

Fathers' infant-directed speech and its effects on child language development

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Abstract

Infant-directed speech (IDS), a speaking style distinguished by its higher pitch, slower tempo, and exaggerated intonation, has been documented in speech directed towards infants across many cultures and languages. Previous research shows that IDS in the context of parent-infant interactions is associated with advances in children's language learning. While we have long known that fathers, like mothers, produce IDS, most research on IDS to this day has focussed exclusively on female (maternal) speech. In light of the recent societal changes which have increased fathers' time spent in hands-on activities with children, I argue that the research on IDS needs to move away from using the maternal template. I first describe why IDS plays a central role in language development. I then outline known similarities and differences between paternal and maternal IDS, and point to potential biases and challenges within the research that has been conducted so far. Finally, I outline why investigators should strive to include fathers in research on IDS, and conclude with recommendations for follow-up work that can help advance our understanding of fathers' contributions to children's linguistic development.

1 | INTRODUCTION

Infant-directed speech (IDS) refers to a style of speech often used to address young children (Saint-Georges et al., 2013; The ManyBabies Consortium, 2020). Initially termed 'baby talk'

(Ferguson, 1964), later 'motherese', and then 'parentese' (Fernald, 1985; Fernald et al., 1989; Grieser & Kuhl, 1988), this speech register is distinguished from adult-directed speech (ADS) by a variety of segmental and prosodic features, including higher overall pitch and wider pitch range, slowed speech rate, exaggerated intonation contours, fewer and simpler lexical items, shorter utterances, and longer pauses between phrases (Cooper & Aslin, 1990; Fernald, 1985; Fernald et al., 1989; Fernald & Simon, 1984; Garnica, 1977; Grieser & Kuhl, 1988; Stern et al., 1983; Tang & Maidment, 1996). Infant-directed speech is used across cultures in spoken and signed languages by parents, grandparents, siblings, teachers, and adults who do not have their own children (Ferguson, 1964; Jacobson et al., 1983; Kuhl et al., 1997; Reilly & Bellugi, 1996). Across different languages, similarities and differences have been observed in specific linguistic aspects of IDS (Broesch & Bryant, 2015; Han et al., 2020; Narayan & McDermott, 2016). In addition to its unique linguistic signature, IDS is distinct from ADS in that it emphasises positive emotion through auditory and visual cues (Kim & Johnson, 2014; Singh et al., 2002; Trainor et al., 2000), uses distinct facial expressions (Kim & Johnson, 2014), and typically co-occurs with positive social interactions, including eye contact, joint attention, and interactive play (Golinkoff et al., 2015).

In terms of its effects on infants, IDS is reported to have four main functions: communicating affect, facilitating social interactions, engaging and maintaining infants' attention, and facilitating language learning (Saint-Georges et al., 2013). These processes are hypothesised to be the foundation for infants' preference for IDS over ADS, which has been demonstrated in study after study (e.g., see Cooper & Aslin, 1990; Fernald, 1985; Hayashi et al., 2001; Newman & Hussain, 2006; Santesso et al., 2007; Singh et al., 2002). The three most common methods for measuring infants' preference for IDS include head-turn preference, central fixation, and eye tracking (The ManyBabies Consortium, 2020). Recently, three large studies examined the robustness of these effects across cultures, procedures, languages, and laboratories. The first, by Dunst et al. (2012), examined data across 34 experiments and reported a robust effect size (Cohen's $d = 0.72$) for a preference of IDS over ADS. The second, published by The ManyBabies Consortium (2020), combined studies from 67 laboratories across North America, Europe, Australia, and Asia. The reported meta-analytic effect size across all studies was significant (Cohen's $d = 0.35$). The third study, also by The ManyBabies Consortium, examined the IDS preference across 17 laboratories in seven countries, and demonstrated that the preference for IDS is equally strong in bilingual and monolingual babies (Byers-Heinlein et al., 2021).

Within the field of language acquisition, the widespread use of IDS, along with infants' robust preference for it, has led researchers to postulate that IDS represents an ideal signal for language learning, due to its attentional-emotional, linguistic, and social cues (Golinkoff et al., 2015; Kuhl, 2007; Newport et al., 1977; Soderstrom et al., 2008). While the field generally agrees that IDS in the context of parent-infant interactions plays a central role in children's language development, the vast majority of research on IDS to this day has focussed exclusively on mothers, likely due to a combination of historical, societal, and economic reasons (reviewed in Section 3). However, given recent global social, economic, and demographic changes, many studies on IDS may not accurately reflect the language experiences of modern-day infants, in which fathers play an increasingly important role (Cabrera et al., 2000). This is particularly true in light of the ongoing COVID-19 pandemic, which has further reshaped parents' work and family life, and in many cases, has substantially increased fathers' time spent in hands on activities with their children (Craig & Churchill, 2021; Shafer et al., 2020). In this review, I argue that the traditional mother-centred view of IDS and its contributions to child language development may be incomplete. In contemporary society, most would agree that fathers matter to children's cognitive development (for review, see Volling et al., 2019). Within the field of developmental cognitive science,

multiple initiatives have recently been launched to include the topic of fathers more heavily in research and theory (Cabrera et al., 2007, 2014; Volling et al., 2019). As language development researchers, we cannot claim to have a thorough understanding of parental language input if paternal IDS is largely ignored. Before reviewing what we currently know about paternal IDS, I describe the role that IDS plays in language learning.

2 | IDS AND LANGUAGE LEARNING

Research studies using a range of procedures have illuminated the specific language learning mechanisms that are boosted through caregivers' usage of IDS. For example, Liu et al. (2003) demonstrated that the degree to which mothers exaggerate vowels in IDS correlates with infants' sound discrimination. Further, IDS has been shown to facilitate infants' word segmentation (Thiessen et al., 2005), word recognition (Singh et al., 2009), and fast mapping (Ma et al., 2011). Studies using naturalistic daylong recordings in infants' homes have linked exposure to IDS with enhanced child language production: Infants who hear more IDS produce higher rates of babbling at around one year of age and have greater productive vocabularies at 24 and 33 months of age (Ramírez-Esparza et al., 2014, 2016, 2017).

With the above findings in mind, a critical question to consider is *how* and *why* IDS helps infants in the process of learning language. The seminal work by Hart and Risley (1995) demonstrated that the total amount of speech heard by an infant is highly correlated with their language outcomes. Children whose parents talk less tend to have smaller vocabularies by the time they are three years old. This difference, known as the '30-million word gap', predicts children's IQ scores and academic success in grade school (cf. Golinkoff, Hoff, Rowe, Tamis-LeMonda, & Hirsh-Pasek, 2019; Hart & Risley, 1995; Rowe, 2012). Yet, a large body of research following these discoveries has come to a more refined conclusion: The sheer number of words that infants hear is insufficient to account for the observed variation in children's language development; the *quality* of language input also needs to be considered (e.g., see Conboy et al., 2015; Hirsh-Pasek et al., 2015; Hoff, 2006; Kuhl et al., 2008; Kuhl et al., 2014; Rowe, 2012; Tamis-LeMonda et al., 2014; Weisleder & Fernald, 2013). With its exaggerated acoustics and accompanying social behaviours, IDS is hypothesised to provide the ideal ('high quality') signal to facilitate language learning. The positive effects of IDS on language learning can be divided into three categories: attentional and emotional, linguistic, and social.

2.1 | Attentional and emotional effects of IDS

In order to learn language, infants must attend to it and discern it from other environmental sounds. As reviewed above, infants show a robust preference for IDS over ADS from very early on, and there are multiple potential reasons for this: First, as argued by Fernald (1992), IDS might have biological roots in the desire of a parent to comfort a child. Second, IDS draws infants' attention to the speaker, likely because of its highly salient acoustic qualities (Cusack & Carlyon, 2003). Research using neuroimaging supports these attentional findings, demonstrating that IDS results in more brain activation than ADS (Peter et al., 2016; Zangl & Mills, 2007). Furthermore, brain studies using continuous and natural IDS stimuli demonstrate that acoustic properties of IDS may facilitate infants' early speech processing and encoding (Kalashnikova et al., 2018; Naoi et al., 2012; Saito et al., 2007; Santesso et al., 2007). Third, while the prosody of

IDS changes with context (Fernald et al., 1989), IDS has been shown to convey positive emotions (Singh et al., 2002; Trainor et al., 2000) through higher mean fundamental frequency (F0) and exaggerated F0 modulations (Fernald & Simon, 1984). For example, expressing approval and eliciting attention in IDS are associated with large bell-shaped (up-down) pitch contours, while soothing is associated with lower-pitched, falling contours (Fernald et al., 1989; Katz et al., 1996). Of course, ADS can also express positive emotion in the auditory domain, and some studies suggest that the expression of emotion in IDS is not necessarily distinct from the expression of emotion in ADS. Rather, what is special about IDS is the widespread expression of emotion to infants, in comparison to the more inhibited expression of emotion in ADS (Trainor et al., 2000). Interestingly, mothers who have depression generally exhibit a ‘flatter’ vocal affect (indexed by reduced F0 modulations), and their infants show reduced learning from IDS (Kaplan et al., 2002). Finally, IDS is typically paired with exaggerated facial expressions (Kim & Johnson, 2014), which further engages infants in conversation with their caregivers and increases the frequency of positive social interactions that co-occur with IDS (Tamis-LeMonda et al., 2014).

2.2 | Linguistic effects of IDS

Infant-directed speech also impacts language learning because of its unique linguistic structure. Although notable variation from language to language has been observed (see e.g. Han et al., 2020; Narayan & McDermott, 2016), IDS generally has a higher pitch, greater pitch excursions, a slower tempo, elongated vowels, and an expanded vowel space in comparison to ADS (Fernald & Simon, 1984; Grieser & Kuhl, 1988; Kuhl et al., 1997; Stern et al., 1983). In addition, the vocabulary of IDS tends to be simple, with frequent repetitions and redundancies (McRoberts et al., 2009). Likewise, IDS utterances tend to be short and simple compared to ADS utterances, with many isolated words and phrases, frequent use of proper names, and a high number of questions (Durkin et al., 1982; Soderstrom et al., 2008).

A large and growing body of research demonstrates that the structural properties of IDS promote specific aspects of language learning. For example, IDS features an expanded ‘vowel triangle’. When plotted in acoustic space, the vowels form a triangle whose points are determined by vowels /i/, /a/ and /u/. These three vowels (called ‘corner vowels’ or ‘point vowels’) are farther apart in IDS than the same vowels in ADS, and the area of the triangle indexes the degree of vowel hyperarticulation. Expansions of the vowel triangle have been proposed to result in clearer, more intelligible speech (Bradlow et al., 1996). The larger acoustic difference between the corner vowels has been argued to simplify and improve the learnability of vowel categories (Kuhl et al., 1997), and the degree to which mothers hyperarticulate vowels has been related to infants’ expressive and receptive vocabulary sizes (Hartman et al., 2017; Kalashnikova & Burnham, 2018). Other linguistic properties of IDS, such as the preponderance of questions, have been proposed to highlight the syntactic regularities in the given language (Soderstrom et al., 2008).

2.3 | Social effects of IDS

Language uptake during parent–child exchanges is also enhanced as a result of positive social interactions, such as joint attention, gaze following, and interactive play, which are known to frequently co-occur with IDS and have been related to children’s vocabulary size (Brooks & Meltzoff, 2005; Hirsh-Pasek et al., 2015). According to social gating theory (Kuhl, 2007), language

learning relies on social interactions between caregivers and children, and IDS is proposed to be a crossroad facilitating these interactions (see also Hoff, 2006; Tamis-LeMonda et al., 2014). Through turn-taking in IDS, parents provide contingent feedback that is continuously adjusted to their infants' linguistic needs. Infants, in turn, adjust their vocalizations in response to parental vocalizations, increasing their complexity (Bornstein et al., 1999; Braarud & Stormark, 2008; Goldstein & Schwade, 2008; Smith & Trainor, 2008), thereby creating a positive feedback loop that further promotes language growth (Warlaumont et al., 2014). Parental use of IDS has recently been shown to enhance caregiver-infant turn-taking (Ferjan Ramírez et al., 2020), which is known to positively impact neural language processing (Merz et al., 2019; Romeo et al., 2018a, 2018b). That is, children who are engaged in more turn-taking exhibit greater brain activity in the left inferior frontal brain areas (Broca's area), which explains the relation between their language exposure and their verbal skills (Romeo, Leonard, et al., 2018).

3 | PATERNAL IDS

While there is a wide consensus that IDS plays an important role in language development and that early language experience has long-lasting consequences on language and cognitive development in general, most of the above reviewed research has focussed exclusively on female IDS. This is puzzling given that the acquisition of language skills occurs within social contexts with *many* caregivers (Bruner, 1981; Kuhl, 2007; Tomasello, 1992; Vygotsky, 1962)—including fathers.

There are multiple reasons why fathers remain mostly absent from research on IDS. Historically, fathers have been considered 'secondary caregivers' who are assumed to be less involved in childrearing. Accordingly, fathers are often excluded from laboratory research appointments, which are frequently attended only by the 'primary caregiver' (Cabrera et al., 2018).

A related reason stems from the social norms about appropriate roles of men and women in parenting in Western societies (Eagly & Wood, 2017). Fathers have traditionally been characterised as being the 'breadwinners' of the family, and also as being less involved in hands-on parenting, leading some to conclude that fathers do not spend enough time with their children to affect their lives emotionally (Amato & Gilbreth, 1999). Infant-directed speech conveys a positive affect and emotion that comforts the infant (Singh et al., 2002; Tarter, 1980), which some may view as conflicting with traditional male gender roles, such as being strong, masculine, and dominant (Kuo et al., 2018). However, recent studies have shown that fathers, like mothers, are warm and nurturing, and demonstrate sensitivity in their interactions with children (Tamis-LeMonda et al., 2013). As family values in Western societies are becoming increasingly egalitarian, and ideas of equal partnership in caretaking and working are now being endorsed by many (Cotter et al., 2011), the notion of the father who is not engaged in hands-on parenting is quite far from reality in many modern families (Cabrera et al., 2018).

Finally, investigators may continue to shy away from including fathers in research on IDS because it is too difficult, too expensive, or some might even think unnecessary, especially if mothers seem more available (Volling et al., 2019). For example, in many societies, paternity leave remains an outlier, and most fathers return to full-time work shortly after their child is born (Petts et al., 2020). Under such circumstances, adjusting data collection times to be convenient for fathers requires more effort, and often more resources from the investigators (e.g., paying personnel to work on weekends or after regular hours; see also Mitchell et al., 2007, for a discussion around challenges and increased costs related to father identification, recruitment, and retention in research studies). As a result, our view of IDS and its impact on child language development

continues to be centred around mothers and, as such, may be incomplete. For example, in a widely cited meta-analysis, Saint-Georges et al., 2013 found that only seven of out of 114 IDS studies included paternal speech. In the next section, I review the current literature on paternal IDS, focussing on similarities and differences between mothers and fathers in their IDS quantity (Section 3.1) and quality (Section 3.2).

3.1 | Quantity of paternal IDS

A number of studies report substantial quantitative differences between maternal and paternal speech in interactions with children, with fathers producing less input than mothers. Early work in this research line was summarised in a meta-analysis, which reported that fathers not only use less language overall compared to mothers, but also less supportive and more directive language than mothers (Leaper et al., 1998). Several more recent observational studies have confirmed the existence of a quantitative gap in IDS specifically between mothers and fathers (e.g., Kwon et al., 2013; Pancsofar & Vernon-Feagans, 2006). These studies have used multiple types of assessment (including video-recorded interactions between fathers and children); however, it should be noted that most father-child assessment measures were originally developed to assess mother-child interactions. While using such assessments is a reasonable first step, it is also likely that such assessments place lesser emphasis on parenting behaviours that are preferred by fathers, such as physical activity (Parke, 2002; Yeung et al., 2001) or rough-and-tumble play, which has been demonstrated to be important in the development of children's social and regulatory skills (Fletcher et al., 2013).

One way for studies to include more behaviours that may be preferred by fathers is to employ daylong recordings in children's naturalistic environments. Technologies such as LENA provide unobtrusive recordings of language input from *all* caregivers, via a lightweight recorder that can be snapped into a chest pocket of children's clothing to record everything that they hear (Gilkerson & Richards, 2020). LENA's acoustic modelling software supplies various estimates of exposure to adult speech, including Adult Word Count, which is further subdivided into words spoken by women and those spoken by men, defined as 'female adult nearby' (FAN) words and 'male adult nearby' (MAN) words. In a large scale semi-longitudinal study using LENA's FAN and MAN estimates, Gilkerson and Richards (2009) reported that mothers accounted for 75% of the total adult words spoken around children between two and 48 months of age. However, follow-up independent research assessing the reliability of LENA estimates demonstrated that classifications of adult word counts are significantly affected by both speaker gender and usage of IDS versus ADS (Lehet et al., 2021). For example, when male speakers use a higher pitch to address their infants, they are more likely to be erroneously tagged as FAN. Since multiple studies have confirmed systematic errors in LENA's automatic annotation (see also Bulgarelli & Bergelson, 2020; Cristia, Bulgarelli, & Bergelson, 2020; Cristia et al., 2020; Wang et al., 2020), researchers who are looking to distinguish maternal and paternal contributions are now encouraged to supplement their LENA analyses with manual annotations, which is extremely labour intensive, slow, and costly.

Using supplemental manual analyses with LENA, Bergelson et al. (2018) studied 61 North American families with infants between three and 20 months of age and reported that infants heard 2–3× more IDS from women than from men. While their use of manual annotation is a great step forward in avoiding the systematic biases of LENA's acoustic modelling, it is still possible that, at least in some of their participating families, fathers may not have been present

in the homes when the daylong recordings were collected. To avoid this potential bias, which would invariably lead to lower male word counts, Shapiro et al. (2021) conducted a longitudinal study of mother-father families with infants at 6, 10, 14, 18, and 24 months in which naturalistic daylong recordings were collected exclusively on weekends when both parents were home. This study used a combination of automatic LENA estimates and manual annotation, and found that infants were exposed to 46.8% fewer words from males than females, and to 51.9% less IDS from fathers than from mothers. Critically, in this study, paternal, but not maternal, IDS predicted children's concurrent linguistic vocalizations, possibly as a result of heightened salience to paternal IDS. The proposed hypothesis is that, under conditions where maternal IDS quantity is high, and/or significantly above its paternal counterpart, paternal IDS may become attentionally more salient within the input, allowing it to differentially relate to child vocalizations (Shapiro et al., 2021; see also; Pancsofar & Vernon-Feagans, 2006). Interestingly, Shapiro and colleagues report that both, paternal and maternal IDS increased from six to 24 months. However, the rate of increase was 2.8× faster in fathers compared to mothers, suggesting that the quantitative gap between maternal and paternal IDS may be particularly pronounced in early infancy, perhaps as a consequence of fathers spending a greater proportion of time interacting with their children in physical play activities, which younger infants may not yet engage in (Parke, 2002; Yeung et al., 2001). A previous study by Leaper et al. (1998) found that in general, the effect sizes associated with quantitative differences in maternal and paternal language input tended to be larger for younger children; however, due to a shortage of longitudinal data, this particular issue requires further investigation.

It is important to emphasize that several studies on quantitative differences between maternal and paternal IDS have also identified contextual factors that contribute to the observed variability in quantity of maternal versus paternal IDS. For example, studies report that, in dyadic interactions, mothers and fathers produce a similar amount of IDS (Bingham et al., 2013; Golinkoff & Ames, 1979; Rowe et al., 2004), but fathers use less IDS than mothers in triadic interactions (Golinkoff & Ames, 1979; Pancsofar & Vernon-Feagans, 2006), leading some researchers to propose that mothers may act as 'gatekeepers' (Altenburger et al., 2020; Beitel & Parke, 1998), and that fathers may feel less responsible for interacting with their children when the mother is present (Bingham et al., 2013). These findings further emphasize the point that children develop in a socially complex context in which mothers and fathers exert influence on their growth both individually and collectively through interactions with each other, amidst other contextual factors (Cabrera et al., 2014). Theories and models explaining the role of parental language input need to acknowledge these complexities.

3.2 | Quality of paternal IDS

While studies consistently report quantitative differences between paternal and maternal IDS, studies that focus on *qualitative* aspects of IDS report mostly similarities. As the field currently stands, paternal and maternal IDS are more similar than different in their prosodic, lexical-semantic, and syntactic characteristics, each of which are briefly reviewed below.

3.2.1 | Prosodic characteristics of paternal IDS

Research has identified two key prosodic and acoustic modifications of the speech signal within IDS: a higher perceived pitch, which corresponds to the fundamental frequency (F0) of the acoustic waveform, and an increased pitch range and variability compared to ADS (Estes & Hurley, 2013; Soderstrom, 2007). Notably, some research (predominantly with mothers) indicates that acoustic properties of IDS can change with infants' age (Narayan & McDermott, 2016). Pitch height, for example, has been shown to increase up until around 1 year of age, and then decreases around after ~16 months of age (Kitamura et al., 2002; Stern et al., 1983). However, stability has also been noted in specific acoustic components of IDS over time. For example, Kalashnikova and Burnham (2018) demonstrate that three components of maternal IDS (pitch, affect, and vowel hyperarticulation) did not vary between 7 and 19 months of age, although they may serve different functions depending on the child's age. Finally, some acoustic characteristics of IDS are known to vary from language to language (Han et al., 2020; Narayan & McDermott, 2016).

Studies using a variety of languages, such as English, Dutch, German, Japanese, and Hungarian, have consistently shown that fathers, like mothers, use a higher pitch in IDS compared to ADS (Amano et al., 2006; Fernald et al., 1989; Gergely et al., 2017; Jacobson et al., 1983; McRoberts & Best, 1997; Warren-Leubecker & Bohannon, 1984; Weirich & Simpson, 2019). Additionally, multiple studies have not detected meaningful differences when comparing maternal and paternal pitch raising in these languages (Fernald et al., 1989; Gergely et al., 2017; Jacobson et al., 1983; Weirich & Simpson, 2019). Regarding pitch variability, it is important to recognise that it can be characterised both within a single utterance and across utterances (Benders et al., 2021), and that differences between male and female speech have been identified with regards to how their pitch is varied at these two distinct levels. At the within-utterance level, which most studies focus on, Japanese- and English-speaking fathers have been shown to vary their pitch less than mothers; furthermore, at the within-utterance level, paternal IDS pitch variability has been shown to be similar to paternal ADS pitch variability (Amano et al., 2006; Fernald et al., 1989). However, at the cross-utterance level, Japanese-, English-, and Dutch-speaking fathers tend to speak with more variability in IDS than in ADS (Amano et al., 2006; Benders et al., 2021; Fernald et al., 1989), varying the pitch between their utterances to a similar or even greater extent than mothers (Benders et al., 2021). This is interesting and consistent with the idea that father-child interactions are characterised by 'bursts of energy' (Feldman, 2003) and a dynamic, playful, and energetic interaction style (Cabrera & Roggman, 2017), whereas mother-child interactions tend to be 'smooth' and 'flowing' (Feldman, 2003; Kokkinaki & Vasdekis, 2015). These findings are also important because they demonstrate the importance of employing a range of acoustic measures in order to fully capture the differences between paternal and maternal IDS.

3.2.2 | Lexical and semantic characteristics of paternal IDS

The literature with female caregivers has found strong and consistent links between lexical and semantic characteristics of maternal IDS and children's early language development (e.g., Hoff & Naigles, 2002; Huttenlocher et al., 2010; Pan et al., 2005; Rowe, 2012). The most commonly used measure is the diversity of parent vocabulary, calculated as the number of word types produced or the type-token ratio (i.e., the total number of unique words divided by the total number of all words). In general, studies report that maternal word types within IDS predict child

vocabulary growth to a greater degree than the sheer amount of maternal talk (e.g., see Huttenlocher et al., 2010; Pan et al., 2005).

Surprisingly few studies have considered lexical and semantic characteristics of paternal IDS. Earlier work includes a study by O'Brien and Nagle (1987), who studied 10 English-speaking families with children between 1.5 and 2 years of age during free play and reported no significant differences between mothers and fathers in their vocabulary diversity within IDS. In a similar context, Ratner (1988) found only minor differences between mothers' and fathers' type-token ratios but observed that fathers used a higher number of rare words and fewer common words than mothers. More recent work also reports few differences between mothers and fathers. For example, Pancsofar and Vernon-Feagans (2006) and Kwon et al. (2013) reported that, when controlling for the amount of talk, fathers' lexical diversity is just as high, if not higher, than that of mothers. Some studies also conjecture that fathers may be more challenging linguistic partners than mothers, as they may request more clarifications or repetitions and use lower frequency words (Majorano et al., 2013; Rowe et al., 2004; Tamis-LeMonda et al., 2012).

3.2.3 | Syntactic complexity of paternal IDS

In general, studies that relate maternal IDS speech complexity to child language growth report positive associations, both with respect to children's vocabulary growth, as well as their syntactic development (e.g., Hoff & Naigles, 2002; Hoff-Ginsberg, 1986; Huttenlocher et al., 1991). In contrast, studies considering the syntactic complexity of paternal IDS have yielded somewhat inconsistent results.

The most commonly used measure of syntactic complexity has been the mean length of utterance (MLU; calculated in words or morphemes, typically on a sample of 100 consecutive utterances collected in a recording session; Brown, 1973), although some studies also consider the diversity of sentence types, the number of *wh*-questions, yes-no questions, and/or the occurrence of specific syntactic structures. Two older studies reported a shorter MLU for fathers compared to mothers (McLaughlin et al., 1983; Rondal, 1980), though other studies, including some relatively recent ones, have not replicated this (Golinkoff & Ames, 1979; O'Brien & Nagle, 1987; Pancsofar & Vernon-Feagans, 2006; Rowe et al., 2004; Tamis-LeMonda et al., 2012). Rowe et al. (2004) report that, while mothers and fathers were similar in their MLU, fathers used significantly more *wh*-questions and more requests for clarifications than mothers; yet, earlier studies reported the opposite findings (Malone & Guy, 1982) or no significant differences between maternal and paternal question use (Golinkoff & Ames, 1979; Hladik & Edwards, 1984).

4 | WHY SHOULD WE STUDY PATERNAL IDS?

Given that paternal and maternal IDS are linguistically quite similar, and that children are typically exposed to less paternal IDS, one might wonder whether including fathers in research on IDS is really necessary. Will adding paternal data really make the needle budge? A growing body of research suggests that it might. As we have seen in Section 3.2, some differences between certain linguistic aspects of paternal and maternal IDS have already been noted. Given the paucity of research on paternal IDS in comparison to maternal IDS, it may very well be the case that other linguistic differences do exist that have not been uncovered yet. Perhaps even more importantly, a number of recent studies indicate that paternal IDS is directly related to

child language outcomes, and that maternal and paternal IDS can differentially relate to child language. For example, in a recent study by Shapiro and colleagues, it was paternal, not maternal, IDS that predicted infants' concurrent linguistic vocalizations between 6 and 24 months of age (Shapiro et al., 2021). Similar associations have been reported by other researchers, often after controlling for maternal language input and demographic factors (Leech et al., 2013; Pancsofar & Vernon-Feagans, 2006; Reynolds et al., 2019; Rowe et al., 2017; Tamis-LeMonda et al., 2012).

For example, a recent study with 50 Irish-English speaking father-child dyads found that fathers' pitch variability is associated with children's receptive vocabulary, independent of child age, gender, and expressive language ability (Quigley et al., 2019). In the domain of lexical semantics, Majorano et al. (2013) reported that Italian fathers' IDS noun frequency during free play at age two was significantly associated with their children's language production and comprehension at age three. Pancsofar and colleagues also reported a link between paternal use of different English verb roots within IDS at 24 months and children's expressive language skills at 36 months (Pancsofar & Vernon-Feagans, 2006), as well as a link between paternal vocabulary diversity during shared book reading in IDS at 6 months and language measures at 15 and 36 months (Pancsofar et al., 2010). In both studies, these associations were found after controlling for maternal language input, parental education levels, and quality of childcare. In the domain of syntactic complexity, Tamis-LeMonda et al. (2012) found that fathers' use of diverse IDS utterance types when children were 24 months of age was a unique predictor of their children's overall language at that age. Along similar lines, Rowe et al. (2017) and Leech et al. (2013) reported that fathers' use of English *wh*-questions within IDS at 24 months was positively associated with children's concurrent vocabulary and verbal reasoning skills. Finally, Reynolds and colleagues found that, in an economically and culturally diverse sample of families with children between six and 36 months of age, fathers' MLU and *wh*-questions during shared book reading in IDS were significantly associated with children's vocabulary upon Kindergarten entry (Reynolds et al., 2019).

While the described contributions of paternal IDS to child language development are meaningful and important, there are other reasons to move away from the maternal template. Infant-directed speech is not used in isolation, but within a social context that typically involves *multiple* caregivers. During the first two years of life, infants are known to benefit from exposure to live speech that is directed to them, as opposed to overheard speech or speech from an electronic source (Golinkoff et al., 2019; Kuhl et al., 2003; Shneidman et al., 2013; Weisleder & Fernald, 2013). This is also the period in development when infants are known to benefit from exposure to speech from multiple speakers (Rost & McMurray, 2009; Seidl et al., 2014). It is also possible that infants in this age range benefit from exposure to distinct behavioural styles that fathers are known to adopt (Cabrera & Roggman, 2017; Cabrera et al., 2000; Popenoe, 1996). Compared to mothers, fathers are often described as more energetic, playful, fun, stimulating, and physically active in their interactions with children (Cabrera & Roggman, 2017; John et al., 2013). Fathers demonstrate positive expressions in shorter and more frequent temporal cycles (Feldman, 2003; Kokkinaki & Vasdekis, 2015), are known to challenge their children to take calculated risks, and engage them in physical and rough-and-tumble play (Fletcher et al., 2013). As such, paternal and maternal language scaffolding through IDS is likely quite distinct. As we have reviewed in Section 3.1, much of the research on IDS within social interactions has ignored the study of parenting behaviours that may be preferred by fathers. In some recent studies that do include fathers and are conducted in naturalistic settings (e.g., the study by Shapiro and colleagues, which used LENA recordings collected in infants' homes *when the fathers were present*), paternal IDS has

been shown to uniquely predict child vocalizations within the first two years of life, despite being significantly less abundant than maternal IDS (Shapiro et al., 2021).

Another reason to study paternal IDS is its potential as a target for co-parenting and father-centred language interventions. A recent parent coaching intervention delivered to English-speaking families in 4 month intervals when the infants were six to 18 months old increased parental IDS and turn-taking, and enhanced infants' vocabulary (Ferjan Ramírez et al., 2020; Ferjan Ramírez et al., 2018). However, most parent coaching appointments in this study were attended exclusively by mothers, leaving us left to wonder whether and how interventions might specifically enhance *paternal* IDS. While fathers have been historically underrepresented in psychosocial intervention research (Tiano & McNeil, 2005), increases in positive outcomes have been reported when both parents are involved (Bagner, 2013; Lundahl et al., 2008). Furthermore, new father-centred interventions have enhanced the quality of father-child interactions (Barr et al., 2014; Chacko et al., 2017), and co-parenting interventions have been shown to enhance parenting quality (Feinberg et al., 2014; Schoppe-Sullivan et al., 2009). However, in preparation for designing father-centred or co-parenting IDS interventions, it will be important to first learn more about fathers' beliefs and attitudes surrounding IDS, the contexts in which paternal IDS is more or less likely to be used throughout infancy, in addition to the cultural, educational, and demographic variables that may contribute to variation in paternal IDS use. Father-centred or co-parenting interventions could be particularly powerful in communities where most infants grow up in two-parent households and where fathers may be more present and involved in infants' day-to-day activities, such as US families of Latinx descent (Lopez & Velasco, 2010), or certain European communities that offer extended paternal leave in infancy (Van Belle, 2016). Such interventions could also be of critical importance in families where members suffer from emotional disorders, such as maternal depression. Infants from two-parent households where mothers are depressed show reduced associative learning from maternal IDS, but enhanced learning from male IDS (Kaplan et al., 2010), suggesting that paternal IDS can hold a privileged status under certain circumstances.

5 | CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

Although the body of literature on fathers' language input to young children has grown significantly over the last few years, research on paternal IDS still pales in comparison to research on maternal IDS. Given the broad societal changes over the last few decades, including the increased participation of mothers in the workforce and the recent family changes related to the COVID-19 pandemic, the role that many fathers play in childrearing has changed, and the research on IDS needs to be adjusted to reflect these changes. While paternal and maternal IDS are similar in terms of their linguistic features, the social contexts and interactions that co-occur with paternal and maternal IDS can be quite distinct. Furthermore, recent research has demonstrated that specific features of paternal IDS can be uniquely predictive of child language outcomes, even after controlling for maternal contributions and demographic variables. What this means is that future studies on IDS should move away from using the maternal template. This will require using multiple methods, including daylong recordings that are collected when fathers are present (and that are analysed manually to avoid potential biases of automatic tagging), qualitative methods (e.g., focus groups and interviews with fathers), and laboratory research using male voices. Further, models of IDS and child language acquisition should be developed on the bases of a broad array of mothering and fathering behaviours, including behaviours that are similar for both parents,

more/less prevalent for one or the other parent, and more/less prevalent in dyadic versus triadic interactions. Such models should include variables that predict father involvement, variables that interact with father involvement, and variables that might influence paternal characteristics and thereby impact father involvement (see Cabrera et al., 2007). Together, these studies will enable researchers to uncover how fathers interact with and relate to their children, and how they engage in different activities through IDS.

Future research should also address paternal IDS within more diverse populations, such as non-White families, multilingual households, single-parent families, and families with same-sex parents. While fathers in mother-father households have been largely sidelined and deserve greater attention, this is even more true of LGBTQ + parents where research on IDS is virtually non-existent. Future research might also consider modelling parent gender as a variable that is multifaceted, rather than binary (Cameron & Stinson, 2019).

Finally, it is important to acknowledge that conducting research with fathers still presents challenges for investigators as it requires more effort, more resources, and often times a different approach to studying parenting behaviours (Mitchell et al., 2007; see also; Volling et al., 2019). For example, investigators will need to think of ways to recruit fathers and invite them to the laboratories in a way that makes fathers feel welcomed and important. Data will have to be collected in ways that accommodate fathers' schedules, and interventions will have to consider behaviours that fathers are comfortable engaging in. Research tools, beyond those that have been used with mothers, will have to be developed to assess, evaluate, and code father-child interactions. While these challenges remain, we cannot claim to have a thorough understanding of the role of parental language if we continue to exclude fathers just because it is too complicated or too expensive to include them.

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