Article

FIRST LANGUAGE

First Language
2018, Vol. 38(5) 503–519

DOI: 10.1177/0142723718778916
journals.sagepub.com/home/fla
SAGE

Early lexical development: Do day care attendance and maternal education matter?

Irene Cadime, Carla Silva, Iolanda Ribeiro and Fernanda Leopoldina Viana
University of Minho, Portugal

Abstract
The aim of this study was to analyse the existence of differences in lexical development as a function of day care attendance and maternal education. Data were collected using the MacArthur–Bates Communicative Development Inventory: Words and Sentences. The reports of 2084 toddlers were analysed. The results for toddlers older than 24 months indicated that those from mothers with higher educational levels produced a higher number of words in all lexical categories than those from mothers with lower educational levels. When considering younger toddlers, a significant effect of maternal education was only found on the number of common nouns produced. Nevertheless, the size of these effects was small. Quantity of day care attendance had no effect on the number of words produced. No interaction effects between maternal education and day care attendance were found. These findings indicate that maternal education may be differently associated with the production of words from different lexical categories.

Keywords
communicative development inventories, day care, lexical development, maternal education, word production

Word comprehension occurs long before word production, and in most of the languages spoken in western countries, there is a relatively stable pattern in the emergence of words from different lexical categories: the first words children produce are usually nouns for

Corresponding author:
Irene Cadime, Research Centre on Child Studies, University of Minho, Gualtar Campus, 4710-057 Braga, Portugal.
Email: irenecadime@ie.uminho.pt

concrete objects or persons, interjections, or other social or routine-related terms. At some point after the 'vocabulary spurt', children start to produce the first predicates and only later do the first closed-class words start to be observed (Bornstein et al., 2004; Caselli et al., 1995; Marjanovič-Umek, Fekonja-Peklaj, & Podlesek, 2013; Papaeliou & Rescorla, 2011).

Several environmental factors have been associated with language development (Rogers, Nulty, Betancourt, & DeThorne, 2015). One factor is socioeconomic status (SES): there is some evidence that parents from higher socioeconomic levels provide more input (more tokens) to their children and use more diverse vocabulary than parents from lower levels, which enhances children's lexicon (Hart & Risley, 1995; Hoff-Ginsberg, 1991; Rogers et al., 2015). Maternal education level has been used as the main indicator of family SES in most studies on language development (Ensminger & Fothergill, 2003). However, the disadvantage of children from less educated mothers in expressive vocabulary has not always been observed. Some studies using parental reports of children's communicative abilities found evidence that a higher level of maternal education is associated with a higher number of words produced by the children (e.g. Andonova, 2015; Fenson et al., 2007; Jackson-Maldonado et al., 2003), but others found no differences in vocabulary production as a function of maternal education (e.g. Stolt et al., 2007).

The bulk of research cited so far has focused on parents' behaviour and characteristics that can be associated with children's lexical development. However, the current economic and job market demands in western societies mean that the number of children that attend formal child care services before the age of three years is rising and in some countries a considerable percentage of children spend a large period of the week in these services. This is the case in Portugal: although the Portuguese day care system is not universal, it is widely used. Statistics from 2010–2011 indicated that about 33% of children under three years old living in Portugal attended child care centres, mostly full-time (European Commission, 2013).

However, large-scale studies that explore the effects of day care attendance on children's language development are scarce. One exception is the National Institute of Child Health and Human Development (NICHD) Early Child Care Research Network Study of Early Child Care and Youth Development (SECCYD) conducted in the United States. The results of the study indicated that although the number of care hours per day was not associated with better language outcomes for children, the cumulative experience in day care centres was associated with better outcomes when compared with home care, when quality was similar between both settings (NICHD Early Child Care Research Network, 2000). Although this is a very important finding, large-scale studies that investigate the effects of day care attendance in other countries are needed because of possible cultural and educational variations. Moreover, although research indicates that maternal education and the attendance at formal day care structures are two factors that can influence children's linguistic abilities, the effect of these two variables on lexical development in early ages has seldom been investigated conjointly. One exception is the study by Caughy, Dipietro, and Strobino (1994), where the interaction effects between SES and day care attendance in the first three years of age were studied. The study analysed if these effects were related to children's reading and mathematical skills at five to six

years of age. The results indicated a significant interaction effect that suggested that day care attendance was more beneficial for children from lower SES. However, this study measured SES using family income as an indicator and not maternal education. In a similar study, Christian, Morrison, and Bryant (1998) explored the existence of interaction effects between maternal education and the amount of centre-based day care attendance (prior to kindergarten) on several skills, including maths, word recognition, alphabet knowledge and verbal achievement, using a sample of children aged approximately five years old. Their results also indicated that children from mothers with lower educational levels were the ones who benefited most from day care attendance, but these findings were limited to maths achievement. Although these findings provide important insights, both of these studies (Caughy et al., 1994; Christian et al., 1998) explored the existence of an interaction effect of day care attendance×SES on later academic-related skills and not on the lexicon size of children during the first three years of age.

Another important question is whether effects of education and day care would hold across all lexical categories, or whether the effects would be specific to certain types of words. Most of the studies investigating the relationship between maternal education and lexical development indicate that greater diversity of vocabulary and structures provided by mothers with higher educational backgrounds leads to gains in children's total vocabulary (Hoff, 2003; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010; Rowe, 2012). Thus, it is plausible to assume that these gains would be encountered also when analysing the effects of maternal education on the production of words from different lexical categories. However, this does not seem to be the case. In one study with Estonian-speaking children aged 8 to 16 months old, children from mothers with higher educational levels were found to produce more common nouns and predicates, but no effects of maternal education were found for social terms (Schults, Tulviste, & Konstabel, 2012). Nevertheless, this issue has not been explored using speakers of other languages and therefore it is not clear if this finding is a product of cultural practices or if it reflects more universal differences related with the maternal education levels. Additionally, it is unclear whether the diversity in the interactions with peers and adults and the multi-talker input present in day care exerts more effects on the toddlers' learning of certain types of lexical categories, or if these interactions exert an equal influence across all types of words.

Therefore, the main goal of this study was to investigate the effects of the quantity of day care attendance and maternal education on the lexical development of one group of toddlers, using data obtained in one large-scale study conducted in Portugal. Lexical development was analysed considering not only the total number of words produced by the children but also the number of words produced in each of the four lexical categories that have been extensively used in other studies (Caselli et al., 1995; Kern, 2007; Stolt et al., 2007): (1) social terms; (2) common nouns; (3) predicates; and (4) grammatical function words.

Taking into account the findings of studies conducted in other populations, positive relationships between maternal education and lexical development, as well as between the quantity of day care attendance and lexical development, are expected. Additionally, potentially different effects of day care for children of lower vs higher educated mothers are expected, considering some results that suggest that day care attendance is more beneficial for low SES children.

Methods

Participants and procedures

The data used in this study were retrieved from the databases of the adaptation study of the European Portuguese version of the MacArthur–Bates Communicative Development Inventory: Words and Sentences (PT-CDI: WS; Silva et al., 2017), in which the reports of 3012 toddlers were collected. For the purpose of this study, only participants who had an indication of the maternal education level and indication of the number of months that the child had been attending day care were considered. Toddlers who did not attend day care services were also not included in this study. Therefore, the data of 2084 toddlers aged 16–30 months old were used. The participants were from the seven regions of Portugal: North (n = 773; 37.1%), Centre (n = 439; 21.1%), Lisbon (n = 505; 24.2%), Alentejo (n = 115; 5.5%), Algarve (n = 136; 6.5%), Madeira (n = 56; 2.7%) and Azores (n = 60; 2.9%). These percentages are representative of the distribution of the Portuguese population per geographical area (North: 34.9%, Centre: 21.8%, Lisbon: 27.1%, Alentejo: 7%, Algarve: 4.3%, Madeira: 2.5%, Azores: 2.4%).[1]

Table 1 shows the mean time of day care attendance as well as the distribution of the sample as a function of gender and maternal education in each age month. The number of boys and girls was similar in all months of age. Almost half of the mothers had a higher education degree, but the number of mothers who completed a graduate degree (i.e. master's or PhD) was much lower than the number of mothers who completed just an undergraduate degree (i.e. bachelor's).

Given that the data were retrieved from the database of the European Portuguese CDI: WS adaptation study, the same exclusion criteria are applied: premature children with low birth weight (less than 1500 grams), children whose parents did not speak European Portuguese, and children with severe medical conditions that can potentially affect language development. In the sample used in this study, only in 3.1% cases was a second language spoken at home. Toddlers were kept in the sample if at least one parent spoke Portuguese at home.

Ethics approval was obtained from the Portuguese Commission of Data Protection. The data were collected using a paper-and-pencil version of the instrument, which was distributed in more than 200 day care centres across the country. An online version of the same instrument was also publicized in web forums and through email lists. The instrument was accompanied by a sociodemographic questionnaire to collect information about the child, parental education and time of day care attendance (measured as number of months that the child had been attending day care centres). All parents provided written formal consent.

Instrument

The European Portuguese version of the MacArthur–Bates Communicative Development Inventory: Words and Sentences (PT-CDI: WS) was used (Silva et al., 2017). This inventory is completed by parents, who are asked to report their children's linguistic and communicative abilities (Fenson et al., 2007). The PT-CDI: WS is designed to be completed by parents of children aged 16–30 months. For the purposes of this study, only the results

Table 1. Number of participants by age, gender, maternal education, and descriptive statistics for day care attendance.

Age (months)	Toddlers' gender			Maternal education				Day care attendance (in months) *M* (SD)
	Female	Male	No info.	Less than high school	High school	Undergraduate	Graduate	
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	
16	45 (49.5%)	46 (50.5%)	0 (0.0%)	27 (29.7%)	26 (28.6%)	34 (37.4%)	4 (4.4%)	7.82 (4.00)
17	44 (38.6%)	69 (60.5%)	1 (0.9%)	24 (21.1%)	43 (37.7%)	40 (35.1%)	7 (6.1%)	8.45 (3.98)
18	66 (46.5%)	75 (52.8%)	1 (0.7%)	40 (28.2%)	37 (26.1%)	56 (39.4%)	9 (6.3%)	9.41 (4.48)
19	65 (46.8%)	74 (53.2%)	0 (0.0%)	42 (30.2%)	43 (30.9%)	47 (33.8%)	7 (5.0%)	10.78 (4.73)
20	81 (51.3%)	76 (48.1%)	1 (0.6%)	42 (26.6%)	43 (27.2%)	61 (38.6%)	12 (7.6%)	11.73 (4.88)
21	72 (49.0%)	75 (51.0%)	0 (0.0%)	37 (25.2%)	45 (30.6%)	59 (40.1%)	6 (4.1%)	11.88 (5.17)
22	78 (53.4%)	67 (45.9%)	1 (0.7%)	38 (26.0%)	41 (28.1%)	58 (39.7%)	9 (6.2%)	13.15 (5.08)
23	70 (49.6%)	71 (50.4%)	0 (0.0%)	37 (26.2%)	42 (29.8%)	51 (36.2%)	11 (7.8%)	13.35 (5.31)
24	64 (44.8%)	78 (54.5%)	1 (0.7%)	36 (25.2%)	41 (28.7%)	60 (42.0%)	6 (4.2%)	13.90 (5.79)
25	74 (48.4%)	78 (51.0%)	1 (0.7%)	37 (24.2%)	59 (38.6%)	53 (34.6%)	4 (2.6%)	14.83 (5.81)
26	61 (42.7%)	82 (57.3%)	0 (0.0%)	29 (20.3%)	59 (41.3%)	46 (32.2%)	9 (6.3%)	15.51 (6.13)
27	74 (47.1%)	83 (52.9%)	0 (0.0%)	37 (23.6%)	49 (31.2%)	63 (40.1%)	8 (5.1%)	15.77 (6.99)
28	63 (41.2%)	90 (58.8%)	0 (0.0%)	48 (31.4%)	42 (27.5%)	56 (36.6%)	7 (4.6%)	16.83 (7.54)
29	70 (46.1%)	81 (53.3%)	1 (0.7%)	48 (31.6%)	44 (28.9%)	55 (36.2%)	5 (3.3%)	17.67 (7.35)
30	49 (46.7%)	56 (53.3%)	0 (0.0%)	29 (27.6%)	37 (35.2%)	34 (32.4%)	5 (4.8%)	17.91 (8.27)
Total	976 (46.8%)	1101 (52.8%)	7 (0.3%)	551 (26.4%)	651 (31.2%)	773 (37.1%)	109 (5.2%)	13.44 (6.55)

Note: *M* = Mean; SD = Standard deviation.

Table 2. Number of items in each category of the PT-CDI: WS vocabulary checklist.

Category	Number of items
1. Interjections, sound effects and animal sounds[a]	22
2. Animals[b]	47
3. Vehicles[b]	13
4. Toys[b]	15
5. Food and drink[b]	63
6. Clothing[b]	40
7. Body parts[b]	34
8. Small household items[b]	49
9. Furniture and rooms[b]	26
10. Outside things[b]	20
11. Places to go	18
12. People[a]	27
13. Games, routines and greetings[a]	36
14. Verbs[c]	84
15. Descriptive words/Qualifiers[c]	47
16. Words about time	11
17. Demonstratives, possessives and personal pronouns[d]	21
18. Question words[d]	15
19. Prepositions and adverbs[d]	21
20. Articles and quantifiers[d]	20
21. Modal and auxiliary verbs	5
22. Connecting words[d]	5
Total	639

[a]Social terms; [b] Common nouns; [c] Predicates; [d] Function words.

obtained in the vocabulary checklist of the CDI: WS were used. In the PT-CDI: WS, the checklist is composed of 639 words, and parents must flag the ones that their child produces. Consequently, only one indicator of lexical development is considered for children assessed with this CDI: the number of words produced. The words that make up the checklist are grouped into 22 categories (see Table 2). Regarding the psychometric properties of the measure, a very high Cronbach's alpha value was obtained for this subscale ($\alpha = .99$) in the validation study of the PT-CDI: WS. Additionally, a high correlation ($r = .87$) between the ratings provided by parents and day care teachers was obtained for the vocabulary subscale of the PT-CDI: WS (Viana et al., 2017).

Results

We examined the effects of maternal education and day care attendance on lexical development by considering, first, the total number of words produced and, second, the number of words produced in each lexical category (see Table 2 for the words included in each lexical category). Maternal education was analysed as a categorical variable with four categories: less than high school education, high school education, undergraduate degree and graduate

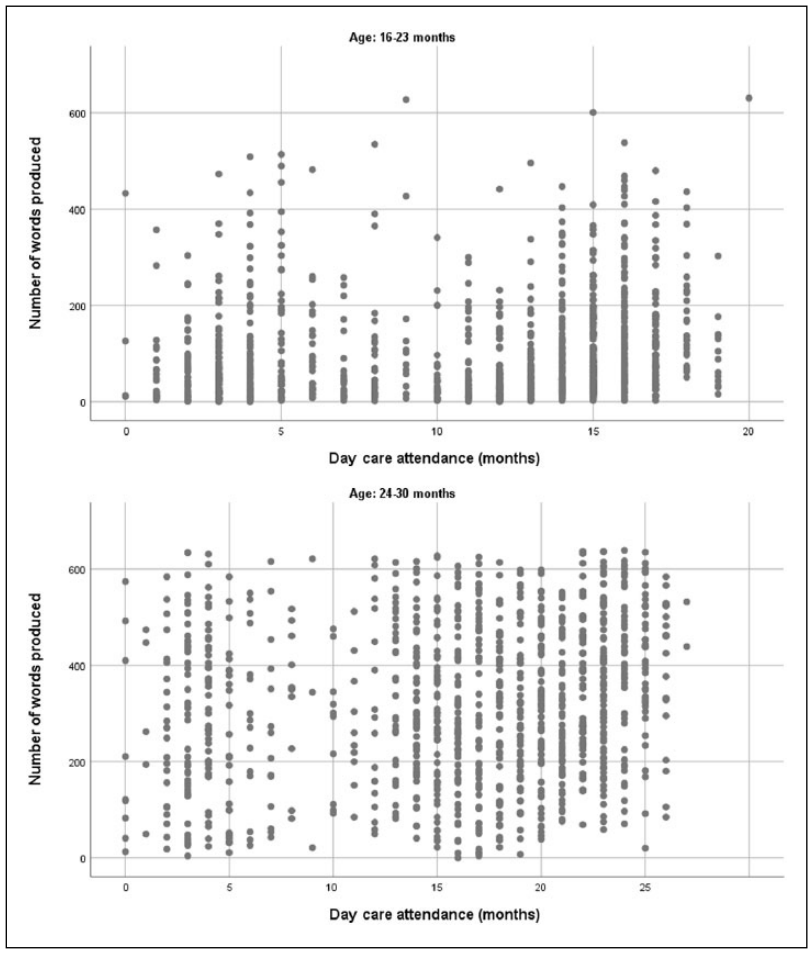

Figure 1. Scatterplots representing the relationship between the number of words produced and number of months of day care attendance in two age intervals.

degree. Day care attendance was measured as the total number of months that children had attended day care. As expected, on average, older children attended day care institutions for longer periods than younger children. However, the variance in duration of day care attendance in each age group was large. No differences in the number of months of attendance were found among the four maternal education levels, $F(3, 2080) = 1.709$, $p = .163$. The correlation between age and the number of months of day care attendance was significant, $r = .448$, $p < .001$. As a consequence, the effect of age was controlled for in the statistical analyses. Data were plotted to explore if there was a linear relationship between the number of words produced and number of months of day care attendance. The observation of these scatterplots (see Figure 1) suggests a nonlinear relationship between both variables. Previous studies which investigated the effects of the quantity of day care attendance on

children's linguistic abilities measured the time of day care attendance in either total number of months (e.g. Christian et al., 1998) or years of attendance (e.g. Caughy et al., 1994). In this study, day care attendance was converted into a categorical variable. For the purposes of this study we considered four groups for the analyses: (1) equal or less than 6 months of day care attendance ($n = 455$); (2) between 7 and 12 months of day care attendance ($n = 295$); (3) between 13 and 18 months of day care attendance ($n = 878$); (4) more than 19 months of day care attendance ($n = 456$). These time units were chosen in order to obtain meaningful units of analysis, given that six-month periods were considered long enough for effects of day care experience to accumulate. Additionally, using these time units allowed us to obtain groups with roughly equivalent numbers of participants.

Consequently, taking into account the fact that maternal education and day care attendance were categorical variables, analysis of covariance (ANCOVA) was run to test their effects on the total number of words produced by toddlers. This analysis was followed by a multivariate analysis of covariance (MANCOVA) to test for effects on the four lexical categories. Because of the large age range of the participants and the variability associated with it, age was inserted in all analyses as a covariate. As children become more verbal, the relationship between the quantity of day care attendance and word production might change. Consequently, in order to evaluate if the differences as a function of day care and maternal education are constant across the age range, the analyses were conducted separately for two age groups: 16–23 months old and 24–30 months old. Partial eta squared was used as measure of effect size, indicating the percentage of variance explained by each predictor.

Total number of words produced

Table 3 presents the descriptive statistics of the toddlers' word production (total and per lexical category).

The ANCOVA results indicated that age was the only variable with a significant effect on the total number of words produced by children in the 16–23 months old group, $F(1, 1061) = 302.617$, $p < .001$, partial $\eta^2 = .222$. Regarding the same age group, the effects of maternal education, $F(3, 1061) = 2.073$, $p = .102$, partial $\eta^2 = .006$, and quantity of day care attendance, $F(3, 1061) = 0.601$, $p = .614$, partial $\eta^2 = .002$, were not significant. The interaction effect between maternal education and day care attendance was also not significant, $F(9, 1061) = 1.192$, $p = .296$, partial $\eta^2 = .010$.

Regarding the 24–30 months old group, the ANCOVA results suggested a significant effect of age on the total number of words produced by toddlers, $F(1, 989) = 96.312$, $p < .001$, partial $\eta^2 = .089$. Maternal education also had a significant, but small, effect, $F(3, 989) = 4.716$, $p = .003$, partial $\eta^2 = .014$. Bonferroni post-hoc comparison tests indicated that children from mothers with less than high school education produced significantly fewer words (see Table 4) than children from mothers with an undergraduate ($p = .009$) and a graduate diploma ($p = .031$). The remaining pairwise comparisons were nonsignificant ($p > .05$). Day care attendance had no significant effect on the total number of words produced by toddlers aged 24–30 months old, $F(3, 989) = 1.108$, $p = .345$, partial $\eta^2 = .003$. The interaction effect between maternal education and day care attendance was also not significant, $F(9, 989) = 1.496$, $p = .145$, partial $\eta^2 = .013$.

Table 3. Descriptive statistics of the number of words produced by toddlers.

Age (months)	Total words		Social terms		Common nouns		Predicates		Function words	
	M (SD)	Range	*M* (SD)	Range	*M* (SD)	Range	*M* (SD)	Range	*M* (SD)	Range
16	28.38 (29.53)	1–132	13.95 (10.44)	1–51	9.18 (13.19)	0–73	2.23 (5.82)	0–48	2.27 (3.50)	0–15
17	36.58 (48.84)	0–300	16.46 (11.34)	0–61	14.08 (28.13)	0–181	2.75 (7.30)	0–47	2.52 (4.23)	0–29
18	58.23 (56.56)	1–341	23.18 (13.27)	0–69	23.49 (29.41)	0–166	5.52 (11.37)	0–76	4.58 (6.28)	0–40
19	71.38 (72.20)	0–427	24.98 (14.08)	0–77	31.47 (39.40)	0–213	6.98 (12.61)	0–82	5.79 (7.14)	0–46
20	106.86 (99.46)	3–601	31.96 (17.07)	1–83	50.42 (53.92)	0–272	12.22 (19.95)	0–130	8.75 (11.43)	0–82
21	117.65 (100.07)	3–628	32.24 (15.69)	3–84	59.41 (57.28)	0–307	13.16 (19.67)	0–130	9.24 (10.32)	0–74
22	160.80 (126.44)	3–538	39.42 (17.32)	2–78	79.52 (67.69)	0–266	22.74 (27.38)	0–114	13.16 (13.61)	0–72
23	190.94 (130.14)	11–631	42.67 (17.59)	5–83	94.89 (67.27)	1–301	29.26 (30.88)	0–130	17.28 (16.14)	0–82
24	240.03 (153.38)	0–625	48.07 (18.98)	0–85	119.71 (78.67)	0–306	40.50 (36.01)	0–130	22.49 (17.84)	0–81
25	275.31 (147.94)	18–634	50.58 (18.10)	12–85	139.56 (73.26)	2–303	47.83 (37.67)	0–130	26.00 (19.72)	0–82
26	297.01 (149.36)	10–634	53.17 (17.04)	4–85	149.70 (75.90)	0–303	54.31 (38.39)	0–130	27.43 (19.01)	0–81
27	328.38 (150.85)	26–614	55.76 (17.18)	10–84	162.37 (75.98)	3–294	61.97 (38.12)	0–130	33.58 (21.18)	0–82
28	341.74 (159.96)	4–632	56.75 (17.98)	1–85	170.20 (78.66)	1–307	64.68 (41.90)	0–130	35.18 (22.28)	0–82
29	356.59 (166.82)	4–639	56.03 (20.67)	2–85	179.70 (79.35)	1–307	67.03 (43.03)	0–130	37.97 (24.42)	0–82
30	415.21 (156.86)	20–637	62.97 (17.81)	10–85	197.92 (77.55)	0–306	86.43 (36.96)	0–130	48.87 (22.41)	0–82
Total	206.37 (174.39)	0–639	41.39 (22.13)	0–85	101.41 (88.62)	0–307	35.19 (39.97)	0–130	20.02 (21.28)	0–82

Note: *M* = Mean; SD = Standard deviation.

Table 4. ANCOVA and MANCOVA estimated marginal means and standard errors as a function of maternal education for the 24–30 months old group.

Lexical categories	Maternal education			
	Less than high school	High school	Undergraduate	Graduate
	EMM (SE)	EMM (SE)	EMM (SE)	EMM (SE)
Social terms	49.42 (1.46)	53.48 (1.24)	55.45 (1.27)	58.38 (3.51)
Common nouns	136.74 (6.13)	155.10 (5.21)	163.47 (5.31)	179.82 (14.72)
Predicates	48.24 (3.12)	58.90 (2.65)	61.18 (2.70)	69.27 (7.49)
Function words	28.09 (1.69)	33.07 (1.44)	32.73 (1.47)	40.08 (4.07)
Total words	274.69 (12.35)	314.27 (10.50)	326.62 (10.70)	364.62 (29.65)

Note: EMM = Estimated marginal mean; SE = Standard error.

Words produced per lexical category

Regarding the 16–23 months old group, the MANCOVA multivariate results indicated a strong effect of age, based on Hotteling's trace, $T = 0.325$, $F(4, 1058) = 85.91$, $p < .001$, partial $\eta^2 = .245$. Subsequent univariate tests indicated that age had an effect on the production of words from all four categories: social terms, $F(1, 1061) = 306.73$, $p < .001$, partial $\eta^2 = .224$; common nouns, $F(1, 1061) = 302.71$, $p < .001$, partial $\eta^2 = .222$; predicates, $F(1, 1061) = 192.25$, $p < .001$, partial $\eta^2 = .153$; and function words, $F(1, 1061) = 197.34$, $p < .001$, partial $\eta^2 = .157$.

Regarding the same group, multivariate results also indicated a significant effect of maternal education, $T = 0.021$, $F(12, 3170) = 1.805$, $p = .042$, partial $\eta^2 = .007$. Follow-up univariate analyses indicated a small but significant effect on the number of common nouns produced, $F(3, 1061) = 2.815$, $p = .038$, partial $\eta^2 = .008$. Post-hoc Bonferroni tests indicated that children from mothers with a graduate diploma (estimated marginal mean = 71.09, SE = 13.40) produced a higher number of common nouns ($p = .032$) than children from mothers with high school education (estimated marginal mean = 29.42, SE = 6.61). The remaining pairwise comparisons were not significant ($p > .05$). The effects of maternal education on the production of the other three lexical categories were non-significant. The MANCOVA results also indicated that the effect of day care attendance was not significant, $T = 0.010$, $F(12, 3170) = 0.918$, $p = .528$, partial $\eta^2 = .003$. The interaction between maternal education and day care attendance was also not significant, $T = 0.039$, $F(36, 4226) = 1.149$, $p = .250$, partial $\eta^2 = .010$.

Regarding the 24–30 months old group, the MANCOVA multivariate results indicated a strong effect of age, based on Hotteling's trace, $T = 0.152$, $F(4, 986) = 37.558$, $p < .001$, partial $\eta^2 = .132$. Subsequent univariate tests indicated that age had an effect on the production of words from all four categories: social terms, $F(1, 989) = 39.816$, $p < .001$, partial $\eta^2 = .039$; common nouns, $F(1, 989) = 85.399$, $p < .001$, partial $\eta^2 = .079$; predicates, $F(1, 989) = 96.124$, $p < .001$, partial $\eta^2 = .089$; and function words, $F(1, 989) = 112.445$, $p < .001$, partial $\eta^2 = .102$.

Multivariate results also indicated a significant effect of maternal education, $T = 0.022$, $F(12, 2954) = 1.828$, $p = .039$, partial $\eta^2 = .007$. Follow-up univariate analyses indicated a small but significant effect on the number of social terms produced, $F(3, 989) = 4.033$, $p = .007$, partial $\eta^2 = .012$; on the number of common nouns, $F(3, 989) = 4.748$, $p = .003$, partial $\eta^2 = .014$; on the number of predicates, $F(3, 989) = 4.482$, $p = .004$, partial $\eta^2 = .013$; and on the number of function words produced by the toddlers, $F(3, 989) = 3.361$, $p = .018$, partial $\eta^2 = .010$. Post-hoc Bonferroni tests indicated that children from mothers with a graduate diploma produced a higher number of common nouns ($p = .042$), a higher number of predicates ($p = .058$) and a higher number of function words ($p = .040$) than children from mothers with less than high school education (see Table 4). Children from mothers with an undergraduate diploma produced more social terms ($p = .011$), more common nouns ($p = .006$) and more predicates ($p = .010$) than children from mothers with less than high school education (see Table 4). Children from mothers with high school education also produced more predicates than children from mothers with less than high school education ($p = .056$). The remaining pairwise comparisons were not significant ($p > .05$).

Regarding this second age group, multivariate results also indicated that the effect of day care attendance was not significant, $T = 0.016$, $F(12, 2954) = 1.346$, $p = .185$, partial $\eta^2 = .005$. The MANCOVA results also indicated that the effect of interaction between maternal education and day care attendance was not significant, $T = 0.043$, $F(36, 3938) = 1.181$, $p = .212$, partial $\eta^2 = .011$.

Discussion and conclusion

This study aimed to investigate the effects of maternal education and day care attendance on the lexical development of toddlers aged 16–30 months old, considering the results obtained in the large-scale study of validation of the Macarthur–Bates Communicative Development Inventory: Words and Sentences for European Portuguese. The analyses were conducted separately for two age groups (equal or less than 23 months old; equal or greater than 24 months old) and the results suggest that the effects across the investigated age range are not constant.

Regarding the effects of maternal education in the older group ($\geqslant$ 24 months old), the results of this study indicated that toddlers of more educated mothers produced more words in general as well as more social terms, common nouns, predicates and function words. With the exception of the results for the production of predicates, differences were mainly observed between the group with less educated mothers (less than high school education) and the two groups with more educated mothers, who had a higher education degree (undergraduate or graduate). As said before, the mechanisms underlying the relationship between maternal education and children's linguistic development are well known and are mainly related with the quantity and quality of the input that mothers provide to their children (Huttenlocher, Vasilyeva, Waterfall, Vevea, & Hedges, 2007). However, other SES-related characteristics also seem to be involved. Recent research has shown that parents with higher SES have a greater knowledge of child development and greater verbal facility, which, in turn, predicts children's linguistic

growth positively (Rowe, 2008). It is not clear which of these factors contributed to the effect of maternal education in our study.

However, the results for the younger group of toddlers (⩽ 23 months old) indicated that maternal education only had a significant effect on the number of common nouns produced. Some studies conducted with English-speaking middle-class families indicate that, at early stages of lexical development, mothers engage frequently in 'object-naming games' with their young children, eliciting and giving feedback regarding the production of object names, which are mainly common nouns (Goldfield, 1993; Nelson, Hampson, & Shaw, 1993). It is possible that mothers from lower educational levels do not engage so frequently in this type of game, thus leading to differences in the production of common nouns by the toddlers. The examination of the type of interactions between mothers and their young children could provide a more clear insight on this issue.

The non-existence of maternal education effects on the production of other types of words may be due to the fact that words from categories such as predicates and function words are scarce in the toddlers' lexicons in the early stages of vocabulary development. Thus, the lack of group differences could be a consequence of the low number of predicates and function words produced. At these early stages, children's lexicons are mostly composed of social terms and common nouns (Caselli, Casadio, & Bates, 1999; Rescorla, Nyame, & Dias, 2016; Schults et al., 2012; Stolt, Haataja, Lapinleimu, & Lehtonen, 2008). However, significant differences were observed for the production of common nouns, but no differences in the production of social terms were observed as a function of maternal education. This finding is similar to the results observed for Estonian-speaking children by Schults et al. (2012), who found a significant effect of maternal education on the production of nouns, but no effect on social terms in a younger sample than ours (8–16 months). The reasons for the absence of differences in the number of social terms produced by children as a function of maternal education might be related with the type of words used by parents in their child-directed speech. Research results have suggested that higher parental education is related to the use of a more sophisticated vocabulary by parents, as measured by the use of rare words, which in turn is associated with larger vocabularies of children in the future (Rowe, 2012). Social terms are words related mainly with daily routines, games and people and are therefore quite common and widely used. Therefore, it is possible that the growth of other lexical categories is more prone to the sophistication of the vocabulary used by adults than the growth of the production of social terms, at least at an early stage of vocabulary development.

Another important result of this study was that the effect size of maternal education was extremely small, explaining less than 2% of the variance observed in children's word production. This effect size is very similar to those obtained in other studies which compared the word production of toddlers from mothers with different educational levels using the CDI: for example, in the American CDI (Fenson et al., 2007), after controlling for toddlers' age, maternal education accounted for 0.6% of the variance in toddlers' word production, whereas in the Mexican CDI (Jackson-Maldonado et al., 2003), maternal education accounted for 2% of the variance in word production, also after controlling for toddlers' age. The effects obtained in these studies were quite similar to the ones obtained in our study, even with differences in the composition of the samples: both previous studies (Fenson et al., 2007; Jackson-Maldonado et al., 2003) included children

who attended and who did not attend day care centres (and this variable was not controlled for in the analyses), whereas our study included only children attending day care centres. Some other studies obtained larger effect sizes for maternal education. For example, using a sample aged between 16 and 31 months old, Hoff (2003) found that maternal education explained about 5% of the variance in the number of words produced by toddlers, after accounting for birth order and vocabulary measured 10 months earlier. However, several characteristics of Hoff's study prevent a direct comparison between its results and the results of our study: the sample was composed of toddlers whose primary caretaker was the mother, measures of spontaneous speech instead of parental reports were used for data collection and age was not controlled for in the analyses. Additionally, it is possible that the percentage of variance explained would increase if other variables were also considered in our study. Research has shown that other factors related specifically with the type of mother–child interactions, such as mother's responsiveness, explain an additional and important percentage of variance in children's expressive vocabulary (Tamis-LeMonda, Kuchirko, & Song, 2014). Furthermore, lexical development is very complex and depends not only on environmental factors, but also on genetic factors or even on the interaction of gene-environment variables, as has been argued in research (Dale, Tosto, Hayiou-Thomas, & Plomin, 2015; Rogers et al., 2015).

Regarding the effects of day care attendance, our results indicated that the quantity of day care attendance did not have an effect on the number of words produced by the toddlers at any age stage, whether considering total words or specific lexical categories. This finding is not in accordance with the results of other studies conducted in different countries that suggested a positive effect of the quantity of day care attendance on children's linguistic abilities (e.g. Christian et al., 1998; NICHD Early Child Care Research Network, 2000). Although the NICHD study indicated positive effects of cumulative experience in day care centres on children's linguistic development, it also highlighted the fact that caregivers' use of speech was predictive of the linguistic skills of children up to three years old: 'more stimulation from the caregiver – asking questions, responding to vocalizations, and other forms of talking – was linked to somewhat better cognitive and language development' (NICHD Early Child Care Research Network, 2006, p. 12). Including measures of child-directed speech, responsiveness and language stimulation practices implemented by caregivers in day care – whether these are educators or assistants – could provide more clear insights into this issue, given the demonstrated importance of the input that children receive (Goodman, Dale, & Li, 2008; Hurtado, Marchman, & Fernald, 2008; Newman, Rowe, & Bernstein Ratner, 2016; Weisleder & Fernald, 2013). Using a more fine-grained measure of day care attendance, such as hours of attendance per week, and/or using measures of day care quality could also yield different results.

Another interesting result was that no interaction effects between maternal education and day care attendance were found. Previous research has shown that children from low SES who have more experience in centre-based care have better cognitive and linguistic skills in the long term (Broberg, Wessels, Lamb, & Hwang, 1997; Caughy et al., 1994; Christian et al., 1998). However, it has been argued that these effects might be confounded by the quality of the programmes implemented in day care centres and other characteristics of families (NICHD Early Child Care Research

Network, 2000). The participants in our study were sampled from approximately 200 Portuguese day care institutions. These institutions probably reflect a wide range of practices and programme quality. Additionally, in Portugal, most of the day care centres for children up to three years old are private but co-financed by governmental (public) funds. Therefore, the amount of the fees that parents pay depends on the family's income; very low-income families do not pay any fee. As a consequence, most of the day care centres receive children from very different SES levels, and high-quality day care programmes are not implemented only with children from the same SES level. Therefore it is possible that day care quality, and the mix of children, differed more than in previous studies, making it harder to observe differential effects of day care attendance as a function of SES.

The main limitation of this study is that information was collected using only parental reports. Although parental reports are widely used in children's language research, some concerns have been raised regarding reporting biases of parents from different SES. The results of several studies (e.g. Feldman et al., 2000; Fenson et al., 2007; Jackson-Maldonado et al., 2003) indicate that parents with lower educational levels often over-report their children's CDI comprehension scores. However, this is not the case for the reports of children's word production, given that no evidence of SES-related reporting bias has been observed. The finding that word comprehension is more prone to over-reporting than word production can be explained by the fact that it is easier to notice what a child produces, as it is promptly observed, than to infer what the child understands, as different individuals can have distinct interpretations of the possible behaviours that suggest that a word is comprehended (Dockrell & Messer, 1999). Thus, research results indicate that the CDI is a valid and reliable tool to measure expressive vocabulary (Bleses et al., 2008; Dale, 1991; Fenson et al., 2007; O'Toole & Fletcher, 2010; Pérez-Pereira & Resches, 2011).

Although sufficient validity and reliability have been demonstrated for this measure of word production, some concerns have also been raised regarding precision in reporting the production of words from some lexical categories. For example, it has been argued that 'it might be easier for the parents to notice and remember the words their children use to name objects than those used to label actions or to describe objects' (Schults et al., 2012, p. 679). Nevertheless, parental reports have advantages over other methods for assessing children's linguistic abilities: they enable data collection from large samples and provide a more representative picture of children's abilities. Parents can observe and have access to a wide range of situations that professionals cannot, given that they observe children during a limited amount of time and usually in contexts unfamiliar to the child (Jackson-Maldonado et al., 2003).

To conclude, this study reinforces the body of research that suggests that maternal education is one fair predictor of children's lexical abilities in the first years of life, but also demonstrates that the cumulative experience in day care centres is not associated *per se* to better lexical outcomes. However, we must highlight that this is not a study of the overall population of children in this age range, but a study focusing on children who are attending day care centres. As a consequence, findings cannot be generalized to children not attending day care services.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported by European Regional Development Fund (FEDER) through the European programme COMPETE (Operational Programme for Competitiveness Factors), under the National Strategic Reference Framework (QREN) - FCOMP-01-0124-FEDER-029556, by FCT (Fundação para a Ciência e a Tecnologia PTDC/MHC-PED/4725/2012) and by the Research Centre on Child Studies (CIEC-UM, reference POCI-01-0145-FEDER-007562). The first and second authors are also supported by grants SFRH/BPD/102549/2014 and SFRH/BD/86795/2012 from FCT.

Note

1. Data from Census 2011.

ORCID iD


Irene Cadime https://orcid.org/0000-0001-8285-4824

References

Andonova, E. (2015). Parental report evidence for toddlers' grammar and vocabulary in Bulgarian. *First Language*, *35*, 126–136.

Bleses, D., Vach, W., Slott, M., Wehberg, S., Thomsen, P., Madsen, T. O., & Basbøll, H. (2008). The Danish communicative developmental inventories: Validity and main developmental trends. *Journal of Child Language*, *35*, 651–669.

Bornstein, M. H., Cote, L. R., Maital, S., Painter, K., Park, S. Y., Pascual, L., & Vyt, A. (2004). Cross-linguistic analysis of vocabulary in young children: Spanish, Dutch, French, Hebrew, Italian, Korean, and American English. *Child Development*, *75*, 1115–1139.

Broberg, A. G., Wessels, H., Lamb, M. E., & Hwang, C. P. (1997). Effects of day care on the development of cognitive abilities in 8-year-olds: A longitudinal study. *Developmental Psychology*, *33*, 62–69.

Caselli, M. C., Bates, E., Casadio, P., Fenson, J., Fenson, L., Sanderl, L., & Weir, J. (1995). A cross-linguistic study of early lexical development. *Cognitive Development*, *10*, 159–199.

Caselli, M. C., Casadio, P., & Bates, E. (1999). A comparison of the transition from first words to grammar in English and Italian. *Journal of Child Language*, *26*, 69–111.

Caughy, M., Dipietro, J. A., & Strobino, M. (1994). Day-care participation as a protective factor in the cognitive development of low-income children. *Child Development*, *65*, 457–471.

Christian, K., Morrison, F. J., & Bryant, F. B. (1998). Predicting kindergarten academic skills: Interactions among child care, maternal education, and family literacy environments. *Early Childhood Research Quarterly*, *13*, 501–521.

Dale, P. S. (1991). The validity of a parent report measure of vocabulary and syntax at 24 months. *Journal of Speech, Language, and Hearing Research*, *34*, 565–571.

Dale, P. S., Tosto, M. G., Hayiou-Thomas, M. E., & Plomin, R. (2015). Why does parental language input style predict child language development? A twin study of gene-environment correlation. *Journal of Communication Disorders*, *57*, 106–117.

Dockrell, J., & Messer, D. (1999). *Children's language and communication difficulties: Understanding, identification and intervention*. London, England: Continuum.

Ensminger, M. E., & Fothergill, K. (2003). A decade of measuring SES: What it tells us and where to go from here. In M. H. Bornstein, & R. H. Bradley (Eds.), *Socioeconomic status, parenting, and child development* (pp. 13–27). Mahwah, NJ: Lawrence Erlbaum.

European Commission. (2013). *Barcelona objectives: The development of childcare facilities for young children in Europe with a view to sustainable and inclusive growth*. Luxembourg City: Publications Office of the European Union.

Feldman, H. M., Dollaghan, C., Campbell, T., Kurs-Lasky, M., Janosky, J., & Paradise, J. (2000). Measurement properties of the MacArthur Communicative Development Inventories at ages one and two years. *Child Development*, *71*, 310–322.

Fenson, L., Marchman, V., Thal, D., Dale, P. S., Reznick, J. S., & Bates, E. (2007). *MacArthur–Bates Communicative Development Inventories: Users guide and technical manual* (2nd ed.). Baltimore, MD: Paul H Brookes.

Goldfield, B. A. (1993). Noun bias in maternal speech to one-year-olds. *Journal of Child Language*, *20*, 85–99.

Goodman, J. C., Dale, P. S., & Li, P. (2008). Does frequency count? Parental input and the acquisition of vocabulary. *Journal of Child Language*, *35*, 515–531.

Hart, B., & Risley, T. (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore, MD: Brookes Publishing.

Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development*, *74*, 1368–1378.

Hoff-Ginsberg, E. (1991). Mother–child conversation in different social classes and communicative settings. *Child Development*, *62*, 782–796.

Hurtado, N., Marchman, V. A., & Fernald, A. (2008). Does input influence uptake? Links between maternal talk, processing speed and vocabulary size in Spanish-learning children. *Developmental Science*, *11*, 1–16.

Huttenlocher, J., Vasilyeva, M., Waterfall, H. R., Vevea, J. L., & Hedges, L. V. (2007). The varieties of speech to young children. *Developmental Psychology*, *43*, 1062–1083.

Huttenlocher, J., Waterfall, H. R., Vasilyeva, M., Vevea, J., & Hedges, L. V. (2010). Sources of variability in children's language growth. *Cognitive Psychology*, *61*, 343–365.

Jackson-Maldonado, D., Thal, D., Marchman, V., Fenson, L., Newton, T., & Conboy, B. T. (2003). *CDI Inventarios MacArthur–Bates del Desarrollo de Habilidades Comunicativas* [CDI MacArthur–Bates Communicative Development Inventories]. Baltimore, MD: Brookes Publishing.

Kern, S. (2007). Lexicon development in French-speaking infants. *First Language*, *27*, 227–250.

Marjanovič-Umek, L., Fekonja-Peklaj, U., & Podlesek, A. (2013). Characteristics of early vocabulary and grammar development in Slovenian-speaking infants and toddlers: A CDI-adaptation study. *Journal of Child Language*, *40*, 779–798.

National Institute of Child Health and Human Development Early Child Care Research Network. (2000). The relation of child care to cognitive and language development. *Child Development*, *71*, 960–980.

National Institute of Child Health and Human Development Early Child Care Research Network. (2006). *The NICHD study of early child care and youth development: Findings for children up to age 4 1/2 years*. Washington, DC: U.S. Government Printing Office.

Nelson, K., Hampson, J., & Shaw, L. K. (1993). Nouns in early lexicons: Evidence, explanations and implications. *Journal of Child Language*, *20*, 61–84.

Newman, R. S., Rowe, M. L., & Bernstein Ratner, N. (2016). Input and uptake at 7 months predicts toddler vocabulary: The role of child-directed speech and infant processing skills in language development. *Journal of Child Language*, *43*, 1158–1173.

O'Toole, C., & Fletcher, P. (2010). Validity of a parent report instrument for Irish-speaking toddlers. *First Language*, *30*, 199–217.

Papaeliou, C. F., & Rescorla, L. (2011). Vocabulary development in Greek children: A cross-linguistic comparison using the Language Development Survey. *Journal of Child Language*, *38*, 861–887.

Pérez-Pereira, M., & Resches, M. (2011). Concurrent and predictive validity of the Galician CDI. *Journal of Child Language*, *38*, 121–140.

Rescorla, L., Nyame, J., & Dias, P. (2016). Vocabulary development in European Portuguese: A replication study using the Language Development Survey. *Journal of Speech, Language and Hearing Research*, *59*, 1484–1490.

Rogers, C. R., Nulty, K. L., Betancourt, M. A., & DeThorne, L. S. (2015). Causal effects on child language development: A review of studies in communication sciences and disorders. *Journal of Communication Disorders*, *57*, 3–15.

Rowe, M. L. (2008). Child-directed speech: Relation to socioeconomic status, knowledge of child development and child vocabulary skill. *Journal of Child Language*, *35*, 185–205.

Rowe, M. L. (2012). A longitudinal investigation of the role of quantity and quality of child-directed speech in vocabulary development. *Child Development*, *83*, 1762–1774.

Schults, A., Tulviste, T., & Konstabel, K. (2012). Early vocabulary and gestures in Estonian children. *Journal of Child Language*, *39*, 664–686.

Silva, C., Cadime, I., Ribeiro, I., Santos, S., Santos, A. L., & Viana, F. L. (2017). Parents' reports of lexical and grammatical aspects of toddlers' language in European Portuguese: Developmental trends, age and gender differences. *First Language*, *37*, 267–284.

Stolt, S., Haataja, L., Lapinleimu, H., & Lehtonen, L. (2008). Early lexical development of Finnish children: A longitudinal study. *First Language*, *28*, 259–279.

Stolt, S., Klippi, A., Launonen, K., Munck, P., Lehtonen, L., Lapinleimu, H., & Haataja, L. (2007). Size and composition of the lexicon in prematurely born very-low-birth-weight and full-term Finnish children at two years of age. *Journal of Child Language*, *34*, 283–310.

Tamis-LeMonda, C. S., Kuchirko, Y., & Song, L. (2014). Why is infant language learning facilitated by parental responsiveness? *Current Directions in Psychological Science*, *23*, 121–126.

Viana, F. L., Cadime, I., Silva, C., Santos, A. L., Ribeiro, I., Santos, S., & Monteiro, J. (2017). *MacArthur–Bates Inventários de Desenvolvimento Comunicativo* [MacArthur–Bates Communicative Development Inventories]. Maia, Portugal: Lusoinfo.

Weisleder, A., & Fernald, A. (2013). Talking to children matters: Early language experience strengthens processing and builds vocabulary. *Psychological Science*, *24*, 2143–2152.