full-term groups: sex, birth order, family history of language and/or learning disorders, and recurrent otitis media (> 4 episodes in a year). As expected, the low-risk preterm children had a lower gestational age (p < .001) and birth weight (p < .001), higher frequency of being one of a multiple birth (p < .001) or cesarean delivery (p < .001), and longer length of stay in the hospital neonatal ward (p < .001) than their full-term peers. Perinatal complications were found only in low-risk preterm children, with the exceptions being those who were small for their gestational age at birth and those who suffered respiratory distress, which were more frequent in low-risk preterm children (p = .032 and p < .001, respectively) than in full-term children. Lastly, no significant differences were found between the two groups regarding parental and child sociodemographic characteristics, namely, mothers' and fathers' age, nationality (with minimal percentages of mothers and fathers of non-Italian nationality in both groups; see Table 1 for details), education level, and working/nonworking condition, as well as a proportion of children exposed to a language other than Italian and that of children attending nursery school.

Tools and Procedure

The study was approved by the Bologna Health Authority's Independent Ethics Committee (EM 194-2017_ and EM 193-2018_76/2013/U/Sper/AOUBo). All parents of eligible children were contacted by phone at 30 months, informed about the investigation, and asked to fill in the informed written consent for participation in the study, data analysis, and data publication. For the preterm children, age was corrected for prematurity in order to take into account their level of neurobiological maturation, as in previous studies conducted on preterm children in the first 2 years of life (Johnson & Marlow, 2006; Sansavini, Guarini, & Caselli, 2011). At the time of the investigation, low-risk preterm children had a mean corrected age of 30.38 months (SD = 0.76) and a mean chronological age of 31.96 months (SD = 1.04). The mean chronological age of the full-term children was 30.25 months (SD = 0.45). The difference between the low-risk preterm children's corrected age and the full-term children's chronological age was not significant, $t(198) = -1.476$, p = .142, whereas the children differed significantly in their chronological age, $t(198) = -15.014$, p < .001. Those parents who agreed to participate received an e-mail containing a personalized link that allowed them to access and fill out the online

Table 1. Biological, medical, and sociodemographic characteristics of low-risk preterm and full-term participants.

Participants' characteristics	Low-risk preterm (n = 100) M/n	Low-risk preterm SD	Full term (n = 100) M/n	Full term SD	Test	p
Gestational age (weeks), M	33.85	2.7	39.26	1.3	12.22	**< .001**
Birth weight (g), M	2,023	650	3,204	470	10.68	**< .001**
Sex (female), n	48.0		52.0		0.32	.572§
Birth order					5.58	.062§
Firstborn, n	59.0		65.0			
Second-born, n	26.0		30.0			
Third-born or more, n	15.0		5.0			
Multiple birth, n	33.0		1.0		36.27	**< .001**§
Type of delivery (cesarean), n	85.0		30.0		61.89	**< .001**§
Length of stay in hospital (weeks), M	2.55	4.0	0.42	0.3	–7.42	**< .001**
Small for gestational age, n	15.0		5.0		5.56	**.032**§
Respiratory distress syndrome, n	40.0		2.0		43.52	**< .001**§
Mechanical ventilation, n	10.0		0		10.53	**.001**§
Apnea, n	4.0		0			.121*
Bronchopulmonary dysplasia, n	3.0		0			.246*
Intraventricular hemorrhage Grade I/II, n	3.0		0			.246*
Sepsis, n	4.0		0			.121*
Retinopathy of prematurity Grade I/II, n	3.0		0			.246*
Family history of language and/or learning disorders, n	16.0		16.0		0.00	1.000§
Otitis media > 4 episodes/year, n	5.0		9.0		1.23	.407§
Exposure to another language, n	7.0		5.0		0.35	.767§
Nursery school attendance, n	22.0		19.0		0.28	.599§
Mother's age (years), M	38.0	5.1	36.8	4.0	–1.25	.213
Father's age (years), M	40.6	5.7	39.4	5.0	–1.14	.253
Mother's nationality[a] (Italian), n	92.0		96.0		1.42	.373§
Father's nationality[b] (Italian), n	95.0		97.0			.721*
Mother's education ≤ 13 years, n	44.0		36.0		1.33	.248§
Father's education ≤ 13 years, n	60.0		53.0		1.00	.318§
Nonworking mother, n	13.0		14.0		0.04	.836§
Nonworking father, n	0.0		0.0		—	—

Note. Significant results are in bold. The Mann–Whitney test for independent samples was used, except when indicated: § = chi-square test and * = Fisher's exact test. Perinatal complications were the following: small for gestational age: birth weight < 10th percentile for gestational age; respiratory distress syndrome: acute illness coming on within 4–6 hr of delivery, characterized clinically by a respiratory rate of ≥ 60/min, dyspnea, and respiratory distress; apnea: more than four episodes of apnea per hour or more than two episodes of apnea per hour if ventilation with bag and mask was required; bronchopulmonary dysplasia: need for both supplemental oxygen for ≥ 28 days and at 36 weeks of postconceptional age; intraventricular hemorrhage: originating within the subependymal germinal matrix filling less than respectively 10% (Grade I) and 50% (Grade II) of the ventricular area on parasagittal view; retinopathy of prematurity: vasoproliferative retinopathy that resolved without a specific therapy before the presumed date of birth; sepsis: presence of a positive blood culture and/or clinical and laboratorial signs.

[a]Mother's nationality other than Italian. Low-risk preterm sample: n = 8 (Colombian n = 1, Moroccan n = 1, Moldovan n = 1, Peruvian n = 1, Polish n = 1, Romanian n = 1, Russian n = 1, Swedish n = 1); full-term sample: n = 4 (Albanian n = 1, Moldovan n = 1, Romanian n = 2).
[b]Father's nationality other than Italian. Low-risk preterm sample: n = 4 (Albanian n = 1, Dominican n = 1, Moroccan n = 1, Peruvian n = 1, missing data n = 1); full-term sample: n = 3 (Israeli n = 1, Romanian n = 2).

questionnaire, created by the researchers with the Qualtrics platform (https://www.qualtrics.com). The questionnaire filled in by parents consisted of different sections.

Sociodemographic Characteristics

The first section collected information concerning the children's health and environmental experiences (i.e., recurrent otitis media, family history of language and/or learning disorders, exposure to languages other than Italian, and attendance at nursery school) and parents' sociodemographic characteristics (i.e., parents' age, nationality, educational level [≤ 13 years, i.e., having at most a high school diploma, or > 13 years, i.e., having a university degree], and occupation [i.e., working condition or nonworking condition, including both housewife and unemployed conditions]).

Word Comprehension, Word Production, and Incomplete and Complete Sentence Production

The Italian versions of the CDI Short Forms were used to assess word comprehension (Gestures and Words), word production, and incomplete and complete sentence production (Words and Sentences; Caselli et al., 2015). Short forms of the CDI are suitable, reliable, and valid tools for screening projects and for identifying late talkers (Fenson et al., 2007; Kim et al., 2014), showing a high reliability (Cronbach's α ≥ .97) and a high concurrent validity with the corresponding long forms (Pearson r ≥ .88; Fenson et al., 2000). The Italian versions of the CDI Short Forms have been recently adopted in screening programs conducted in Italy on 2- to 3-year-old children (Bello et al., 2018). The Italian version of the CDI Gestures and Words Short Form has been validated on 583 Italian children aged 8–24 months and used for children older than 24 months who have an expressive language delay, showing a good concurrent validity (Pearson $r > .70$) with the Gestures and Words Complete Form (Caselli et al., 2015). The Italian version of the CDI Words and Sentences Short Form has been validated on 816 Italian children aged 18–36 months, showing a high concurrent validity (Pearson $r = .92$) with the Words and Sentences Complete Form (Caselli et al., 2015; Rinaldi et al., 2019).

Concerning word comprehension, the first section of the Gestures and Words Short Form, consisting of a list of 100 words, was used. Parents were asked to check the words their child understood; a score of 1 was given for each item checked. Word comprehension (i.e., the total number of words understood) was computed. For word production and incomplete and complete sentence production, Sections 1 and 2 of the Words and Sentences Short Form were used. Section 1 consisted of a list of 100 words, and parents were asked to indicate if their child spontaneously produced each word. A score of 1 was given for each item checked. The total number of words produced was computed to assess word production. In addition, vocabulary size was classified as ≤ 5th percentile or ranging from > 5th to ≤ 10th percentile by referring to the corresponding Italian population percentile values (Caselli et al., 2015). In Section 2, investigating children's use of morphology and syntax, parents were asked to answer whether their child had already begun to combine words. If their answer was "no," the absence of word combination was scored. If their answer was "sometimes" or "yes," the parents were required to indicate, from a list of 12 pairs of sentences, which sentence of each pair best reflected the way their child talked. For each pair, two different levels of grammatical completeness were given, the first incomplete and the second complete, for function words (e.g., pronouns, articles, and prepositions). The total number of incomplete and complete sentences was computed.

Additional Indexes of Communicative and Linguistic Skills

The presence/absence of communicative gestures—in particular, declarative pointing—as well as decontextualized comprehension, verbal imitation, phonological accuracy (complete, partial, or absent), and symbolic play were addressed through CDI Words and Sentences Short Form specific questions (Caselli et al., 2015; see Supplemental Material S1 for details).

Cognitive Skills

Cognitive skills were assessed with the Italian version of the Parent Report of Children's Abilities–Revised (Cuttini et al., 2012), a parental questionnaire examining nonverbal cognitive abilities, which has been adapted for very preterm children assessed at 2 years of corrected age (Cuttini et al., 2012; Johnson et al., 2008) and, more recently, at 24–27 months of corrected age (Johnson et al., 2019). The Italian version of the Parent Report of Children's Abilities–Revised (Cuttini et al., 2012) has been validated on 120 Italian very preterm children, revealing a moderate concurrent validity ($r = .60$) with the mental development index of the Bayley Scales of Infant and Toddler Development–Second Edition (Bayley, 1993) at 2 years of corrected age.

We used the first section, which assesses nonverbal cognitive abilities (34 items), such as spatial abilities, symbolic play, planning and organizing, adaptive behaviors, and memory. Items were phrased in terms of specific activities, and parents were asked to indicate whether they had seen their child performing each activity. If their answer was "yes," a score of 1 was given, whereas "no" or "don't know" responses were scored as 0. A total cognitive score was computed by summing up the number of positive answers, indicating the child's acquired abilities.

Motor Skills

Gross motor, fine motor, perception–action integration, and total motor skills were assessed with the Italian version of the Early Motor Questionnaire (EMQ; Libertus & Orioli, 2014), a parent report on early motor development used in research and clinical contexts for children aged from 2 to 24 months (Libertus & Landa, 2013; Libertus & Violi, 2016; Moore et al., 2019). The EMQ revealed a high concurrent validity with the Mullen Scales of Early Learning: AGS Edition (Mullen, 1995), with correlations ranging from .91 to .97 between the three corresponding motor sections (Libertus & Landa, 2013). It is divided into three sections. Section 1 aims to describe gross motor skills (49 items), Section 2 aims to describe fine motor skills (48 items), and Section 3 aims to describe perception–action skills (31 items). To quantify parents' certainty, the EMQ uses a 5-point scale ranging from −2 (i.e., the child not showing the behavior yet) to +2 (i.e., the child clearly displaying the behavior). To compute the raw scores, we converted the 5-point scale ranging from −2 to +2 to an equivalent 5-point scale ranging from 1 to 5. The EMQ raw scores were computed by summing up the scores of the questions for each of the three sections (gross motor, fine motor, and perception–action), and the EMQ total motor score was computed by summing up the scores of each section.

Data Analyses

A latent profile analysis was conducted to identify homogeneous subgroups of children according to their lexical skills (word comprehension and word production) and grammatical skills (incomplete and complete sentence production). Groups were obtained based only on variables representing lexical and grammatical skills. Preterm birth was not imposed as an a priori potential stratifying factor but only verified a posteriori whether it could be associated to the profiles. Latent profile analysis is analogous of latent class analysis when the observed variables of the model are continuous; however, it is more complex because it estimates subgroups conditional to the mean and variances of the continuous observed variables (Nylund-Gibson & Choi, 2018). Thus, several hypotheses at different levels of flexibility regarding the within-class variance–covariance structure needed to be tested to find the model that best fits the data in increasing order of flexibility (Masyn, 2013): the class-invariant diagonal structure, the class-varying diagonal structure (CVD), the class-invariant unrestricted structure (CIU), and the class-varying unrestricted structure. We estimated the latent profiles for each of these four structures and for one to five latent classes. To choose the best solution, we first identified a set of candidate models based on the lowest Akaike information criterion and Bayesian information criterion indices and subsequently analyzed them in terms of interpretability and class distribution. Entropy was also calculated, with values > .80 indicating a good quality of classification of individuals into profiles. We assessed the factors associated with profile membership by applying the three-step method that is currently recommended (Heron et al., 2015; Nylund-Gibson & Choi, 2018; Vermunt, 2010). First, the latent profile analysis model was estimated without including covariates, then each subject was assigned to the most likely class (i.e., profile), and finally a multinomial logistic regression of the classification variable on the set of predictors was performed.

The children's characteristics were compared across the four latent profiles. Categorical variables were analyzed using chi-square test (or Fisher's exact test when at least one expected value was < 5). As the latent profiles are more than two, when the test was significant, post hoc analyses were conducted to identify which pairs of profiles differed significantly and were performed using adjusted residual calculations (with residuals > |2| indicating a significant difference). Comparisons involving scale variables used one-way analysis of variance (or Kruskal–Wallis rank test when the normality assumption of scale variables could not be confirmed), and post hoc analyses were performed with Scheffé correction.

The multinomial logistic regression to assess predictors of profile membership was carried out using as predictors preterm birth and the variables that showed $p < .200$ in the bivariate test of independence with latent profiles. Starting from this set of predictors, a final model was presented that retained only the variables significant at $p < .05$ in at least one profile comparison.

Finally, the association of latent profiles, with the children's cognitive skills measured by the Parent Report of Children's Abilities–Revised and with their gross motor, fine motor, perception–action, and total motor skills measured by the EMQ, was investigated with an analysis of covariance, adjusting for preterm birth using the categorical variable low-risk preterm versus full-term, consistently with the study design. All analyses were carried out using Stata v.15.1 and rejecting null hypotheses at $p < .05$.

Results

Among the several models that were tested, not all provided a solution, due to estimation convergence problems (see Supplemental Material S2). Based on fit statistics, the candidate models were the CVD with three classes (that showed the best fit), the CIU with four and five classes, and the CVD with five classes. The CIU model with four classes, which imposes items to be uncorrelated within classes and allows items' variance to be different among classes, was chosen because it allowed the most straightforward class interpretation and provided more detail than the CVD model with three classes. The entropy index was very high, indicating that the great majority of individuals were allocated to classes (i.e., profiles) with a low degree of uncertainty.

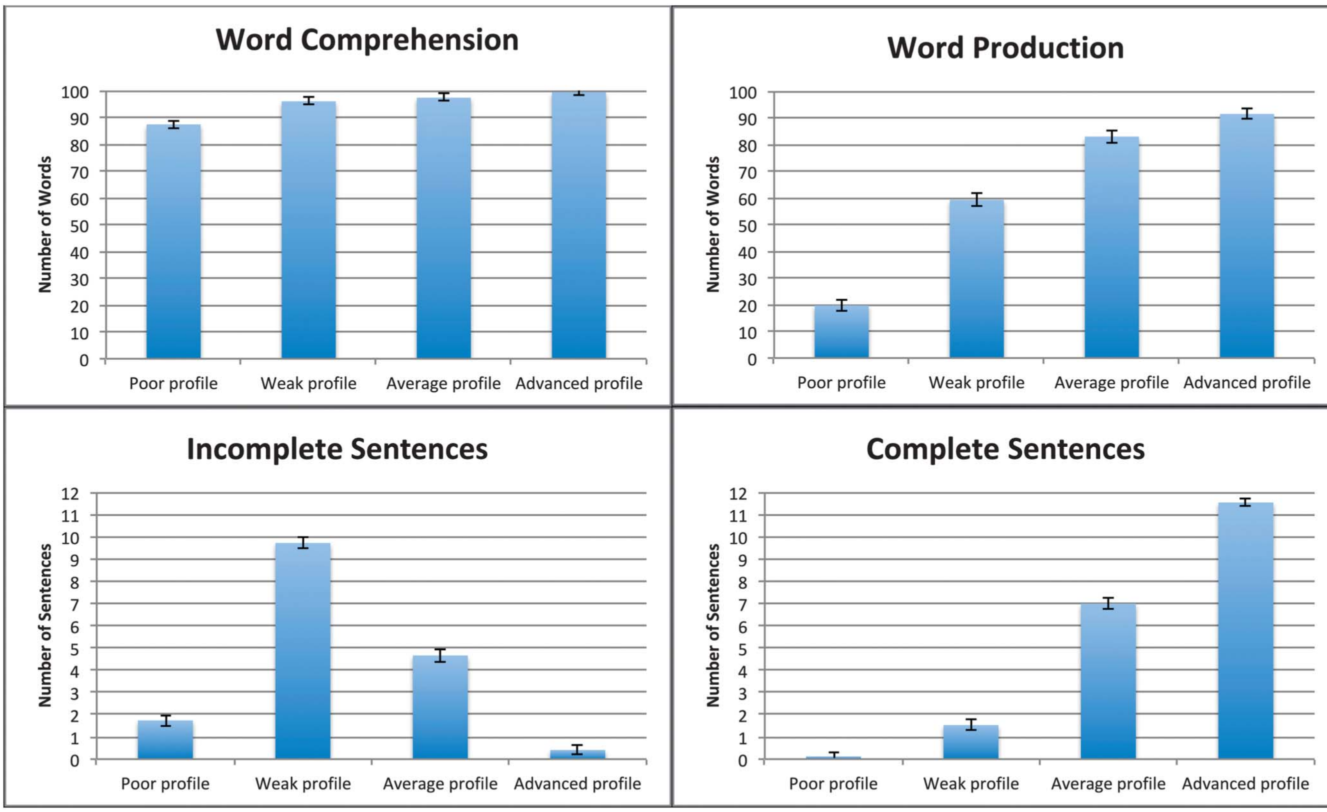
By examining the distribution of the four performance scales in each profile (see Figure 1 and Supplemental Material S3), the profiles clearly appear to have been identified by increasing levels of linguistic performance. Children assigned to Profile 1, which we defined as the *poor* profile (n = 42, 21%), as it was the most severe for language delay, had the lowest levels of word comprehension, word production, and sentence production. Children in Profile 2, which we defined as the *weak* profile (n = 45, 22.5%), had a normal level of word comprehension but a still-limited word production and mainly incomplete sentence production. Children in Profile 3, which we defined as the *average* profile (n = 50, 25%), showed a normal level of word comprehension, normal word production, and more complete than incomplete sentence production. Finally, children in Profile 4, which we defined as the *advanced* profile (n = 63, 31.5%), showed the best performance on all aspects, with the highest level of word and complete sentence production.

Looking further at the four identified language profiles (see Table 2), it can be noted that, according to the criteria used in the literature (Dale et al., 2003; Desmarais et al., 2008; Fenson et al., 2007; Hawa & Spanoudis, 2014; Rescorla, 2011) and the Italian normative values (Caselli et al., 2015), in the *poor* profile, all but three children were late talkers; their vocabulary size was ≤ 5th percentile for most of them (83.3%) or between the 6th and 10th percentiles in a few cases (9.5%). Word combination was absent in half of them still, decontextualized comprehension and verbal imitation were still lacking in about one fourth of them, and about 10% of them did not yet show symbolic play; moreover, phonological accuracy was mainly absent (52.4%) or partially acquired (45.2%).

Among the children belonging to the *weak* profile, most had a limited expressive vocabulary, with about 18% being late talkers and most of them (15.6%) having a vocabulary size comprised between the 6th and 10th percentiles. Only two children did not yet combine words, all children showed decontextualized comprehension and verbal imitation, and all but three demonstrated symbolic play; about one third had not yet mastered phonological accuracy, and more than half had mastered it partially.

All children belonging to the *average* profile presented with normal language development except one, whose vocabulary size was between the 6th and 10th percentiles. All showed decontextualized comprehension and verbal imitation, and all but one also showed symbolic play; more than

Figure 1. Estimated means and standard errors of word comprehension, word production, incomplete sentences, and complete sentences across the four latent profiles.



half had partial phonological accuracy, whereas one third had acquired it completely.

Finally, all children belonging to the *advanced* profile showed normal language development, decontextualized comprehension, and verbal imitation, and all but one demonstrated symbolic play. Moreover, most of them (73%) had complete phonological accuracy, whereas about one fourth had partially acquired it.

Table 2. Indexes of children's communicative and linguistic delays across the four latent profiles.

	Poor (n = 42)		Weak (n = 45)		Average (n = 50)		Advanced (n = 63)				
Indexes	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	**Test**	***p***	**Post hoc test**
Vocabulary size ≤ 5th	35	83.3	1	2.2	0	0.0	0	0.0	153.85	**< .001§**	**1[a], 2[b], 3[b], 4[b]**
5th > ≤10th	4	9.5	7	15.6	1	2.0	0	0.0		**.001***	**2[a], 4[b]**
Word combination absence	21	50.0	2	4.4	0	0.0	0	0.0		**< .001***	**1[a], 3[b], 4[b]**
Declarative pointing absence	0	0.0	0	0.0	0	0.0	0	0.0	—	—	
Decontextualized comprehension absence	9	21.4	0	0.0	0	0.0	0	0.0		**< .001***	**1[a], 4[b]**
Verbal imitation absence	10	23.8	0	0.0	0	0.0	0	0.0		**< .001***	**1[a], 4[b]**
Phonological accuracy absence[c]	22	52.4	16	35.6	3	6.0	2	3.2	48.65	**< .001§**	**1[a], 2[a], 3[b], 4[b]**
Partial	19	45.2	25	55.6	29	58.0	15	23.8	16.86	**.001§**	**3[a], 4[b]**
Complete	1	2.4	4	8.9	18	36.0	46	73.0	73.64	**< .001§**	**1[b], 2[b], 4[a]**
Symbolic play absence	4	9.5	3	6.7	1	2.0	1	1.6		.167*	

Note. Significant results are in bold. § indicates chi-square test, and * indicates Fisher's exact test.

[a]Adjusted residuals > 2 indicate the variable had a significantly higher than expected frequency in the reported class(es). [b]Adjusted residuals < −2 indicate the variable had a significantly lower than expected frequency in the reported class(es). [c]Absence of phonological accuracy was reported as an index of phonological delay at 30 months; partial and complete phonological accuracy, both typical at 30 months, were reported for data completeness.

Concerning the roles of biological and environmental variables on the different language profiles, all variables related to perinatal children's characteristics, including preterm birth status, did not differ significantly across profiles except for mechanical ventilation, which characterized a few children in the *poor, weak,* and *average* profiles but not in the *advanced* profile (see Table 3). In contrast, some significant differences were found among the sociodemographic variables. Children assigned to the *poor* profile were more likely to have a nonworking mother (30.9% vs. 6.3%–11.1%, $p = .005$) and a father with 13 years of education at most (76.2% vs. 46%–55.6%, $p = .023$) and less likely to attend nursery school (64.3% vs. 79.4%–86.7%, $p = .034$). Children assigned to the *weak* profile were less likely to have a mother of Italian nationality (86.7% vs. 90.5%–100%, $p = .008$). Children assigned to the *advanced* profile were less likely to have a nonworking mother (6.3% vs. 10%–30.9%, $p = .005$) and a father with 13 years of education at most (46% vs. 54%–76.2%, $p = .023$), and all had a mother of Italian nationality (100% vs. 86.7%–96%, $p = .008$; see Table 3).

The variables being small for gestational age at birth, family history of language and/or learning disorders, nursery school attendance, nonworking mother, and father's education were significant at $p < .200$ in bivariate analysis and were used as predictors in the multivariable multinomial regression of profile membership along with preterm status. Mechanical ventilation, intraventricular hemorrhage, sepsis, exposure to another language, and mother's nationality, although significant at $p < .200$ in bivariate analysis, were not included because of their very small, or sometimes null, frequency within profiles (see Table 3). In the

Table 3. Participants' biological, medical, and sociodemographic characteristics across the four latent profiles.

	Poor (n = 42)		Weak (n = 45)		Average (n = 50)		Advanced (n = 63)				
Participants' characteristics	***M/n***	***SD* (%)**	***M/n***	***SD* (%)**	***M/n***	***SD* (%)**	***M/n***	***SD* (%)**	**Test**	***p***	**Post hoc test**
Preterm birth, *n* (%)	18	(42.9)	25	(55.6)	27	(54.0)	30	(47.6)	1.88	.599§	
Gestational age (weeks), *M*	36.9	3.8	36.4	3.6	36.0	3.6	36.9	2.9	0.75	.523&	
Birth weight (g), *M*	2,613	822	2,596	937	2,484	787	2,728	751	0.83	.478&	
Sex (female), *n* (%)	23	(54.8)	21	(46.7)	28	(56.0)	28	(44.4)	2.08	.556§	
Birth order										.468*	
Firstborn, *n* (%)	24	(57.1)	26	(57. 8)	31	(62.0)	43	(68.3)			
Second-born, *n* (%)	14	(33.3)	11	(24.4)	14	(28.0)	17	(27.0)			
Third-born or more, *n* (%)	4	(9.5)	8	(17.8)	5	(10.0)	3	(4.8)			
Multiple birth, *n* (%)	8	(19.0)	7	(15.6)	11	(22.0)	8	(12.7)	1.90	.593§	
Delivery (cesarean), *n* (%)	23	(54.8)	28	(62.2)	32	(64.0)	32	(50.8)	2.56	.464§	
Length of stay in hospital (weeks)	2.2	5.2	1.7	2.8	1.5	2.3	0.8	1.1	2.21	.531§	
Small for gestational age, *n* (%)	5	(11.9)	8	(17.8)	4	(8.0)	3	(4.8)		.148*	
Respiratory distress, *n* (%)	9	(21.4)	10	(22.2)	13	(26.0)	10	(15.9)	1.80	.622§	
Mechanical ventilation, *n* (%)	2	(4.8)	4	(8.9)	4	(8.0)	0	(0)		.055*	
Apnea, *n* (%)	1	(2.4)	1	(2.2)	1	(2.0)	1	(1.6)		1.000*	
Bronchopulmonary dysplasia, *n* (%)	2	(4.8)	0	(0)	0	(0)	1	(1.6)		.277*	
Intraventricular hemorrhage I/II, *n* (%)	2	(4.8)	1	(2.2)	0	(0)	0	(0)		.064*	
Sepsis, *n* (%)	2	(4.8)	2	(4.4)	0	(0)	0	(0)		.091*	
Retinopathy of prematurity I/II, *n* (%)	1	(2.4)	0	(0)	2	(4.0)	0	(0)		.236*	
Family history of language and/or learning disorders, *n* (%)	10	(23.8)	4	(8.9)	10	(20.0)	8	(12.7)	4.70	.196§	
Otitis media > 4 episodes/year, *n* (%)	4	(9.5)	1	(2.2)	4	(8.0)	5	(7.9)		.526*	
Exposure to another language, *n* (%)	4	(9.5)	5	(11.1)	2	(4.0)	1	(1.6)		.118*	
Nursery school attendance, *n* (%)	27	(64.3)	39	(86.7)	43	(86.0)	50	(79.4)	8.68	**.034**§	**1[a]**
Mother's age (years), *M*	37.2	5.4	38.0	4.5	36.9	3.9	37.4	4.6	0.50	.686&	
Father's age (years), *M*	39.7	6.2	40.6	5.3	39.3	4.8	40.5	5.4	0.46	.712&	
Mother's nationality[c] (Italian), *n* (%)	38	(90.5)	39	(86.7)	48	(96.0)	63	(100.0)		**.008***	**2[a], 4[b]**
Father's nationality[d] (Italian), *n* (%)	38	(92.7)	43	(95.6)	49	(98.0)	62	(98.4)		.355*	
Mother's education ≤ 13 years, *n* (%)	22	(52.4)	15	(33.3)	21	(42.0)	22	(34.9)	4.28	.233§	
Father's education ≤ 13 years, *n* (%)	32	(76.2)	25	(55.6)	27	(54.0)	29	(46.0)	9.58	**.023**§	**1[a], 4[b]**
Nonworking mother, *n* (%)	13	(30.9)	5	(11.1)	5	(10.0)	4	(6.3)	14.46	**.002**§	**1[b], 4[a]**
Nonworking father, *n* (%)	0		0		0		0		—	—	

Note. Significant results are in bold. One-way analysis of variance for independent samples was used, except when indicated: § = chi-square test, * = Fisher's exact test, and & = Kruskal–Wallis rank test.

[a]Adjusted residuals < −2 indicate the variable had a significantly lower than expected frequency in the reported class(es). [b]Adjusted residuals > 2 indicate the variable had a significantly higher than expected frequency in the reported class(es). [c]Mother's nationality other than Italian. Profile 1: *n* = 4 (Moroccan *n* = 1, Moldovan *n* = 1, Polish *n* = 1, Romanian *n* = 1), Profile 2: *n* = 6 (Moldovan *n* = 1, Peruvian *n* = 1, Romanian *n* = 2, Russian *n* = 1, Swedish *n* = 1), Profile 3: *n* = 2 (Albanian *n* = 1, Colombian *n* = 1), Profile 4: none. [d]Father's nationality other than Italian. Profile 1: *n* = 3 (Israeli *n* = 1, Moroccan *n* = 1, Romanian *n* = 1, missing data *n* = 1), Profile 2: *n* = 2 (Peruvian *n* = 1, Romanian *n* = 1), Profile 3: *n* = 1 (Dominican *n* = 1), Profile 4: *n* = 1 (Albanian *n* = 1).

Table 4. Multinomial logistic regression of profile membership with low-risk preterm status and medical and sociodemographic characteristics as predictors.

Profile	RRR	95% CI of RRR	*p*
Poor			
Low-risk preterm birth	0.695	[0.30, 1.62]	.399
Small for gestational age	3.001	[0.63, 14.21]	.166
Nonworking mother	5.064	[1.47, 17.43]	**.010**
Father's education ≤ 13 years	3.102	[1.26, 7.61]	**.013**
Weak			
Low-risk preterm birth	1.170	[0.53, 2.58]	.697
Small for gestational age	4.097	[1.00, 16.73]	**.049**
Nonworking mother	1.664	[0.41, 6.77]	.477
Father's education ≤ 13 years	1.372	[0.62, 3.03]	.433
Average			
Low-risk preterm birth	1.222	[0.57, 2.60]	.603
Small for gestational age	1.633	[0.34, 7.77]	.538
Nonworking mother	1.519	[0.38, 6.08]	.555
Father's education ≤ 13 years	1.303	[0.61, 2.78]	.493
Advanced	Base outcome		

Note. Significant results are in bold. RRR = relative risk ratio; CI = confidence interval.

final model (see Table 4), nursery school attendance and family history of language and/or learning disorders were dropped because they did not reach significance and preterm status was not associated with any of the four profiles.

Being assigned to the *poor* profile was more likely for children whose families had disadvantaged conditions: nonworking mother (relative risk ratio [RRR] = 5.064, indicating a 5-times greater risk of being in the *poor* profile than being in the *advanced* profile for children whose mother was unemployed or a housewife) and father's education of ≤ 13 years (RRR = 3.102, indicating a 3-times greater risk of being in the *poor* profile than being in the *advanced* profile for children whose father had a lower education level). *Weak* profile membership was predicted only by being small for gestational age at birth (RRR = 4.097, indicating a 4-times greater risk of being in the *weak* profile than in the *advanced* profile for these children), whereas none of those covariates could determine assignment to the *average* and *advanced* profiles.

Concerning the relations between language profiles and cognitive and motor skills, children assigned to the *poor* profile were associated with significant lower scores on all skills except for fine motor skills in comparison to children assigned to the *advanced* profile, used as a reference profile (see Table 5 and Figure 2). Specifically, *poor* profile membership predicted 2.5 times lower cognitive scores, 4.7 times lower gross motor scores, 4.6 times lower perception–action scores, and 13.8 times lower total motor scores.

Children classified in the *weak* profile had significantly lower cognitive and perception–action total scores. Specifically, *weak* profile membership predicted 2.3 times lower cognitive scores and 4.7 times lower perception–action scores.

In contrast, children belonging to the *average* profile did not differ significantly from children in the *advanced* profile (see Table 5). Preterm status was never significantly associated with lower cognitive and motor skills scores.

Discussion

This study identified four distinct language profiles in a sample of 30-month-old children with several elements of novelty with respect to the existing literature. We targeted both low-risk preterm and full-term children by using an online procedure for data collection and employing a complex data-driven analysis based on multiple lexical (word comprehension and word production) and grammatical (incomplete and complete sentence production) skills. The use of additional communicative-linguistic measures, such as gesture production and phonological accuracy, and the analysis of biological and environmental predictive factors as well as the relations with cognitive and motor skills allowed for a detailed description of these profiles.

Language Profiles in Low-Risk Preterm and Full-Term Children at 30 Months

Profile 1, which we defined as *poor* (21%), reported the lowest performances in lexical (both receptive and expressive), grammatical, and phonological accuracy skills with almost all children being severe late talkers. Profile 2, which we defined as *weak* (22.5%), included children showing some expressive lexical, grammatical, and phonological weaknesses, a few of them being late talkers, generally less severe. Profile 3, which we defined as *average* (25%), included almost all children, except one, with a good lexicon with grammar and phonological accuracy in a consolidating phase. Profile 4, which we defined as *advanced* (31.5%), included all children with an advanced lexicon and grammar and mainly complete phonological accuracy.

Prevalence of late talkers was above 20% in the whole sample suggesting that, when both low-risk preterm and full-term children are considered, prevalence is somewhat higher than that observed in the general population at 24–27 months (Bello et al., 2014; Collisson et al., 2016; Korpilahti et al., 2016b; Zubrick et al., 2007), except for a study reporting a value similar to ours (Reilly et al., 2010). The prevalence found in our study is instead more similar to that reported for very preterm children at 24 and 30 months (i.e., 20%–24%; Sansavini, Guarini, et al., 2010; Sansavini, Guarini, Savini, et al., 2011) and considerably lower than that found in extremely preterm children at the same age (i.e., 40%–45% [Charkaluk et al., 2019; Sansavini et al., 2019; Sentenac et al., 2020] or 65%, when associated with chronic lung disease [Loeb et al., 2020]).

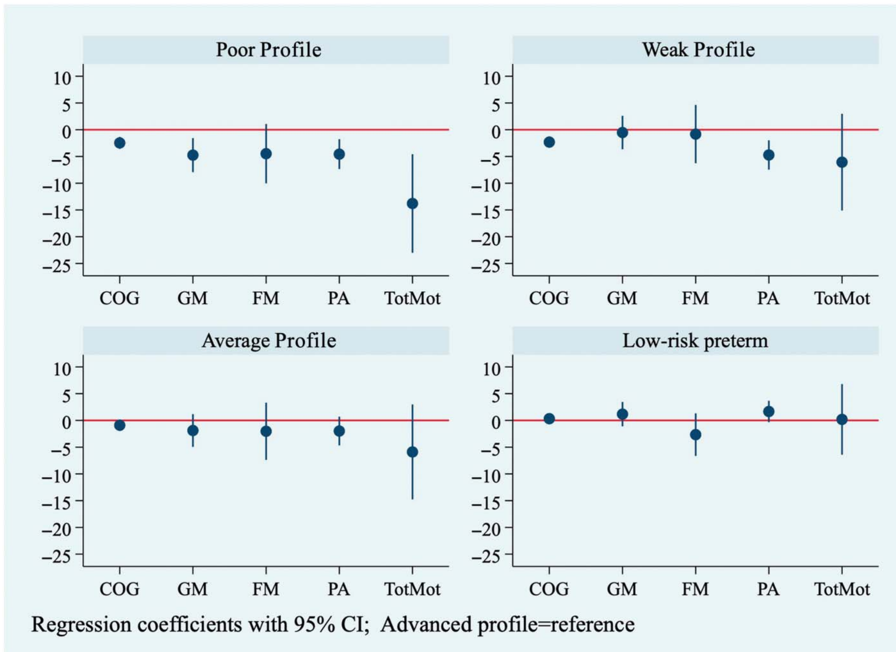
Children assigned to the *poor* profile showed the poorest performances in receptive lexicon, and about one fourth of them did not yet show decontextualized comprehension or verbal imitation. Our findings thus highlight that a severe language delay is often not limited to expressive skills but also involves receptive skills, providing new evidence to support the results of a previous study that found in 24-month-old late talkers a more severe subgroup of children with both expressive and receptive delays (Desmarais et al., 2010). Because this subgroup of late talkers is also at a higher risk for continued language delays (Chilosi et al., 2019;

Table 5. Analysis of covariance of cognitive and motor skills in the four latent profiles controlled for low-risk preterm status.

	Cognitive (*n* = 193)			Gross motor (*n* = 192)			Fine motor (*n* = 192)			Perception–action (*n* = 192)			Total motor (*n* = 192)		
Profile	**Coeff.**	**95% CI**	***p***	**Coeff.**	**95% CI**	***p***	**Coeff.**	**95% CI**	***p***	**Coeff.**	**95% CI**	***p***	**Coeff.**	**95% CI**	***p***
Poor	−2.467	[−3.58, −1.35]	**< .001**	−4.746	[−7.92, −1.57]	**.004**	−4.479	[−10.02, 1.07]	.113	−4.567	[−7.35, −1.78]	**.001**	13.792	[−23.00, −4.58]	**.004**
Weak	−2.311	[−3.38, −1.24]	**< .001**	−0.524	[−3.64, 2.59]	.741	−0.819	[−6.26, 4.62]	.767	−4.720	[−7.45, −1.99]	**.001**	−6.063	[−15.11, 2.98]	.188
Average	−0.901	[−1.95, 0.15]	.092	−1.883	[−4.94, 1.17]	.226	−2.029	[−7.37, 3.31]	.454	−1.981	[−4.66, 0.70]	.147	−5.893	[−14.76, 2.98]	.192
Advanced	ref.														
Low-risk preterm birth	0.327	[−0.46, 1.12]	.415	1.173	[−1.10, 3.45]	.311	−2.656	[−6.63, 1.32]	.189	1.670	[−0.32, 3.67]	.100	0.187	[−6.41, 6.79]	.956
Constant	28.751	[27.97, 29.54]		230.089	[227.8, 232.4]		202.995	[199.0, 206.9]		147.582	[145.6, 149.6]		580.666	[574.1, 587.2]	

Note. Data of seven participants for the cognitive score and of eight participants for the motor scores were missing. Significant results are in bold. Coeff. = coefficient; CI = confidence interval.

Figure 2. Analysis of covariance of cognitive and motor skills in the four latent profiles controlled for low-risk preterm status. CI = confidence interval; COG = cognitive score; FM = fine motor score; GM = gross motor score; PA = perception–action score; TotMot = total motor score.



Rescorla, 2011; Thal et al., 2004), receptive skills should be accurately assessed for a better understanding of the nature of language delays and implementation of customized and timely interventions.

Children belonging to the *poor* profile showed also absent or very scarce sentence production, with half of them not yet combining words. These findings present additional evidence of the existence in late talkers of a continuity between lexicon and grammar, with the latter triggered by reaching a "critical mass" in expressive vocabulary, as previously documented in typical development (Bates & Goodman, 1997; Caselli et al., 1999) and in small groups of atypically developing children (Thal et al., 2004; Weismer et al., 2011). We found this continuity between lexicon and grammar development also across the other three profiles. Most of the children belonging to the *weak* profile, who had limited expressive vocabulary, produced mainly incomplete sentences. Conversely, children belonging to the *average* profile, who had a normal expressive lexicon, produced more complete than incomplete sentences. Finally, children belonging to the *advanced* profile showed the highest word and complete sentence production.

More than half of the children assigned to the *poor* profile also lacked phonological accuracy, and the others had acquired it only partially, producing new evidence for previous studies that have found a smaller phonological inventory and simpler syllabic structures in late talkers (Bello et al., 2018; Carson et al., 2003; Desmarais et al., 2010; Mirak & Rescorla, 1998). Interestingly, phonological accuracy also was lacking in about one third of children belonging to the *weak* profile, the rest of them showing a partial acquisition of it; it was partially acquired or—in about one third—completely acquired in children assigned to the *average* profile, and it was almost completely acquired in children belonging to the *advanced* profile. These findings present new evidence about the existence of relations between phonological and lexical skills, as documented by previous studies (Stoel-Gammon, 2011), and a wide interindividual variability in phonological accuracy acquisition, as documented in the Italian population through parental reports up to 30–36 months (Caselli et al., 2015).

Taken together, our findings underscore the need to identify late talkers going beyond the only criterion of expressive language delay to examine also word comprehension, grammatical skills, and additional linguistic skills, such as phonological accuracy, which would thus deserve further investigation in future studies using both parental reports and direct assessment of child language skills. In contrast, because declarative pointing was mastered by the whole sample, our findings highlight that, at 30 months, this is no longer a discriminating index for identifying late talkers as it is at previous ages (Sansavini et al., 2019).

Biological and Environmental Risk Factors Characterizing Different Language Profiles

Biological and environmental risk factors distinctively characterized language profiles. Being small for gestational age at birth predicted the assignment of children to the *weak* profile. Our results provide new evidence, in a sample at low biological risk, of previous findings (Sentenac et al., 2020; Zubrick et al., 2007) that showed that children with a not optimal weight at birth (i.e., below −1 *SD*) or being small for gestational age had more likely *poor* or *weak* language skills at 24 months of age.

By contrast, low-risk preterm birth status per se was not associated with any of the four profiles, suggesting that, when inserted in a regression model including other biological and environmental risk factors, it did not have a relevant impact by itself in determining language profile at 30 months of age. Our findings confirmed those of some previous studies on low-risk preterm children (Charkaluk et al., 2019; Perez-Pereira et al., 2014) but were partially discordant with others (Cheong et al., 2017; Zambrana et al., 2020). This discordance may depend on the characteristics of participants as well as on the age of and tools used for language assessment. Indeed, our preterm sample was at low risk, having a rather high gestational age and very rare severe neonatal complications. By contrast, the study by Cheong et al. (2017), which assessed language development with the Bayley Scales of Infant and Toddler Development–Third Edition at 2 years of age in moderate and late preterm children (32–36 weeks of gestational age), also included those with motor impairments or severe cognitive deficits. Furthermore, Zambrana et al. (2020), who assessed language with the Ages and Stages Questionnaire at 1.5, 3, and 5 years of age, found that low-risk preterm children (born at 34–36 weeks of gestational age) had an increased risk of language delay with respect to full-term children at 1.5 years of age, but this risk sensibly decreased at 3 and 5 years of age. Therefore, we cannot exclude that, considering earlier ages, different tools, and criteria of inclusion, our findings would have been different.

Neither male sex nor a family history of language impairments was a predictive factor of being a late talker in this study. These findings are in contrast to those of several studies on language delays (Bishop et al., 2003; Collisson et al., 2016; Marini et al., 2017; Sansavini, Guarini, Savini, et al., 2011; Zambrana et al., 2014; Zubrick et al., 2007) but concordant with those of another study examining 30-month-old preterm children with language delay (Loeb et al., 2020). Inconsistent findings on the above factors have been also highlighted by a recent meta-analysis (Fisher, 2017); thus, larger samples of late talkers from both the general and the preterm population would be necessary for further investigating this issue.

Assuredly, our findings highlighted that, in a sample at low biological risk, environmental factors were more highly associated with children's linguistic outcomes. Specifically, we found that disadvantaged conditions represented by having a nonworking mother, for example, unemployed or a housewife, or a father with a low education level increased children's risk of belonging to the *poor* profile. These findings partially confirmed and expanded those of previous studies (Collisson et al., 2016; Hawa & Spanoudis, 2014; Horwitz et al., 2003; Korpilahti et al., 2016a; Reilly et al., 2010; Sansavini, Guarini, Savini, et al., 2011; Zubrick et al., 2007). Both low educational and occupational levels are widely recognized risk factors for language delays. Concerning the parental educational level, several studies have found that a low maternal educational level has a detrimental impact on children's language skills (Dale et al., 2003; Horwitz et al., 2003; Loeb et al., 2020; Sansavini, Guarini, Savini, et al., 2011; Sentenac et al., 2020) in terms of the low quantity and quality of speech input provided to the children (Rowe, 2012). Conversely, very few studies have examined the role of the father's educational level on children's language development. A recent study by Korpilahti et al. (2016a) found that a father's higher educational level and social status correlated with more advanced child lexical development. Our findings provide new evidence in this field, confirming the relevance of also including paternal variables among potential environmental risk factors.

Language Profiles and Their Relation With Cognitive and Motor Skills

With respect to the relationships between language profiles and cognitive and motor skills, our findings confirm that all of the above domains are closely interrelated and deserve to be assessed to describe and distinguish language profiles at 30 months of age. Concerning cognitive skills, children belonging to the *poor* profile and the *weak* profile reported lower scores, compared to their peers assigned to the *advanced* profile. On one side, these findings confirm those of previous studies that highlighted cognitive weaknesses in late talkers (Bello et al., 2018; Buschmann et al., 2008; Thal et al., 2005) and in preterm children with language weaknesses or delays (Loeb et al., 2020; Sansavini et al., 2014). On the other side, our study expands the literature on language development and its relation to the cognitive domain, revealing that vulnerabilities in this developmental area are associated with weaknesses not only in receptive skills, as found in previous studies (Bello et al., 2018; Desmarais et al., 2010), but also in expressive skills, specifically receptive and expressive vocabulary size, consistently with those of Desmarais et al. (2010). As argued by Thal et al. (2005), variations in specific cognitive functions associated with language may also explain variations in language learning. Along these lines, studies on late talkers have revealed weaknesses in specific abilities related to cognition and language, such as symbolic play (Bello et al., 2018; Desmarais et al., 2010; Rescorla & Goossens, 1992). In this study, most children demonstrated symbolic play, except a few (less than 10%) belonging to the *late* or *weak* profiles. Thus, future studies should address this issue by administering specific cognitive tasks in order to further investigate the relationship between cognitive and expressive lexical skills.

In addition to cognitive weaknesses, motor weaknesses were found in children belonging to the *poor* profile, who showed lower performances in gross motor, perception–action, and total motor skills, and in children belonging to the *weak* profile, who earned lower scores in perception–action skills than their peers assigned to the *advanced* profile. These findings present new evidence that late talkers and children with language weaknesses also have vulnerabilities in the motor domain (Iverson & Braddock, 2011; Zubrick et al., 2007), in line with a growing body of literature on the existence of tight associations between motor and language skills in typically and atypically developing children, including those with language delays or impairments (Hill, 2001; Iverson, 2010; Iverson & Braddock, 2011; Leonard & Hill, 2014; Zubrick et al., 2007) and those born preterm (Charkaluk et al., 2019; Loeb et al., 2020; Sansavini et al., 2014). An intriguing possible explanation for the co-occurrence of language and motor weaknesses among late talkers was provided by the "dynamic system" theory (Thelen & Smith, 1994). Developmental systems are strictly intertwined, and a minimal disruption in one of them could have cascading effects on the other domains (Thelen & Smith, 1994). Several studies have provided evidence that early gross motor and fine motor skills were a prerequisite for language development and that the acquisition of new motor skills may affect language development (Iverson, 2010). A direct conclusion of this theoretical perspective is that delays in early motor skills may have cascading effects on later development that extend beyond the motor domain, as has been shown for early gross motor and fine motor skills affecting gesture and language development (LeBarton & Iverson, 2016; Zuccarini et al., 2017, 2018) as well as cognitive development (Ruff et al., 1984; Zuccarini et al., 2017).

Another possible explanation for the co-occurring weaknesses in the language and motor domains was that they are due to a general neuromaturational delay (Hill, 2001). Interestingly, in his review, Hill (2001) highlighted that language and motor coordination impairments were often co-occurring in children with language impairments, and several explanations have been advanced. One hypothesis concerns a general information-processing deficit, particularly for integrating sensory information that needs to be elaborated in rapid succession, as is required in perception–action skills, which would explain the co-occurrence of cognitive, perception–action, and language weaknesses, as we found in children belonging to both the *late* and *weak* profiles. Another explanation, supported by neuroimaging studies, underlines that some areas in the brain are activated by both language and motor functions, suggesting that representations of hands, arms, and the vocal tract have common underlying neural patterns (Heiser et al., 2003). A third explanation suggests the existence of a general neuromaturational delay that could explain the co-occurrence of language and cognitive and gross motor delays (Hill, 2001). Consistent with these findings, we found that only children belonging to the *poor* profile showed diffuse poor performances in gross motor, perception–action, and total motor skills, suggesting that poor motor skills may be associated with vulnerabilities in language development with a greater effect when both gross motor and perception–action skills are compromised. Thus, relationships between gross motor, fine motor, perception–action, and language skills need to be further investigated to develop an understanding of the wide variability and limited stability of individual differences in language development at early ages and to explore language outcomes.

Strengths and Limitations of the Study

A main strength of this study was the use of a person-centered and cross-domain approach for identifying language profiles among a relatively big sample of low-risk preterm and full-term children at 30 months of age. A second strength was the examination of several biological and environmental risk factors as possible predictors of late-talking status that can reflect children's individual differences in language profiles. A third strength was the adoption of an online procedure for data collection. In agreement with a previous web-based screening study conducted in Norway (Kristoffersen et al., 2013), we noted several advantages of using this procedure. It was cost and time efficient and helpful in reducing coding errors. Moreover, it contributed to a good parental participation rate (57% of parents accepted to participate and filled out the questionnaires), which is 10 points higher than that observed in a recent paper-based screening conducted in Italy (Bello et al., 2014) and 20 points higher than that reported in a previous web-based language screening conducted on the general population in Norway (Kristoffersen et al., 2013), probably thanks to a larger number of people having access to Internet in recent years and an increasing attention to early child development. Nevertheless, we noted that another 27% of parents, who accepted to participate, did not complete the questionnaire. It is possible that giving parents the option to fill out the questionnaires online at home encouraged them to take their time responding, but this, in turn, might also have implied that they forgot to do it, did not feel committed to completing it, or decided to not participate any longer.

Some limitations of the current study need to be taken into account. First, our preterm sample was relatively homogeneous, and the generalizability of our results is limited to the low-risk preterm population and a comparable full-term population. In addition, we cannot exclude that the slight lower birth weight of preterm children participating with respect to those not participating in the screening (mean difference = 236 g) could have affected the results. Therefore, children with a wider range of gestational age and birth weight should be included in future language screening programs. Furthermore, the findings of the current study can be generalized to countries, similar to Italy, where socioeconomic differences are not too large, public health care and school services are available free of charge for the entire population, and housing in environmentally unsafe areas is not as strongly associated with familial low income. Second, we used parent report questionnaires. Although literature has documented that measures obtained through a parent report are comparable to those obtained through a direct assessment (Sachse & Von Suchodoletz, 2008), combining parent report tools with a direct clinical assessment of children identified as late talkers could be helpful for confirming their language difficulties and the nature of their language delays (Bishop & McDonald, 2009). Moreover, as shown in the literature (Bello et al., 2018; Rescorla et al., 2000), future studies investigating other aspects of children's language skills, such as spontaneous speech and socioconversational skills, could be helpful for a deeper understanding of late talkers' linguistic profiles and characteristics. Third, in this study, we examined 30-month-old children by focusing on a single age point. This limited our possibilities for exploring the stability of the four profiles across time. Longitudinal studies are needed to address this issue.

Implications for Practice

Some relevant clinical implications can be derived from our findings. First, using a person-centered approach appears particularly useful for identifying children who need more careful watching and more regular follow-up as they progress from infancy to preschool age and for implementing early customized interventions targeted at each child language profile. In recent years, several programs involving parents have been effectively implemented to improve the language skills of late talkers (Buschmann et al., 2015; Girolametto et al., 1996; Kruythoff-Broekman et al., 2019) and should thus be preferred with respect to "watch-and-see" approaches (Bishop et al., 2016; Capone Singleton, 2018). The major aim of these interventions was to support parents in using adequate strategies for promoting their child's language development. Thus, a person-centered approach appears useful to parents for modeling strategies and conversational practices according to their child's language profile.

Second, by using a cross-domain approach and finding associations between language profiles and cognitive and motor skills, our results underscore the relevance of investigating these skills in a clinical assessment. As shown in the literature, children with language impairments may also have difficulties in nonlinguistic cognitive functions, such as working memory (Marini et al., 2017), and in gross and fine motor functions, such as motor coordination or fine motor dexterity (Brookman et al., 2013; Hill, 2001). Therefore, identifying weaknesses in other developmental domains and applying interventions that support nonverbal functions could have positive cascading effects on language development.

Third, our findings showed that online data collection appears promising and should be encouraged in clinical practices and in follow-up programs, exploring its possibilities for reaching a higher number of families. This is even more worth pursuing nowadays because of the COVID-19 pandemic, which compelled psychologists to employ online technologies for assessment and intervention (European Federation of Psychologists' Associations, 2020), although some limitations in participation and access to technology need to be taken into account.

Conclusions

In summary, our findings highlighted four distinct language profiles, *poor, weak, average,* and *advanced,* in 30-month-old low-risk preterm and full-term children, allowing us to differentiate them across multiple linguistic, cognitive, and motor skills. In particular, children belonging to the *poor* profile, reporting both receptive and expressive weaknesses, and those belonging to the *weak* profile, showing only expressive weaknesses, should be monitored over time through a cross-domain approach to verify whether they will recover or persist in their delay up to 4 years of age, when a developmental language disorder can be diagnosed. This consideration is particularly relevant because language difficulties appear to be not specific but rather one aspect of a broader spectrum of weaknesses characterizing children with language weaknesses. Language weaknesses also appear to be strictly associated with some environmental factors, such as the mother's nonworking status and the father's low educational level, with some biological factors, such as being small for gestational age at birth, also impacting language development in children at low biological risk. This confirms the importance of considering language delay as a multifactorial phenomenon and implementing timely parental interventions to promote language development in these children with particular attention to those characterized by multiple factors of risk. Finally, some aspects of research methodology, such as the online data collection for parental questionnaires and statistical data-driven approaches singling out distinct profiles, can widen the understanding of language interindividual variability for scientists and clinicians operating in this field.

Author Contributions

Alessandra Sansavini: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Funding acquisition, Project administration, Supervision. **Mariagrazia Zuccarini:** Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Dino Gibertoni:** Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. Arianna Bello: Writing – review & editing. **Maria Cristina Caselli:** Writing – review & editing. **Luigi Corvaglia:** Methodology, Data curation. **Annalisa Guarini:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Funding acquisition.

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