The Critical Role of Interactive Features in the Language and Speech Developmental Trajectories of Children Experiencing Neglect: Results of the ELLAN study

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Conflict of Interest

There are no conflict of interest.

Abstract

Purpose: This study examines the critical role of interactive and linguistic features of the family environment in the language and speech developmental trajectories of children with a history of neglect. The proposed hypothesis is that the quality of interactive features will be the primary determinant of whether children follow a normative (control-like) or low developmental trajectory.

Method: Data were collected from the longitudinal ELLAN study conducted in Quebec (Canada), involving 41 children who had experienced neglect, living in either biological or foster families. Children's language and speech development was assessed through measures of expressive and receptive vocabulary, mean length of utterances, and percentage of words correct at six time points between 36 and 66 months of age. The child's language and speech development was classified into one of two categories: normative or low. Parent-child interactive and linguistic features were analyzed using 15-minute video recordings of semi-structured play sessions conducted at home.

Results: Low levels of parental interactive features—such as sensitivity, reactivity, and reciprocity—were positively associated with lower language and speech trajectories in children. Among linguistic features, only the parental mean length of utterances showed a significant link to low trajectories. These patterns were observed consistently in both biological and foster families.

Conclusion: The findings demonstrate that interactive features play a critical role in shaping the language and speech trajectories of children experiencing neglect, even more so than linguistic features. This study highlights the importance of high-quality interactions with parents in mitigating the negative effects of neglect on language and speech development. A targeted and adaptive approach, emphasizing parental strengths, has the potential to significantly improve developmental outcomes for children growing up in contexts of adversity.

Keywords. language and speech development; preschoolers; child neglect

Introduction

In North America, neglect is the most common form of maltreatment among children under the age of 6 (Gonzalez et al., 2023). These children are more likely than their peers to experience significant developmental difficulties, particularly in language development (Lum et al., 2015; Sylvestre et al., 2016). No aspect of language or speech development is spared and up to three out of four children exposed to neglect exhibit clinically significant difficulties (Sylvestre et al., 2023).

Language and speech develop through social interactions, the earliest and most crucial of which occur between the young child and their parents (Di Sante & Sylvestre, 2023). However, since neglect is defined as a disruption of parent-child interactions (DePanfilis, 2006; Lacharité, 2021), this context deprives the children of the optimal conditions to develop their language and speech skills (Di Sante et al., 2020; Julien et al., 2023; Sylvestre et al., 2023). Research data suggest that the parental behaviors essential for supporting language and speech development are adopted much less frequently by parents involved in a situation of neglect (Di Sante et al., 2020). Given the direct role these behaviors play in language and speech development, their malleability and responsiveness to intervention (Pace et al., 2017; Reilly & McKean, 2023), it is crucial to investigate their influence on the developmental outcomes of children in situations of neglect. This is the objective of the present article.

Child neglect

Child neglect is characterized by a failure of the child's parents or legal guardians, despite available resources, to meet the child's essential health, physical and educational needs, or to provide - or permit access to - the care required for the child's physical or mental health (Quebec Youth Protection Act, chapter P-34.1: Government of Quebec, 2024). This insufficient response of the caregiving environment to a child's basic needs poses significant risks to the child's development, safety, and well-being (Child Welfare Information Gateway, 2022).

In the province of Quebec, Canada, where this study was conducted, when a youth protection intervention team determines that parents cannot be relied upon to adequately care for their child, they may be placed in a foster family. Such placements remain in effect until the biological family's situation has improved sufficiently to ensure the child's safety and support their developmental needs. The duration and nature of the foster care can vary widely, from short-term to long-term, or even permanent placements.

In Quebec, over 6,000 children under the age of 6 (1.2% of all children in this age group; Institut de la statistique du Québec, 2021) were taken into care by youth protection services for neglect or serious risk of neglect in 2022-23. This number represents 62.3% of all reports made to youth protection authorities for this age group. "Children in care" are those for whom a report has been retained and who are assessed as being in a situation that compromises their safety or development (Bilan des directeurs de la protection de la jeunesse, 2023). This proportion is similar to that observed in the United States, where 76% of retained reports for children under 6 years of age are related to neglect (U.S. Department of Health and Human Services, 2022). Yet, as experts consistently point out, these already very high prevalence rates are likely underestimated, as neglect is particularly difficult to detect. Its effects often go unnoticed because neglect tends to result from omissions rather than overt actions (Blumenthal, 2015; English et al., 2005; Hyter, 2021).

Language and speech development of children experiencing neglect

At preschool age, difficulties in receptive and expressive language skills (vocabulary, morphosyntax, pragmatics) are consistently higher among children in situations of neglect compared to their same-age peers (Di Sante et al., 2020; Fox et al., 1988; Julien et al., 2019; Spratt et al., 2012; Sylvestre et al., 2023). However, much less is known about their speech development. To date, only one study has specifically examined this domain (Culp et al., 1991). In that study, which included 41 children in situations of neglect and 13 children experiencing both neglect and abuse (mean ages = 41.5 and 41.2 months, respectively), speech development fell within the typical range, albeit slightly below average.

In francophone children, difficulties appear as early as the pre-linguistic period (23.8% of children aged between 2 and 9 months) and increase with age, affecting 41.7% of children aged 21 to 36 months. A global assessment of the language development of these children found a high level of difficulties in language comprehension and expression (Sylvestre & Mérette, 2010). Moreover, one study found that at the age of 4, the mean length of utterances (MLU) of children experiencing neglect is significantly shorter than that of their same-age peers (Julien et al., 2019). This study also revealed that 25.6% of these children exhibit clinically significant morphosyntactic difficulties, which is more than five times the rate observed among children who have not experienced neglect (4.7%).

A recent longitudinal study tracked 69 children with a history of neglect and a comparison group of 99 children with no such history from ages 3 to 5.5 years, with assessments conducted at six-month intervals across six time points. Results revealed that, overall, children exposed to neglect demonstrated significantly lower levels of language and speech development compared to their non-neglected peers (Sylvestre et al., 2023). As early as age 3, up to 75% of children experiencing neglect showed lower performance than children in the comparison group in at least one of the assessed components (receptive vocabulary, expressive vocabulary, morphosyntax, or the percentage of words produced correctly) at one or more time points. Moreover, nearly half (48%) of these children demonstrated lower performance in two components. Both receptive and expressive vocabulary were assessed using the French versions of the

Peabody Picture Vocabulary Test–Revised (PPVT-R; Dunn et al., 1993) and the Expressive One-Word Picture Vocabulary Test–2000 (EOWPVT-2000; Brownell, 2000). Morphosyntactic development was evaluated by calculating the MLU in morphemes based on a 50-utterance language transcript. This measure captures grammatical complexity more accurately than MLU in words and is particularly well suited to analyzing a morphologically rich language such as French (Parisse & Maillart, 2004). Language samples for this calculation were obtained during a 15-minute semi-structured symbolic play session between the child and the research assistant, using the Neighborhood Game (Sylvestre, Di Sante et al., 2023). This procedure was conducted using a standardized script and materials to ensure consistency across participants. Speech sound development was assessed using the *Évaluation sommaire de la phonologie chez les enfants d'âge préscolaire* (Summary Assessment of Phonology in Preschool Children; MacLeod et al., 2014), which involved asking the child to either spontaneously name 40 pictured words or repeat them after the examiner. A transcription of each word using the International Phonetic Alphabet is provided with this tool. This allowed for the calculation of the percentage of words correct (PWC), based on whether a word contained at least one error in a word, regardless of the type of error (e.g., addition, substitution, or omission of any vowel or consonant within the word). Inter-rater agreement for identifying the presence/absence of word-level error was deemed satisfactory: 95.5% for verification by a second rater on 10% of the data, and 88.4% for independent ratings on 4.2% of the data (see Sylvestre et al., 2023 for details).

Sylvestre et al.'s study (2023) also identified two subgroups of children among those exposed to neglect: one with a developmental trajectory significantly below that of the comparison (no neglect) group (low trajectory), with effect sizes ranging from 1.4 to

3 standard deviations below the control mean, depending on the variable; and another with a trajectory similar to those of children who have not experienced neglect (normative or control-like trajectory). For the normative subgroup, development appeared to be delayed, with moderate deviations at age 3, but the subsequent rate and pattern of progression were like those of the comparison group. By age 3.5, the development of children in this subgroup no longer differed from that of the comparison group, except for expressive vocabulary, where a slight gap persisted until age 5. In contrast, in the subgroup that exhibited significant difficulties (low trajectory), language development evolved over time but remained significantly below that of children in the comparison group, reaching up to three standard deviations below the mean at 5.5 years for both receptive and expressive vocabulary. The situation appears slightly different for speech development, where children exposed to neglect tend to catch up with the comparison group over time.

In the Sylvestre et al. (2023) study, the low trajectory subgroup included between 29% and 58% of the participants in situations of neglect, depending on the components measured. These proportions highlight a striking vulnerability among these children, given that the prevalence of language difficulties in the general population of children aged 6 years and under is estimated at between 10% to 20% (Horwitz et al., 2003; Reilly et al., 2007; Zubrick et al., 2007), and that of speech sound disorders at between 3% and 5% (Eadie et al., 2014; Sylvestre et al., 2020). These children are therefore markedly overrepresented in the pediatric population experiencing language and/or speech difficulties (Gayaldo & Gladfelter, 2022).

All of the children in this study met the criteria for intervention by child protection services due to substantiated or serious risk of neglect, as defined by the

Quebec Youth Protection Act (referred to above). Accordingly, participants were comparable in terms of both the grounds for protection and the severity of their situation. The fact that all of these children were exposed to neglect in a comparable manner, yet some developed at the same level as their same-age peers, is indicative of resilience (Sattler et al., 2023). A plausible explanatory hypothesis is that, despite the disruption of the parent-child relationship caused by neglect (DePanfilis, 2006; Lacharité, 2021), some parents may still engage in one or more behaviors that are essential to supporting their child's language and speech development. If this hypothesis proves accurate, it could inform the development of prevention and intervention services aimed at helping parents to positively influence their child's language and speech trajectories (Roberts & Kaiser, 2015).

Children in foster families. Although few studies have directly examined the impact of foster placement on young children's language and speech development, existing evidence suggests that living in a foster family may have a protective effect on children's language and speech development. For instance, Zajac et al. (2019) found that children involved with child protection services and placed in foster families had higher receptive vocabulary scores at 36 and 48 months compared to those who remained with their biological parents, although these differences were no longer significant after adjusting for caregiver education, marital status, and household income. Similarly, a large population-based study conducted in South Australia reported that by school entry (mean age = 5.7 years), children placed in foster care had a lower risk of vulnerability in language, cognitive, and communication skills (Lanais et al., 2024). However, because the children in that study were older than those in our sample, it remains unclear whether such findings can be generalized to preschool-aged children. These limitations underscore the importance of examining the potential influence of foster placement on language and speech development in the present study.

Parental behaviors associated with language and speech development

Language and speech development originates in social interactions, particularly those between young children and their parents. To learn to speak, children must be exposed to linguistic models provided by their caregivers (Bruner, 1983; Vygotsky, 1978). These interactions activate the neuronal mechanism involved in processing the linguistic, acoustic, and social properties of the input the child hears (Evans, 2001; Kuhl, 2007). Several researchers have sought to define what constitutes a high-quality language- and speech-learning environment (e.g., Anderson et al., 2021; Hoff, 2006; Pace et al., 2017; Romeo et al., 2018; Rowe, 2012; Rowe & Snow, 2020). Across studies, two interrelated components consistently emerge. The first focuses on the features of the linguistic input itself, that is, what the child hears from the parent. The second pertains to the interactive features of the context, namely how the parents engage with the child while delivering linguistic input.

Parental linguistic features. Four main parental linguistic features have been identified in scientific literature as key aspects of the quality of parental input: the number of words addressed to the child, the diversity of vocabulary used, the number of utterances produced, and the linguistic “complexity” of those utterances (Anderson et al., 2021; Rowe, 2012, 2013; Rowe & Snow, 2020). Previous research indicates that mothers in situations of neglect talk less to their child during play (e.g., fewer overall utterances) and use less complex language structures (e.g., fewer multi-clause utterances and shorter MLU) compared to mothers in typical caregiving contexts (Eigsti & Cicchetti, 2004).

Parent-child interactive features. Among the essential parent-child interactive features involved in language and speech development, parental responsiveness stands out as the most significant (Madigan et al., 2019; Pace et al., 2017; Romeo et al., 2018; Rowe & Snow, 2020). Responsiveness is a construct that requires parents to manifest a combination of the following behaviors and aptitudes: first and foremost, perceiving what interests the child and paying attention to both verbal and non-verbal communication signals sent by the child (*sensitivity*); second, acknowledging these interests and communicative signals by responding promptly and appropriately (*reactivity*); and lastly, establishing a dyadic communicative engagement with the child that allows for multiple back-and-forth exchanges (often referred to as "serve and return interactions") on the same topic (*reciprocity*) (Di Sante & Sylvestre, 2023). Di Sante et al. (2020) reported that these three behaviors are less frequently adopted by parents in situations of neglect. This was evidenced by Glass's Delta statistics of 1.63, 2.26, and 1.71 respectively, which represent the number of standard deviations by which these behaviors differ from those observed in the comparison group. These results are concerning, given that a meta-analysis (n = 36 studies; 7,315 parent-child dyads, age 12-57 months) confirmed a relationship between parental responsiveness (r = .27) and children's language development (Madigan et al., 2019). This relationship is stronger for children growing up in families characterized by low socio-economic status compared to those from more affluent environments (Romeo et al., 2018).

Parenting in foster families. Although foster care is intended to provide a more supportive environment for children experiencing neglect, there has been little research on how parenting behaviors in foster families compare to those in biological families. Existing studies report mixed findings. For example, Linares et al. (2006) found that, after controlling for relevant covariates (e.g., maternal age), foster and biological parents displayed similar levels of positive, appropriate, and harsh discipline, although foster parents tended to report that they have clearer expectations regarding the child. While placement is typically intended to promote the child's safety and development, recent evidence suggests that foster parenting can involve significant challenges. A latent profile analysis by Dowdy-Hazlett and Clark (2024) showed that 64% of foster parents experience moderate to high levels of stress related to their caregiving role. These findings point to the need to further investigate how parental behaviors that support language and speech development may differ between biological and foster caregivers.

In Sum

Children exposed to neglect are at high risk of experiencing significant language and speech difficulties from an early age. Nonetheless, recent longitudinal findings suggest that not all children are equally affected. While some children with a history of neglect display persistently low trajectories, others follow developmental paths comparable to their peers, suggesting the presence of resilience processes.

Although prior research has documented general differences in the caregiving environments of children exposed to neglect versus their non-exposed peers, it has not sufficiently examined how specific interactive and linguistic features contribute to the diverse language and speech developmental trajectories observed within this population. In particular, the role of parental interactive and linguistic features remains underexplored. Moreover, the potential protective influence of foster care, through improved relational and linguistic conditions, has yet to be empirically demonstrated.

Current study

The present study aims to gain a deeper understanding of how the linguistic environment shapes the language and speech development of children exposed to neglect. Specifically, it examines how key features of parental input—namely interactive characteristics (parent sensitivity, reactivity, reciprocity) and linguistic characteristics (quantity of words and utterances, vocabulary diversity, utterance complexity)—are associated with the developmental trajectories of language and speech in preschool-aged children with a history of neglect, as described in Sylvestre et al. (2023). Since neglect is characterized by a disruption of parent-child interactions, which are foundational to early language learning (DePanfilis, 2006; Lacharité, 2021), we hypothesize that the quality of interactive features plays a critical role in determining whether children follow normative (control-like) or low developmental trajectories. This hypothesis is supported by growing evidence that a rich and responsive relational context, made possible through sustained parent-child interaction, is a necessary precondition for providing children with adequate linguistic input and effective scaffolding (Romeo et al., 2021). Furthermore, considering that some children experiencing neglect are placed in foster families during early childhood, this study also examines whether the caregiving context (biological vs. foster family) is associated with differences in language and speech trajectories.

Method

Data for the present study are drawn from the Early Longitudinal Language and Neglect (ELLAN) study, conducted in Quebec between 2014 and 2019 (Sylvestre et al.) and involve a subset of the same participant cohort. This study was approved by the research ethics committees of the Centre jeunesse de Québec (CJQ-IU-2014-03) and the Centre jeunesse de Montréal (CJM-IU 14-05-06). Participation was entirely voluntary, and written informed consent was obtained from all individuals during the initial assessment visit, when the children were three years old. On each visit, parents received monetary compensation, and children were given a small toy. Although modest, these gestures were intended as tokens of appreciation for the families' time and engagement.

Participants

The sample for this longitudinal study (six measurement points) consisted of children with a documented history of neglect, recruited from four of Quebec's Youth Protection Centers (Quebec City, Montreal, Chaudière-Appalaches and Laval). To meet the eligibility criteria, the situation of neglect or serious risk of neglect had to be confirmed by a psychosocial worker according to the provisions of the Quebec Youth Protection Act, Chapter P-34.1 (Government of Quebec, 2024) and then validated by a clinical counselor.

To be included, children had to be 36 months old (+/- 1 week) at study entry. Additionally, their parents had to confirm that the children had been exposed to French for at least 90% of the time since birth. This threshold is based on research indicating that children exposed to a second language less than 10% of the time can be considered comparable to monolinguals (Pearson et al., 1997). Children with conditions potentially associated with language or speech difficulties (e.g., hearing impairment) were excluded. In addition, children who had received or were receiving speech and language therapy services at the time of recruitment were also excluded to minimize potential confounding effects on language and speech development outcomes. However, information on whether participants accessed such services during the course of the study was not collected.

The children's language and speech development was assessed every six months, from ages 36 to 66 months, to describe their developmental trajectories in terms of vocabulary (receptive and expressive), syntax (MLU in morphemes) and speech sound development (PWC) (see Sylvestre et al., 2023 for more details on data collection and inter-rater agreement). The results of Sylvestre et al. (2023) were used to classify children, for each of the four measures, as following either a normative (control-like) trajectory or a low trajectory. Measures of family environmental characteristics, including interactive and linguistic features, were collected at the second measurement point, when the children were 42 months old. This study includes 41 of the 69 children initially recruited, and one of their parents or legal guardians (59.4% of the total sample), for whom measures of family environmental characteristics were available at the second measurement point. Some participants were unavailable for this phase due to family relocation, or the child being placed in foster care outside the research area. Additionally, some data were missing due to equipment malfunctions or breakages. At the time of data collection, the children were either living with their biological families (N=21) or placed in foster care (N=20).

Among the present sample of 41 children, the number of children who belongs to the low trajectory of percent words correct, receptive vocabulary, expressive vocabulary and MLU in morphemes was, respectively, 14, 24, 20, and 26. Seventy-eight percent of the children were classified at least once into a low trajectory, 56 % were classified at least twice, 51 % at least three times, whereas 20 % consistently belonged to the low trajectory across all language and speech measures.

Measures and Procedure

The videos used to observe parental behaviors (interactive and linguistic features) were drawn from a 15-minute free-play session between the parent and child, recorded at the end of a two-hour home visit. To standardize the play context, participants were offered a selection of toys (a farmhouse with characters and animals, a puzzle, a ball, a toy kitchen and food set, a book, a stuffed teddy bear, and a "Mr. Potato Head" toy). Parents were instructed to interact with their child as they normally would, while disregarding the presence of the camera.

Parent-child interactive features. The Coding Observations of Parent-Child Interactions (COPI; Sylvestre et al., 2021) was used to analyze the three dimensions of parent-child interaction related to responsiveness (sensitivity to the child's interests, reactivity, reciprocity) examined in this study. The administration and coding procedures for the COPI, finalized after a rigorous validation process and confirmation of its psychometric properties, are detailed in Sylvestre et al. (2021). The procedure involves analyzing the central portion of the recording, specifically from the 4th to the 11th minute (a total of 7 minutes). During this segment, each feature of the parent's behavior related to responsiveness was coded separately on a 4-point scale: (1) never present, (2) sometimes present, (3) often present, and (4) always present. This resulted in three individual scores, one for each feature.

The COPI's factor structure was validated using 95 videos from a sample of children of the same age and geographic regions as those in the present study. The correlations between the three features of parent-child interaction and the responsiveness factor were strong, with coefficients of .78 (sensitivity), .81 (reactivity), and .88 (reciprocity), confirming their inclusion in this construct. Additionally, high inter-rater (87%–93%) and intra-rater (88%–98%) reliability values were obtained, supporting the tool's robustness (Sylvestre et al., 2021).

Parental linguistic features. Four characteristics were selected to measure the linguistic input provided by the parent: (1) the total number of words produced, (2) the number of different words used (type-token ratio, based on lemmas), (3) the total number of utterances produced, and (4) the MLU in morphemes. To generate these data, a verbatim transcript of the same portion of the video recording (from the 4th to the 11th minute) was produced using CHAT conventions within the CLAN software (MacWhinney, 2000). This software enables detailed linguistic analysis of corpora in multiple languages, including French.

Research assistants were trained in parent-child interaction transcription by a French-speaking speech-language pathologist with expertise in CHAT conventions (author MD). During the training phase, each transcript was reviewed by the expert until the assistants consistently produced transcripts with minimal errors and a quality level comparable to that of the expert. Once this level of accuracy and consistency was reached, transcribers completed the transcriptions independently.

A final verification step ensured reliability: all transcripts were reviewed alongside the corresponding video recordings by a second transcriber trained in the same conventions. When minor discrepancies or disagreements arose (e.g., wording and expressions specific to Quebec French, utterance delimitation, transcription of child speech that was difficult to hear or understand), they were compiled into a document and reviewed case by case with the expert speech-language pathologist (author MD). All issues were resolved through consensus, with final decisions and necessary adjustments (e.g., adding new words to the CLAN dictionary for French analysis) made by the expert.

Within the CLAN software, we first ran a morphological analysis of each word using the MOR grammar for French conventions, which codes transcripts in French with over 95% accuracy (MacWhinney, 2000) and compares favorably with morphological coding conducted by humans. Then, the FREQ command was used to compute total word types, as well as word tokens (total number of different words based on lemmas, which means, for example, that the words “dog” and “dogs” would be counted as one word rather than two). Fillers (e.g., uh, uhm, uhuh) were excluded from the total number of words, but onomatopoeias (e.g., pow, boom, woof) and communicators (e.g., oh, ah, yay) were included. Finally, we ran the MLU program to compute the MLU in morphemes, which is the ratio of morphemes to utterances. Incomplete utterances, those that include unintelligible words and those composed exclusively of the words yes, no, or okay were excluded from the total number of utterances. To ensure data reliability, all transcripts were reviewed alongside the video recordings by a second transcriber trained in the use of these conventions. Discrepancies were discussed and resolved through consensus, with final decisions made by an expert (author MD) when necessary.

Data collection. The questionnaire used to collect socio-demographic information about the participants was completed in the families' homes during the first assessment time point (when the children were 36 months old). Family structure (single-parent or two-parent), number of children in the household, educational level of the parent(s), employment status of the primary respondent (employed, studying, or other activities outside the home), and income level (dichotomized based on the low-income cut-off) were among the data collected. The videos for the subsequent analysis of interactive and linguistic features were recorded during the second visit (when the children were 42 months old).

Statistical data analysis

Statistical analyses were conducted using SAS/STAT software v. 9.4 (SAS Institute Inc., Cary, NC, USA). Descriptive statistics for socio-demographic variables were calculated as proportions in the total sample (N=41) and subsamples of children living with their biological families (N=21) vs those placed in foster families (N=20). The two subgroups were compared in a bivariate analysis using Chi-square testing and they were found significantly different if the observed two-sided p-value was below the Type I error threshold of .05.

We then assessed the relationship between each of the three parent-child interactive features and the children's language and speech developmental trajectories by calculating the risk of children being classified into the low trajectory for each level of the interactive features (COPI; 1-never present, 2-sometimes present, 3-often present, and 4-always present) and comparing them using the bivariate Fisher’s exact test with the SAS FREQ procedure. For this analysis, the “often present” (code 3) and “always present” (code 4) levels were combined due to the rarity of the latter.

The same bivariate approach was applied to examine the relationship between each of the four linguistic features of the parent and each child’s trajectory. For this analysis, the quantitative assessments obtained through the CLAN procedure were categorized into “low”, “moderate” and “high” levels based on terciles of the rankings.

Given that we expected low levels of interactive or linguistic features to increase the risk of a low trajectory in children, one-sided p-values were reported for these bivariate analyses with a pre-determined Type I error threshold set to .025, accounting for a Bonferroni correction for testing two parents’ features (interactive and linguistic). Variables within the interactive and linguistic features were highly correlated ($r > .70$) and therefore no further correction was used. Then, using the combined “often or always present” level of the interactive features as the reference, the ratio of the risks of belonging to the *low trajectory* for the lower interactive features levels [“never” (code 1) and “sometimes” (code 2)] over that of the reference were computed to provide relative risks (RRs). The same approach was used for the linguistic features variables using the "high" level as the reference.

When both interactive and linguistic features were significantly associated with a child's trajectory in the bivariate analyses described above, multivariate analyses were then conducted to predict the risk of belonging to the low trajectory including both interactive and linguistic features as predictors. Log-binomial regression was used to assess the multivariate model based on the GENMOD procedure of SAS with a log link and a binomial distribution. This approach allowed us to determine whether each of the interactive and linguistic variables remained significant when accounting for the presence of the other.

Finally, we stratified the sample according to family status—biological family (N=21) vs foster family (N=20) —to examine whether family status tended to modify the relationship between interactive or linguistic features and trajectories. Given that we expected small numbers of observations within the cells of the table crossing the level of a given feature with the trajectories in a given strata, we performed these stratified analyses only for the interactive and linguistic feature that showed the strongest association (p-value < .01 and RR > 5) with the trajectories in the bivariate analyses of the total sample (N=41).

Results

Table 1 presents a comparison of socio-demographic characteristics between children experiencing neglect living in their biological families (BIO: 51.2%) and those living in foster families (FF). The two groups were comparable in terms of the proportion of males, single-parent households, large sibships (more than two children), and low education levels among the responding parental figures. However, children in biological families were more likely to have a parent without an activity outside the home (BIO: 66.7% vs. FF: 30%, $X_2 = 5.51$, $p = .02$) and were more often from families living below the low-income cut-off (BIO: 76.5% vs. FF: 36.8%, $X_2 = 5.71$, $p = .02$).

< Insert Table 1 >

Bivariate analyses

Table 2 presents the bivariate analyses between each of the interactive (IF) and linguistic features (LF) and the child language trajectory. Among the interactive features, the *sensitivity* variable was significantly associated with the child PWC ($p = .02$): children had a 4.7 times higher risk of following a low PWC trajectory when the parent was never sensitive to their interests, compared to when the parent was often or always sensitive (RR = 4.7 = 55.6/11.8), whereas when the parent was sometimes sensitive, the risk was 4.0 times higher, compared to often or always sensitive (RR = 4.0 = 46.7/11.8). The *reactivity* variable was associated with both the child PWC ($p = .005$) and receptive vocabulary ($p = .015$): when the parent was never or sometimes reactive, the RRs were 8.6 and 6.3 respectively for PWC, and 2.1 and 1.3 respectively for receptive vocabulary. When the parent was never reciprocal with the child (*reciprocity*), the risk that the child belonged to the low trajectory increased by 6.8 times for PWC ($p = .01$), by 2.5 times for receptive vocabulary ($p = .005$), and by 1.7 times for expressive vocabulary ($p = .02$) compared to when the parent often or always engaged in back-and-forth communication.

Among the parental linguistic features, the parent's *MLU in morphemes* was the only variable significantly associated with children's outcomes, specifically expressive vocabulary ($p = .005$). Children whose parents have a low MLU in morphemes were five times more likely to follow a low expressive vocabulary trajectory compared to those whose parents had a high MLU in morphemes.

< Insert Table 2 >

Multivariate analyses

Given that the parent-child *reciprocity* and parent *MLU in morphemes* were both individually associated with the child's expressive vocabulary trajectory, a multivariate model was estimated with these two variables as predictors of the low expressive vocabulary trajectory. Based on the Wald Chi-square statistics, only MLU in morphemes in parents remained significantly related to the child's lower trajectory (p = .01), while the parent-child reciprocity did not contribute additional significant information (p = .55).

Analysis based on child placement: Biological (BIO) vs foster family (FF)

Table 3 presents the results of the stratified analyses in the BIO vs FF subsamples for the strongest bivariate associations found in the total sample (Table 2) with interactive and linguistic features. In BIO families, RRs could not be computed due to the rarity of children in the "often or always" level of interactive and linguistic features. Nevertheless, the risk of a low PWC or expressive vocabulary language trajectory in children decreased with increasing levels of interactive and linguistic features. In FF families, the risks of a child belonging to the low PWC trajectory for the "never", "sometimes" and "often or always" levels were 66.7%, 25.0%, and 7.7%, respectively, yielding RRs of 8.7 and 3.2 for the "never" and "sometimes" levels (p = .03). A similar trend was observed with the expressive vocabulary, though with a lesser evidence (p = .06).

< Insert Table 3 >

Discussion

The primary objective of this study was to investigate the associations between interactive and linguistic features of the caregiving environment and language and speech developmental trajectories in preschool-aged children exposed to neglect. A secondary objective was to explore whether the caregiving context (biological vs. foster family) is linked to differences in these developmental trajectories. The trajectories were previously identified by Sylvestre and collaborators (2023) through a latent trajectory analysis of each of four speech and language components: receptive vocabulary, expressive vocabulary, mean length of utterance (MLU) in morphemes, and percentage of words correct (PWC). Two distinct trajectories were observed: a low trajectory, characterized by persistent language and speech difficulties, and a normative trajectory, comparable to that of children not exposed to neglect. The current findings provide new insights into the environmental factors contributing to these divergent outcomes.

The results of bivariate analyses revealed that each of the parent-child interactive features—sensitivity, reactivity, reciprocity—was significantly associated with at least one of the child's low language or speech developmental trajectories, with reciprocity linked to three out of the four trajectories. For the linguistic features, only MLU in morphemes showed a significant association with the low trajectory of expressive vocabulary. The log-binomial multivariate model indicated that the parental LF-MLU in morphemes alone was sufficient to explain the child's trajectory of expressive vocabulary, while IF-reciprocity did not provide significant additional information beyond linguistic features. These findings partially support the hypothesis that, among children with a history of neglect, the quality of parental behaviors during parent-child interaction plays a crucial role in determining whether children follow a low or a normative language or speech developmental trajectory.

Our results demonstrated that the three interactive behaviors reflecting how parents respond to their child's interests and communication initiatives—sensitivity, reactivity, and reciprocity—when of low quality (never present), significantly increased the risk of the child belonging to a low trajectory. The relative risks associated with these behaviors were often extremely high, as exemplified by the child's PWC trajectory, where a relative risk of 8.6 was observed when the parent was never reactive compared to when the parent was consistently reactive. This finding provides a concrete and compelling illustration of the strong relationship between the parent-child interactive features and the children's early language and speech development. However, it is important to note the strong collinearity between these interactive features, with correlations ranging from .77 to .86. Therefore, although statistical analyses identified one variable as being more strongly associated with a given trajectory, this significant association likely also reflects the influence of the other two interactive features (Levickis et al., 2022; Meng, 2021).

The effect of interactive behaviors was consistently observed for the child's PWC, was more variable for expressive and receptive vocabulary, and was not significant for the child's MLU. Regarding linguistic input, a low parental MLU in morphemes was the only feature associated with an increased risk of difficulties, and this effect is observed exclusively for expressive vocabulary. This finding aligns with previous research showing that MLU, a dimension contributing to the quality of linguistic input, predicts children's likelihood of belonging to low language trajectories (Hirsh-Pasek et al., 2015). In contrast, variables reflecting the quantity of linguistic input—such as the number of words and utterances produced by the parent—were not associated with any developmental trajectories in this sample.

Consistent with findings from other research, the dimension of reciprocity, characterized by back-and-forth parent-child exchanges, emerged as a stronger determinant of language and speech developmental outcomes than the quantity of linguistic input, that is, the total number of words heard by the child (Hirsh-Pasek et al., 2015; Weisleder & Fernald, 2013). For example, in a study examining the quality of nonverbal and verbal parent-child interactions at 24 months, Hirsh-Pasek et al. (2015) found that quality indicators, such as joint engagement and connected communication, were significantly stronger predictors of later language abilities than the quantity of words mothers used during interactions.

Regarding the second objective, although neglect is defined as a disruption of parent–child interaction, some caregivers—whether biological or foster—appear capable of sustaining interactions that are sufficiently responsive and linguistically rich to support normative language and speech developmental trajectories. In our study, no strong evidence of differences was found between biological and foster families in the associations between caregiving features and children's developmental outcomes, as the likelihood of a low trajectory in children tended to decrease with increasing levels of caregiving features across family types. This suggests that when responsive and complex communication is present, both types of caregivers can provide similarly supportive environments. These findings underscore the potential value of targeted interventions aimed at enhancing parental responsiveness and linguistic complexity across diverse caregiving contexts, even in the face of adversity.

In sum, the results of the present study contribute to a growing body of literature underscoring the more critical role of parent-child interaction quality than the quantity of linguistic input provided by parents in shaping children's language and speech outcomes among children exposed to neglect.

Strengths and limitations of the study

Following Hill's criteria for assessing causal relationships (Hill, 1965; INSERM, 2005), the very high relative risks observed in this study suggest strong associations (Criterion 1). Additionally, a dose-response effect is evident (Criterion 2), as risks progressively increase across different levels of interactive and linguistic input measures, for example, from “never present” to “sometimes present” and “always present.” Our findings indicate that variations in interactive and linguistic features are meaningfully related to children’s subsequent language and speech skills, suggesting a potential predictive relationship.

Furthermore, these associations are in line with existing knowledge in the field (Criterion 3), lending support to the plausibility of a causal relationship. Together, the findings contribute to a growing body of evidence suggesting that parent-child interactions and linguistic input may play an important role in children’s language and speech development.

One critical criterion—and the only one absolutely necessary to establish causality (Hill, 1965; INSERM, 2005; Ioannidis, 2005)—is the temporal relationship, meaning that the cause must precede the effect. This condition is met by the longitudinal design of this study. Language and speech developmental trajectories were established over six measurement points (Sylvestre et al., 2023), while predictive variables were assessed at the second measurement period, thereby ensuring that predictors preceded the outcomes in time. Hence, although this study was based on an observational design, the strength of the associations (revealed by $1.7 < RRs < 8.6$) and the evidence of decreasing RRs with increasing levels of IF and LF, supporting a dose-effect relationship, in addition to the temporal relationship suggest causality and support the relevance of an experimental study based on enhancing parents’ features.

When both an interactive and a linguistic feature were associated with a given trajectory in bivariate analyses, a multivariate analysis was used to account for the possible correlations between them. Although the specificity of the observed associations between parent and child variables warrants further replication, the findings provide evidence that parents' interactive behaviors play a meaningful role in predicting (probabilistically) children's language and speech outcomes. These results support the hypothesis that the quality of early parent-child interactions contributes to shaping language and speech developmental pathways, even within high-risk contexts such as neglect.

This study also has certain limitations. First, data on parent-child interactions were collected in a semi-structured play setting, which may not fully reflect interactions in more naturalistic contexts. Nevertheless, using a controlled setting ensured that all participants were exposed to the same standardized conditions. This approach facilitates consistent and comparable data collection, which is essential for reliable cross-participant analysis.

Second, this study focused exclusively on interaction and linguistic input, without controlling for other contextual variables such as socio-economic status or parental education, which might have refined the conclusions. Research on the links between neglect and language development remains scarce and often relies on small samples due to the challenges of recruiting families involved with child protection services. Consequently, conducting subgroup analyses based on socioeconomic status or race/ethnicity is rarely feasible. This methodological limitation should be kept in mind when interpreting the findings. Nevertheless, we were able to explore the potential moderating effect of family status (biological vs. foster families), despite the limited sample size. Within the 20 foster families, we replicated the strong relationship (RR = 8.6) observed in the entire sample through bivariate analysis between reactivity and PWC. Consistently inadequate reactivity again increased the risk of a low speech trajectory by 8.7 times. This relationship was harder to observe within the 21 biological families due to the rarity of the "often or always" level of reactivity of the parent but followed a similar pattern of decreasing risk with levels of reactivity. Furthermore, the relationship observed in the entire sample between parental MLU in morphemes and the expressive vocabulary trajectory was replicated within both the biological and foster family strata, although with a moderate tendency in the latter. This revealed a consistent inverse dose-effect relationship: lower levels of linguistic performance by the parent were associated with a higher risk of the child following a low trajectory. These findings highlight that, regardless of family status, it is crucial for all adults who interact regularly with a child to adopt responsive, sensitive, and reciprocal behaviors (Potvin, 2021). This also underscores the importance of enhancing the overall quality of a child's linguistic environment as a mean of promoting equity in early development (Di Sante & Sylvestre, 2023).

Another limitation relates to the variability in services that families and children may have received, which was not accounted for in our study. For instance, some families may have participated in attachment-based interventions focused on parent-child interactions (Dubois-Comtois et al., 2017), typically delivered by psychosocial professionals. However, to our knowledge, no intervention provided by Quebec's youth protection services specifically targets the interactive and linguistic features examined in the present study.

Future research and clinical practice

Our study provides robust evidence that children who have experienced neglect are significantly more likely to present with notable language or speech difficulties when raised in low quality environments, both at the interactive and linguistic levels. These findings are critical for identifying children at highest risk and underscore the importance of early interventions aimed at improving the quality of their caregiving environment.

Two key questions arise from these results. Does an improvement in interactive behaviors lead to a change in the developmental trajectory of language or speech for children who have experienced neglect? Addressing this question would not only help confirm the causal relationship between interactive behaviors and developmental outcomes in children exposed to neglect, but also provide valuable practical and clinical insights. Specifically, it would validate the importance of targeting specific parental behaviors, particularly responsiveness to the child. Both interactive behaviors and linguistic input are promising targets for intervention, as they can be effectively improved through speech-language therapy (Pace et al., 2017; Reilly & McKean, 2023). Focusing on these elements may be key to significantly enhancing language and speech outcomes for children living in contexts of adversity.

Any intervention aimed at supporting language development must create supportive environments from an early age by both reducing risk factors and reinforcing or creating protective ones (Jean-Thorn et al., 2023). In this context, a second key question arises: Which interactive and linguistic features of the caregiving environment contribute to favorable language and speech developmental trajectories in children exposed to neglect? Addressing this question could not only provide valuable scientific insights, but also guide practical applications. Building on parental strengths is known to yield numerous benefits (Di Sante & Sylvestre, 2023; Levickis et al., 2022), particularly within the context of youth protection services. Such strengths can serve as buffers, protecting against risks and promoting more positive developmental outcomes. Moreover, strength-based approaches contribute to building a strong therapeutic alliance, which is essential for achieving better outcomes for children and families (Sylvestre & Gobeil, 2020; Valenti et al., 2020).

Conclusion

This study addressed a critical gap by specifically examining the characteristics of parent-child interactions and linguistic input within the context of neglect. While previous research has underscored broad differences in the linguistic environments of children growing up in contexts of adversity, including those with a history of neglect, this study provides a more nuanced understanding. It explores how specific interactive and linguistic features are associated with children's language and speech developmental trajectories, encompassing both expressive and receptive skills.

Our findings suggest that interventions for children exposed to neglect should prioritize guiding parents to refine their interactions and adapt to their children's specific communicative needs (Di Sante & Sylvestre, 2023). By fostering more responsive, reactive, and reciprocal parent-child interactions, the adverse effects of neglect on language and speech development could be mitigated. Additionally, encouraging parents to lengthen their utterances can provide richer and more complex linguistic input. If necessary, following the implementation of these interventions, structured programs that train parents in effective stimulation techniques—such as modeling and reformulating the child's productions—could further enhance the linguistic environment for children at risk of language and speech developmental challenges.

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Data availability statement

Data are available upon request from the authors.

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Supplemental files

The questionnaire used to collect socio-demographic information, as well as a description of the COPI materials used to assess the interactional features, are provided in the supplemental material. A reference to the publicly available CLAN manual, used for the analysis of linguistic features, is also been included.

Table 1

Socio-demographic characteristics of the total sample of children experiencing neglect and of the subsamples of those in their biological family (BIO) and those in a foster family (FF).

Socio-demographic characteristics	Total sample of children experiencing neglect (N=41)	Subsamples		Comparison BIO vs. FF	
		BIO families (N=21)	FF families (N=20)	Chi-square	p-value
Nb (%) of :					
Males	24 (58.5)	12 (57.1)	12 (60.0)	.03	.85
Single-parent households	17 (41.5)	10 (47.6)	7 (35.0)	.67	.41
Large sibships (> 2 children)	17 (41.5)	10 (47.6)	7 (35.0)	.67	.41
Low education (≤ secondary school) [a]	22 (53.7)	14 (66.7)	8 (40.0)	2.93	.09
Parents [a] without an activity outside	20 (48.8)	14 (66.7)	6 (30.0)	5.51	.02
Families below the low-income cut-off [b]	20 (55.6)	13 (76.5)	7 (36.8)	5.71	.02

[a] Responding parental figure.

[b] Due to missing values: N_{Total} =36, N_{BIO} = 17, N_{FF} = 19.

Table 2

Risk of children experiencing neglect being classified into a low language trajectory according to parent-child interactive features (IF) and parent linguistic features (LF) levels. Among the 41 children, the number who belongs to the low trajectory of percent words correct, receptive vocabulary, expressive vocabulary and MLU in morphemes was, respectively, 14, 24, 20 and 26.

	Risk of a low language trajectory in the child											
	Percent words correct (PWC)			Receptive vocabulary			Expressive vocabulary			MLU in morphemes		
Parent-child interactive features (IF) and linguistic features (LF) variables	Risk in % (n)	RR	Fisher p-value[a]	Risk in % (n)	RR	Fisher p-value[a]	Risk in % (n)	RR	Fisher p-value[a]	Risk in % (n)	RR	Fisher p-value[a]
IF-Sensitivity												
Never present (N=9)	55.6 (5)	**4.7**	**.02**	66.7 (6)	1.6	.10	55.6 (5)	1.3	.39	55.6 (5)	.8	.38
Sometimes present (N =15)	46.7 (7)	4.0		73.3 (11)	1.8		53.3 (8)	1.3		60 (9)	.9	
Often/always present (N =17)	11.8 (2)	1.0		41.2 (7)	1.0		41.2 (7)	1.0		70.6 (12)	1.0	
IF-Reactivity												
Never present (N=14)	57.1 (8)	**8.6**	**.005**	85.7 (12)	**2.1**	**.015**	64.3 (9)	1.6	.20	64.3 (9)	1.0	.92
Sometimes present (N=12)	41.7 (5)	6.3		50 (6)	1.3		41.7 (5)	1.0		58.3 (7)	.9	
Often/always present (N=15)	6.7 (1)	1.0		40 (6)	1.0		40 (6)	1.0		66.7 (10)	1.0	
IF-Reciprocity												

Never present (N=13)	61.5 (8)	**6.8**	**.01**	92.3 (12)	**2.5**	**.005**	76.9 (10)	**1.7**	**.02**	69.2 (9)	1.3	.39
Sometimes present (N=17)	29.4 (5)	3.2		47.1 (8)	1.3		29.4 (5)	.6		64.7 (11)	1.2	
Often/always present (N=11)	9.1 (1)	1.0		36.4 (4)	1.0		45.5 (5)	1.0		54.5 (6)	1.0	
LF-Number of words												
Low [b] (N=13)	53.8 (7)	2.3	.07	69.2 (9)	1.3	.30	61.5 (8)	1.3	.18	61.5 (8)	1.0	1.00
Moderate (N=13)	15.4 (2)	.7		46.2 (6)	.9		30.8 (4)	.7		61.5 (8)	1.0	
High (N=13)	23.1 (3)	1.0		53.8 (7)	1.0		46.2 (6)	1.0		61.5 (8)	1.0	
LF-Variety of words												
Low (N=13)	53.8 (7)	2.3	.08	69.2 (9)	1.5	.30	61.5 (8)	1.1	.07	61.5 (8)	1.1	.92
Moderate (N=13)	15.4 (2)	.7		53.8 (7)	1.2		23.1 (3)	.4		69.2 (9)	1.3	
High (N=13)	23.1 (3)	1.0		46.2 (6)	1.0		53.8 (7)	1.0		53.8 (7)	1.0	
LF-Number of utterances												
Low (N=13)	38.5 (5)	1.7	.45	61.5 (8)	1.0	.78	46.2 (6)	.9	.92	61.5 (8)	.9	.92
Moderate (N=13)	30.8 (4)	1.3		46.2 (6)	.7		38.5 (5)	.7		53.8 (7)	.8	
High (N=13)	23.1 (3)	1.0		61.5 (8)	1.0		53.8 (7)	1.0		69.2 (9)	1.0	

LF-MLU in morphemes												
Low (N=13)	46.2 (6)	2.0	.25	84.6 (11)	1.8	.025	76.9 (10)	**5.0**	**.005**	84.6 (11)	1.6	.06
Moderate (N=13)	23.1 (3)	1.0		38.5 (5)	.8		46.2 (6)	3.0		46.2 (6)	.9	
High (N=13)	23.1 (3)	1.0		46.2 (6)	1.0		15.4 (2)	1.0		53.8 (7)	1.0	

RR = Relative Risk

[a] One-sided p-values with significant threshold set to .025.

[b] For LF, the “low”, “moderate” and “high” performance levels are based on terciles of the rankings.

Table 3

Stratified analyses in the subsamples of children experiencing neglect living in their biological family (BIO) and in a foster family (FF) for the strongest associations found in the total sample (Table 2: N=41) with interactive features (IF) and linguistic features (LF).

	Percent words correct (PWC)				Expressive vocabulary		
IF-Reactivity	Risk in % (n)	RR	Fisher p-value[a]	LF-MLU in morphemes	Risk in % (n)	RR	Fisher p-value[a]
Subsample BIO (N=21)							
Never present (N=11)	54.6 (6)	**-**	.28	Low (N=8)	87.5 (7)	-	**.003**
Sometimes present (N=8)	50.0 (4)	-		Moderate (N=8)	25.0 (2)	-	
Often/always present (N=2)	0 (0)	-		High (N=4)	0 (0)	-	
Subsample FF (N=20)							
Never present (N=3)	66.7 (2)	8.7	**.03**	Low (N=5)	60.0 (3)	2.7	.06
Sometimes present (N=4)	25.0 (1)	3.2		Moderate (N=5)	80.0 (4)	3.6	
Often/always present (N=13)	7.7 (1)	1.0		High (N=9)	22.2 (2)	1.0	

[a] One-sided p-values.