

Communicative Function of Pointing and Expressive Vocabulary Acquisition

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Abstract: There is evidence of a strong association between the pointing gesture and early vocabulary acquisition. This study examined the extent to which this association is moderated by the communicative function of children's pointing. A total of 35 children participated in the study. Their use of the pointing gesture and their expressive vocabulary were assessed at 13 and 18 months using the Early Social Communication Scales and the MacArthur-Bates Communicative Development Inventory, respectively. The results of multiple linear regression analyses indicated that variations in the frequency of declarative pointing at 13 months significantly contributed to variations in vocabulary size at both 13 and 18 months, independently of variations in maternal education. In contrast, variations in the frequency of imperative pointing did not concurrently or longitudinally correlate with children's vocabulary sizes. These results suggest that the relation between pointing and early vocabulary acquisition is moderated by the communicative function of the pointing gesture.

Keywords: gestures, language development, vocabulary, pre-verbal communication

A Função Comunicativa do Apontar e a Aquisição do Vocabulário Expressivo

Resumo: Há evidência de forte associação entre o gesto de apontar e a aquisição inicial do vocabulário. Este estudo teve por objetivo examinar em que medida essa associação é moderada pela função comunicativa do gesto de apontar. Participaram do estudo 35 crianças. O uso do gesto de apontar e o vocabulário expressivo foram avaliados aos 13 e 18 meses através das Escalas de Comunicação Social Inicial e do Inventário MacArthur-Bates de Desenvolvimento Comunicativo, respectivamente. Análises de regressão linear múltipla mostraram que variações na frequência do apontar declarativo aos 13 meses contribuíram significativamente para variações no vocabulário aos 13 e 18 meses, independentemente de diferenças na educação materna. Por outro lado, variações na frequência do apontar imperativo não se correlacionaram, concorrentemente ou longitudinalmente, com variações no vocabulário das crianças. Esses resultados sugerem que a relação entre o apontar e a aquisição do vocabulário é moderada pela função comunicativa do gesto de apontar.

Palavras-chave: gestos, desenvolvimento da linguagem, vocabulário, comunicação pré-verbal

La función Comunicativa del Señalar y la Adquisición del Vocabulario Expresivo

Resumen: Hay evidencia de fuerte asociación entre el gesto de señalar y la adquisición temprana del vocabulario. Este estudio tuvo como objetivo examinar en que medida esa asociación es moderada por la función comunicativa del señalar. Participaron del estudio 35 niños. El uso del señalar y el vocabulario expresivo fueron evaluados a los 13 y 18 meses con las Escalas de Comunicación Social Temprana y el Inventario MacArthur-Bates de Desarrollo Comunicativo, respectivamente. Análisis de regresión lineal múltiple mostraron que variaciones en la frecuencia del señalar declarativo a los 13 meses contribuyeron significativamente para variaciones en el vocabulario a los 13 y 18 meses, independientemente de diferencias en la educación materna. En cambio, variaciones en el señalar imperativo no se correlacionaron, concurrentemente o longitudinalmente, con diferencias de vocabulario entre los niños. Esos resultados sugieren que la función comunicativa del señalar modera la relación entre ese gesto y la adquisición del vocabulario.

Palabras clave: gestos, desarrollo del lenguaje, vocabulario, comunicación preverbal

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Numerous studies have examined the role of communicative gestures in language acquisition in recent years. One reason for this interest is the observation that these gestures not only contribute to communicating meanings but are intimately associated with the use of language from the beginning of development (Goldin-Meadow, 2015). Among children's first communicative gestures, pointing has undoubtedly been the primary focus in the literature on early language development (Butterworth, 2003; Colonnese, Stams, Koster, & Noom, 2010, for a meta-analysis). In the present study, we evaluated the relation between pointing

and the development of expressive vocabulary between 13 and 18 months of age in a group of Brazilian children. We were particularly interested in examining the hypothesis that that relation is moderated by the communicative function of the pointing gesture (Colonnesi et al., 2010). To the best of our knowledge, this is the first study to examine this issue in Brazil.

The pointing gesture, defined as the extension of the hand and the index finger toward a specific object or event, emerges between 7 and 15 months of age (Colonnesi et al., 2010). It clearly expresses a communicative intention from the beginning. In fact, pointing is not only frequently accompanied by vocalizations, but also by alternations in the child's gaze between an object or event in the environment and his or her interlocutor (Donnellan, Bannard, McGillion, Slocombe, & Matthews, 2020). However, its function goes far beyond nonverbal communication (Butterworth, 2003). In fact, judging from the results of studies conducted in the last four or five decades, the pointing gesture has a key role in language development.

Both cross-sectional and longitudinal studies have identified a robust correlation between pointing and early language acquisition in both children with typical development (TD) (Colonnesi et al., 2010) and children with developmental disorders, including Autism Spectrum Disorder (ASD) (Harbison, McDaniel, & Yoder, 2017, for a meta-analysis), Down syndrome (Dimitrova, Özçalışkan, & Adamson, 2016) and Williams syndrome (Becerra & Mervis, 2019). Furthermore, there is evidence that the relation between pointing and measures of language development is not an artifact of individual differences in potentially important factors such as maternal education (Manwaring et al., 2019) or initial language development (Becerra & Mervis, 2019; Rowe & Goldin-Meadow, 2009).

Despite this evidence, not all studies have found a significant association between pointing and early language development (Colonnesi et al., 2010), suggesting that the existence of this association or its intensity is moderated by other factors. According to Colonnesi et al. (2010), an important moderating factor is the motivation or communicative function of the pointing gesture.

Two types of motivation have often been attributed to the pointing gesture in the literature on early language development (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979): the declarative and the imperative. Pointing is considered a declarative gesture when the child's intention is simply to show or share something with others around them. On the other hand, it is considered an imperative gesture when his or her intention is to direct the behavior of other people for the child's own benefit in order to achieve some objective, for example, a desired toy. Meta-analyses such as those by Colonnesi et al. (2010) of children with TD from 15 to 20 months of age and Harbison et al. (2017) of children with ASD from 18 to 89 months, describe significant associations between declarative but not imperative pointing and oral language acquisition ($r = 0.34$ for declarative vs. $r = 0.04$, for imperative pointing; Colonnesi et al., 2010).

Taken together, these results suggest that the association between pointing and language acquisition is limited to declarative pointing. However, the reasons for this are not clear. In fact, both the declarative and the imperative pointing gestures are used in the context of shared attention and both have a clear communicative intention. In other words, both seem to reflect children's understanding that people are intentional beings whose mental states can be manipulated and shared – an important sociocognitive skill not only for the development of the ability to use pointing gestures communicatively but also for the development of oral language (Bates et al., 1979; Salo, Rowe, & Reeb-Sutherland, 2018; Tomasello, Carpenter, & Liszkowski, 2007). Tomasello et al. (2007) have argued that this understanding is the main factor behind the association between the pointing gesture and language acquisition.

Likewise, given that both types of pointing are often followed by verbal information about the child's focus of attention, they both should create opportunities for language learning (Donnellan et al., 2020). How, then, can the different results found for these two types of pointing be explained? Harbison et al. (2017) suggested that the lack of a significant association between imperative pointing and language development in their study might have resulted from inadequate statistical power. Furthermore, relatively few prior studies investigated the relation between imperative pointing and language development (Colonnesi et al., 2010; Harbison et al., 2017). In view of this limitation, it is not surprising that Harbison et al. (2017) called for further studies to examine the relation between imperative pointing and oral language development measures.

The results of at least two recent studies suggest that examination of this relation is important. Özçalışkan, Adamson and Dimitrova (2016) evaluated the correlation between pointing and subsequent language development in two groups: a group of children with TD and a group of children with ASD. The pointing gesture was evaluated in different communicative contexts arranged in such a way as to encourage the use of declarative pointing (e.g., interactive reading of picture books) or imperative pointing (e.g., toys placed on a high shelf, out of the child's reach). In both groups, variations in the frequency with which children pointed to objects or events around them significantly predicted further language development, regardless of context. Similar results were found by Lüke, Grimminger, Rohlfing, Liszkowski and Ritterfeld (2017) in a study of German-learning children with and without language delay. In the present study, we evaluated the extent to which these results can be generalized to pointing gestures encoded as declarative or imperative, not only based on the context in which they occur, but also as a function of the child's behavior when interacting with an adult in a situation involving various types of activities.

Similar to the work by Lüke, Grimminger et al. (2017) and Özçalışkan et al. (2016), the present study was longitudinal and evaluated the association between children's use of pointing gestures with a declarative or imperative function and their vocabulary acquisition between 13 and 18 months of age. This study aimed to examine the extent to which this

association is moderated by the communicative function of the pointing gesture. As described above, the results of prior studies examining this issue are contradictory. The present study will contribute to elucidating the role played by the communicative function of the pointing gesture in early vocabulary development.

Method

Participants

A total of 35 children (26 girls and 9 boys) from middle to upper-middle class families in Belo Horizonte-MG participated in the study. They were recruited just before they were 9 months of age with the help of pediatricians. Only children born at term and who were developing normally according to their pediatricians were included. Assessments took place in the children's homes at three different times: at 9 ($M = 278.11$ days, $SD = 7.16$ days), 13 ($M = 300.97$ days, $SD = 4.68$ days) and 18 months of age ($M = 403.97$ days, $SD = 6.02$ days). Only the data collected at ages 13 and 18 months were included in the present study. Data were collected between November 2006 and December 2007.

Instruments

The Early Social Communication Scales (ESCS) (Mundy et al., 2003) evaluate the development of nonverbal communication in children aged 8 to 30 months. The scales consist of a series of semi-structured activities involving toys and figures with the objective to stimulate communicative behaviors from the child. Only pointing gestures and words spontaneously produced by the children during the ESCS were coded. Unintelligible utterances were not coded.

Pointing was defined as the extension of the index finger toward an object, with the other fingers folded in the direction of the palm of the hand. Following the criteria specified in the ESCS manual, pointing was classified as a declarative gesture when children pointed to moving objects, figures on the wall or in a book. The declarative pointing gesture was often accompanied by verbalizations such as "Look" or simply "Oh". On the other hand, pointing was classified as an imperative gesture when the child pointed to a mechanical toy immediately after it stopped moving or used the pointing gesture together or alternately with other behaviors which indicated their desire to obtain an object (e.g., a reaching gesture or the verbalization "Give").

The total number of pointing gestures produced by the child during the ESCS administration was calculated separately for declarative and imperative gestures. Only spontaneous pointing gestures (i.e., those which were not immediately preceded by pointing gestures produced by the examiner or the child's mother) were included. All pointing gestures were coded by the second author. To check the reliability of the measures, the first author independently coded 18 randomly chosen ESCS administrations (nine at

13 months and nine at 18 months). The reliability indexes were obtained by dividing the total number of agreements by the sum of agreements and disagreements between the two coders. These indexes were 0.89 at 13 months and 0.79 at 18 months for imperative pointing and 0.81 at 13 months and 0.88 at 18 months for declarative pointing.

The children's spontaneous verbalizations during the ESCS administration were used to calculate the total number of words (hereafter, tokens) and the number of different words (hereafter, types) that the children produced. The reliability indices for the number of tokens and types of words were calculated in the same way as for pointing gestures. They were: 0.70 at 13 months and 0.87 at 18 months for word tokens and 0.71 at 13 months and 0.83 at 18 months for word types.

Brazilian version of the MacArthur-Bates Communicative Development Inventory - Words and Sentences (CDI-II) (Silva, 2006). The CDI-II (Fenson et al., 1993) is a parent-report inventory used to assess language development between 16 and 30 months of age. The inventory is divided into two parts. In the first, parents or caregivers are asked to indicate from a list of words those that the child produces spontaneously. The list in the Brazilian version is made up of 737 words including sound effects, nouns, social formulas, adjectives, adverbs, verbs, articles, prepositions, etc. The second part includes a series of questions about syntactic and morphological development. Only the vocabulary checklist was included in the present study.

The mothers completed the first part of the CDI-II at all sessions. The total number of words they indicated when the children were 13 and 18 months old was used as a measure of expressive vocabulary. Children's expressive vocabulary size at 13 months was significantly correlated with their expressive vocabulary size at 18 months ($r = 0.70$, $p < 0.01$).

In order to examine the validity of the Brazilian version of the CDI-II, we calculated the correlations between children's vocabulary as measured by the CDI-II and the number of word types they produced during the ESCS administration at the same or different ages. All correlations were moderate or high (r s ranging between 0.53 and 0.72, all p s < 0.01).

Socioeconomic Questionnaire. At the beginning of the study, the mothers also completed a questionnaire about the family's monthly income and both parents' educational level and profession. Maternal education level was used as an indicator of socioeconomic level, since there is evidence that it is one of the socioeconomic indicators most consistently associated with variations in children's vocabulary, in addition to being closely correlated with the other indicators (Rowe, 2008). The mothers were classified as having at least a bachelor degree ($N = 22$) or not ($N = 13$). Among those who did not have a bachelor degree, 12 had completed high school and one had completed primary school.

Procedures

Data collection. The ESCS was administered during home visits in a room in the residence with an empty table. The child sat on the mother's lap in a chair on the

opposite side of the table from the examiner's chair during the procedure. The mother was instructed to avoid interacting with the child during the administration of the scales. Only the mother, the child, the examiner and an assistant responsible for handling a video recording camera were in the room during the administration of the scales. The objects used were kept within the examiner's reach but out of the child's field of vision. The administration lasted approximately 20 minutes and was filmed for later coding of the children's speech and gestures. The child's mother completed the first part of the CDI-II after the administration of the ESCS, with the help of the examiner.

Data analysis. Pearson correlations were performed to examine the associations between declarative and imperative pointing gestures, vocabulary and maternal education level. When relevant, multiple linear regression analyses were also performed to assess the contribution of variations in children's pointing gestures to individual differences in their vocabulary after controlling for the contribution of the other variables included in the present study.

Ethical Considerations

The data reported in this study were collected as part of a collaborative project involving the Department of Psychology at the University of Texas in Austin, USA, and the Department of Psychology at the Universidade

Federal de Minas Gerais. The project was approved by the Institutional Review Board of the University of Texas (IRB No. 2004-12-038) and by the Review Board of the Universidade Federal de Minas Gerais (No. 049/06).

Results

Table 1 shows the descriptive statistics for pointing gestures, number of word tokens and word types during the ESCS administration, and the number of words in the child's expressive vocabulary, separately for 13 and 18 months of age. The distributions differed significantly from the normal distribution for all variables (all $ps < 0.01$, Shapiro-Wilk test). In particular, number of word types and word tokens and numbers of both types of pointing gestures at 13 months showed strong positive asymmetry, with many children not manifesting these behaviors during the ESCS administration or doing so at a very low frequency. For example, at 13 months, 20 children did not produce an imperative pointing gesture, 11 did not produce a declarative pointing gesture, and 17 did not produce any words during the ESCS administration. At 18 months, 11 children did not produce any imperative pointing gestures and eight did not produce any declarative pointing gestures. In addition, one child's expressive vocabulary at 13 months was more than 3 SDs greater than the group mean.

Table 1

Descriptive Statistics for Pointing Gestures, Word Tokens and Types, and Vocabulary at 13 and 18 Months of Age

Measure	Mean	Median	SD	Range	Skewness	Kurtosis
13 months						
Imperative pointing	1.26	0	2.21	0 – 8	2.00	2.97
Declarative pointing	4.11	2	6.25	0 – 26	2.11	4.13
Word Tokens	5.06	1	8.92	0 – 41	2.70	8.06
Word Types	1.43	1	1.84	0 – 6	1.01	0.36
CDI-Vocabulary	12.03	10	8.25	0 – 43	1.78	4.70
18 months						
Imperative pointing	2.69	1	3.64	0 – 16	2.16	5.10
Declarative pointing	5.11	4	5.83	0 – 23	1.82	3.23
Word Tokens	31.37	15	35.61	0 – 132	1.31	1.27
Word Types	7.43	5	8.67	0 – 42	2.34	6.73
CDI-Vocabulary	88.69	50	83.81	9 – 320	1.35	0.94

Note. $N = 35$.

In view of the observed skewness, we performed logarithmic transformations as recommended by Field (2009). After being transformed, most variables showed skewness and kurtosis values between ± 1.5 , and the distribution for the vocabulary measure at 18 months did not differ significantly from the normal distribution. However, the kurtosis value

for the vocabulary measure at 13 months remained > 3.5 , even after logarithmic transformation. To address this problem, vocabulary scores were winsorized to two standard deviations from the mean as recommended by Field (2009). After this procedure, the vocabulary measure at 13 months showed appropriate skewness and kurtosis values.

Both vocabulary and the use of gestures and verbalizations during the ESCS administration increased over the course of the study. Declarative pointing was significantly correlated with imperative pointing on both occasions, as shown in Table 2. Declarative pointing at 13 months, but not imperative pointing, significantly correlated with children’s vocabulary at both 13 and 18 months. On the other hand, neither declarative

pointing nor imperative pointing at 18 months significantly correlated with the children’s vocabulary at the same time.

Level of maternal education was not significantly associated with children’s vocabulary as measured by the CDI-II at either 13 or 18 months of age. Likewise, except for declarative pointing at 13 months of age, maternal education was not significantly correlated with children’s pointing gestures.

Table 2

Bivariate Correlations Among Pointing Gestures, Word Tokens and Types, and Children Vocabulary at 13 and 18 Months of Age

Measures	2	3	4	5	6	7	8	9	10	11
13 months										
1. Imperative Pointing	.57**	.05	-.01	.22	.23	.09	.33	.22	.13	.19
2. Declarative Pointing	1	.19	.18	.48*	.35*	.19	.31	.25	.40*	.36*
3. Word Tokens		1	.89**	.55*	-.03	.11	.40*	.53*	.50*	.20
4. Word Types			1	.53*	-.05	.06	.43*	.55*	.57**	.34*
5. Vocabulary				1	.19	.25	.54*	.54*	.70**	.20
18 months										
6. Imperative Pointing					1	.52*	.04	-.10	.12	-.27
7. Declarative Pointing						1	.04	.10	.15	-.06
8. Word Tokens							1	.89**	.64**	.16
9. Word Types								1	.72**	.16
10. Vocabulary									1	.29
11. Maternal Education										1

Note. * $p < .05$; ** $p < .001$.

In view of these results, three multiple linear regression analyses were subsequently performed. The first examined the extent to which variations in the declarative pointing gesture at 13 months explained differences in the children’s vocabulary at the same time, controlling for maternal education level (Table 3). The other two examined whether variations in the frequency of declarative pointing gestures at 13 months contributed significantly to individual differences in vocabulary at 18 months, after controlling for the effect of maternal education level and vocabulary at 13 months (Table 4). Only maternal education and the child’s declarative pointing were included in the regression in the first model, while the child’s vocabulary at 13 months was

included in addition to these variables in the second model. The independent variables in all analyses were entered into the regression simultaneously. The assumptions for performing a linear regression were met for all models.

As can be seen in Table 3 and Table 4 (Model 1), declarative pointing at 13 months predicted individual differences in children’s vocabulary at both 13 and 18 months, even after controlling for the effect of maternal education level. However, after the children’s vocabulary at 13 months was included in the regression (Table 4, Model 2), declarative pointing no longer significantly contributed to individual differences in children’s vocabulary at 18 months ($t = 0.31, p = 0.76$).

Table 3

Multiple Linear Regression: Predicting Vocabulary at 13 Months Controlling for Maternal Education

Predictor	B	t	p-value	95% CI for B	Semi-partial r
Constant	2.08	12.98	< .01	[1.76; 2.41]	
Maternal Education	0.05	0.24	.81	[- 0.36; 0.45]	.04
Declarative pointing at 13 months	0.27	2.80	.01	[0.07; 0.46]	.43

R^2 Adjusted = .18; $F(2, 32) = 4.80, p = .015$

Note. $N = 35$; $CI =$ Confidence Interval.

Table 4

Multiple Linear Regression: Predicting Vocabulary at 18 Months Controlling for Maternal Education and Vocabulary at 13 Months

Model 1					
Predictor	<i>B</i>	<i>t</i>	<i>p</i> -value	95% <i>CI</i> for <i>B</i>	<i>Semi-partial r</i>
Constant	3.52	12.98	< .01	[2.96; 4.07]	
Maternal Education	0.32	0.95	.35	[- 0.36; 1.00]	.15
Declarative pointing at 13 months	0.33	2.03	.05	[0.00; 0.65]	.32
Adjusted $R^2 = .14$; $F(2, 32) = 3.69$, $p = .036$					
Model 2					
Constant	1.30	2.43	.02	[0.21; 2.39]	
Maternal Education	0.27	1.02	.32	[- 0.27; 0.81]	.13
Vocabulary at 13 months	1.06	4.51	< .01	[0.58; 1.54]	.57
Declarative pointing at 13 months	0.04	0.31	.76	[- 0.24; 0.33]	.04
Adjusted $R^2 = .46$; $F(3, 31) = 10.74$, $p < .001$					

Note. $N = 35$; *CI* = Confidence Interval.

Discussion

The aim of the present study was to examine the relation between pointing and vocabulary development between 13 and 18 months in Brazilian Portuguese-learning children. We were particularly interested in evaluating whether this relation is moderated by the communicative function of the pointing gesture. In line with the results of two meta-analyses (Colonnesi et al., 2010; Harbison et al., 2017), our results showed that declarative, but not imperative, pointing correlated significantly with child vocabulary size. However, these results were limited to pointing at 13 months. Variations in the frequency of declarative pointing at 13 months were significantly correlated with variations in children's vocabulary at both 13 and 18 months. On the other hand, neither declarative nor imperative pointing at 18 months correlated with the child's vocabulary at the same time. These results are discussed below together with their implications for our understanding of the relation between pointing and initial vocabulary development.

According to a prominent position in the literature (Bohn, Zimmermann, Call, & Tomasello, 2018; Tomasello et al., 2007), the association between pointing and language results from the fact that both presuppose socio-cognitive and socio-motivational abilities, which are key for the development of social communication. According to this view, communication development, whether through gestures or words, is based on children's understanding that people are intentional mental beings and on their motivation to cooperate and share their interests and intentions with them. Tomasello and colleagues have argued that this common socio-cognitive and socio-motivational structure is at the heart of the relation between pointing and language development.

However, not every pointing gesture is associated with language development. For example, in the study by Lüke, Grimminger et al. (2017), in contrast to pointing with the

index finger, individual differences in the frequency of the pointing gesture with the whole hand at 12 months did not predict language skills a year later. Our results suggest that the communicative intention of the pointing gesture also is an important factor. In line with the results of Colonnesi et al.'s (2010) and Harbison et al.'s (2017) meta-analyses, only the declarative pointing gesture correlated with vocabulary development in the present study.

Some scholars have suggested that declarative pointing is cognitively more complex than imperative pointing, and that this difference is behind the discrepancies found in the correlation between these gestures and language development (see Lüke, Grimminger et al., 2017, for a discussion). On the other hand, as Lüke, Grimminger et al. (2017) argued, there is evidence that imperative pointing involves communicative intentions and motivations as complex as declarative pointing (van der Goot, Tomasello, & Liszkowski, 2014). In fact, these researchers showed that both declarative and imperative pointing at 12 months contributed significantly and equivalently to variations in different language measures at 24 months. As noted earlier, similar results were obtained by Özçalışkan et al. (2016). How can these results be reconciled with those obtained in the present study?

One possibility concerns the way in which pointing was coded. In the studies by Lüke, Grimminger et al. (2017) and Özçalışkan et al. (2016), pointing was coded as imperative or declarative based only on the experimental context in which the gesture occurred. In contrast, the coding of the pointing gesture in the present study also took into account other behaviors of the child, for example, their verbalizations and/or other gestures. Therefore, it is possible that some of the gestures coded as imperative pointing by Lüke, Grimminger et al. (2017) and Özçalışkan et al. (2016) would have been coded as declarative pointing in the present study.

Another possibility is that the frequency and variation of the imperative pointing gesture in the present study were

insufficient for us to be able to observe the effect of its variation on children's vocabulary development. Children in the studies by Lüke, Grimminger et al. (2017) and Özçalışkan et al. (2016) used the pointing gesture much more often than the children in the present study. In fact, while the children with TD in the study by Özçalışkan et al. (2016) produced an average of 10.76 ($SD = 8.71$) imperative pointing gestures at 18 months, the children in our study presented an average of only 2.69 ($SD = 3.64$) at the same age. The imperative pointing frequency was even lower at 13 months of age ($M = 1.26$, $SD = 2.21$) and less than that observed by Lüke, Grimminger et al. (2017) in children one month younger ($M = 1.38$ per trial, in a total of three trials, $SD = 1.22$). In fact, while only one child in Luke, Grimminger et al.'s study did not point with imperative intent in any of the trials, 20 of the 35 children in our study did not point imperatively even once during the ESCS administration at 13 months of age.

Another probable important difference concerns the children's age at the time their language was evaluated, i.e., 13 and 18 months in the present study vs. 24 and 30 months in Lüke, Grimminger et al.'s (2017) and Özçalışkan et al.'s (2016) studies, respectively. As noted below, it is possible that relative to imperative pointing, declarative pointing is more strongly correlated with language measures, especially vocabulary, at earlier stages of language development.

Some authors have argued that another motive of young children's pointing is to request information. Lucca and Wilbourn (2018) suggested that this type of pointing seems particularly beneficial for initial vocabulary acquisition. The reason for this is that when children point, they signal to people around them a referent of interest and thus offer their caregivers a unique opportunity to name the object or event that is the focus of the child's attention. In line with this hypothesis, the 18-month-olds who participated in their study learned the names of objects more readily when they had first pointed at them than when they expressed their interest in the object in another way, for example, by reaching toward the object or by alternating their gaze between the object and the examiner.

Apparently, caregivers are sensitive to the communicative signs of their children's gestures. For example, Olson and Masur (2013) demonstrated that mothers respond differently to their children's declarative and imperative gestures. In a study of 13-month-old children, these researchers observed that mothers named objects more often after declarative than imperative gestures. On the other hand, mothers produced more action words (verbs) after imperative gestures. Given that a substantive part of children's initial lexicons is composed of object names, it is not surprising that variations in the frequency of declarative pointing correlate with variations in early vocabulary acquisition.

In the present study, variations in the frequency of pointing at 18 months of age did not correlate with children's vocabulary at the same time. This not only occurred for imperative pointing, but also for declarative pointing. It is possible that variations in the frequency of pointing are more important for vocabulary development at earlier ages

when children still have a small vocabulary and rely more on gestures to communicate with other people. With language development, it is possible that children begin to rely more on speech to express their interests and intentions. Future studies are needed to evaluate this hypothesis. Research examining the use of communicative gestures by children with and without specific language development delay (see Lüke, Ritterfeld, Grimminger, Liszkowski, & Rohlfing, 2017, for an example) may be particularly enlightening.

Contrary to what has been reported in the literature (see Abel, Schuele, Arndt, Lee, & Blankenship, 2017, for a discussion), we did not find a significant correlation between maternal educational level and children's vocabulary as measured by the CDI-II. One reason for this is that there was little variation in the socioeconomic level of the families that composed our sample. Another possibility is that the impact of socioeconomic differences more clearly manifests itself in more advanced stages of language development (Rowe & Goldin-Meadow, 2009). Future studies including a larger number of children and a wider range of socio-economic differences in Brazil are needed to examine these issues.

It is important that future studies also examine the extent to which the relation between pointing and language development can be explained by other potentially important factors such as the child's level of cognitive development. As previously reported, although declarative pointing at age 13 months contributed to vocabulary at 18 months, its contribution was no longer significant after we controlled for the effect of variations in children's vocabulary at 13 months. It is possible that we would have found a different result had we included a larger and more representative sample of children. In fact, there is evidence that the relation between pointing and later language development is not simply a reflection of variations in cognitive development (Kuhn, Willoughby, Wilbourn, Vernon-Feagans, & Blair, 2014) or in initial language development (Lüke, Leinweber, & Ritterfeld, 2019; Rowe & Goldin-Meadow, 2009).

As far as we are aware, this study is the first to examine the relation between pointing and initial vocabulary development in Brazil. In addition, it has several strengths. For example, the pointing gesture and its functions were strictly defined, and other hand configurations that may have different functions and developmental trajectories were excluded. However, our data are not experimental and although they are consistent with different theoretical models, they do not allow us to determine the nature of the relation between pointing and initial language development.

The issues raised in the course of this discussion should be the subject of future studies which maintain rigor in defining pointing and its functions and seek to unravel the relations between this gesture, language and other factors related to them throughout development. A particularly important factor concerns the verbal and nonverbal responses of parents and/or caregivers to children's pointing and other communicative gestures. In addition, to the extent that children's communicative behaviors depend on the context in which they occur, it is important that studies employ varied methodologies including

not only structured and semi-structured assessment contexts but also more naturalistic contexts such as free interaction between children and their parents or caregivers.

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