



Stimulating language development in the first 1000 days: A scoping review

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ABSTRACT

Acquiring basic language skills is one of the key developmental milestones a child must reach in its early years. Failing to do so can be a sign of language disorders and can lead to problems in later life that can impede all other domains of child development, including socio-emotional development, cognitive development, and later academic achievement. Since parents play a crucial role in early language development, it is important to support them with best practices and provide them with evidence-informed knowledge on language development of their infant. In this scoping review, we narratively synthesized the current scientific literature on stimulating language development in the first 1000 days of life, including during pregnancy. Our synthesis of the current literature emphasizes that the first 1000 days are an extremely important period for language development and that stimulating language development should already start during pregnancy. Importantly, many factors that are central for language development are intervenable and therefore useful targets for public health policy and early prevention. This review can be used to provide professionals and policy makers with better evidence-informed tools and knowledge to support families. Increased parental knowledge may, in turn, improve language development of young children, and subsequently lead to less children starting school with language deficits at later ages and related problems later in life.

1. Introduction

Acquiring basic language skills is one of the key developmental milestones a child must reach in its early years. Failing to do so can lead to language problems and disorders in later life that can impede all other domains of child development, including socio-emotional development [1,2], cognitive development [3], and later academic achievement [4,5]. Pace, Alper [5] even found that language skills at kindergarten entry predicted academic outcomes the most broadly across domains. Yet, healthy language development is not only important for the individual itself, but also for society. Toddlers with immature language skills are found to show more physical aggression, although these effects are small and might not persist after early childhood [6]. Research has found that better higher order language skills (i.e., understanding ambiguity, understanding figurative language) are protective in

adolescents at risk for antisocial behavior [7]. Taken together, it is of the utmost importance for children and society to stimulate language development to promote a healthy, successful next generation.

The origin of language-relevant networks can already be found in the fetal brain [8,9]. The auditory nervous system undergoes primary developmental processes at 20 weeks of gestation [10] and becomes functionally active between GA week 18 and 25 [11,12], and first auditory stimulus-induced fetal body movements are detected at GA week 24 [13]. This indicates that fetuses are able to process and even respond to auditory input from the 5th month of gestation onwards. Furthermore, longitudinal research showed that more maternal intentional speaking to the fetus during pregnancy was associated with better communicative and language development at 18 months of postnatal age [14]. These findings underscore the enduring impact of prenatal auditory experiences on both short- and long-term aspects of infant

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development and demonstrate that stimulation of language development should already start *before* birth.

The Dutch government took responsibility to invest in the first 1000 days of life, starting at conception (or even before). In September 2018, the Dutch Ministry of Health, Welfare, and Sport launched the action program “Solid Start”, a nationally coordinated program that involves collaboration between medical and social-care professionals, policy-makers, parents and organizations [15,16]. While the program has generated a nationwide movement to support parents in providing the best possible start for their (unborn) child, some areas of child development are underrepresented within the program's action, such as stimulating typical language development. While there are multiple reviews on early language development [e.g.,17], many reviews focus on a very specific part of language development, such as infant-directed speech [18]. Additionally, to date, no review captures the whole first 1000 days, including the pregnancy period. The number of articles written on this topic is extremely high, making it impossible to systematically review all relevant articles. Moreover, the body of knowledge is heterogeneous in methods or disciplines. Given these characteristics of the literature, a scoping review is the best option for synthesizing [19].

In the current scoping review, we narratively synthesized the current scientific literature on stimulating language development in the first 1000 days of life. The synthesis answered the following research question: *According to the current scientific evidence, how can parents, caregivers, and day-care workers best stimulate and enhance language development in children between 0 and 24 months, including during pregnancy (or “the first 1000 days”)?* We divided this scoping review into three subsections to ease reading: 1) How, 2) What, and 3) When to talk to infants. In the first part, we review how parents and other caregivers usually talk to infants and young children and what type of interaction stimulates language development most. In the second part, we review the content of interactions with infants and young children in relation to language development. In the third part, we discuss the timing of interactions with infants and young children. Here, we discuss how timing

in interactions matters for language development. Finally, we provide a discussion of how parents and caregivers can be motivated to stimulate their child's language development and review some obstacles as well as opportunities. Along with this review, we provide a list of practical tips for anyone working with young children between the age of 0 and 2 years to stimulate language development, based on our reviewed evidence (see Fig. 1).

2. Method

We conducted a scoping review of the literature on stimulating language development in the first 1000 days of life. We followed the PRISMA-ScR guidelines as much as possible to ensure transparency and methodological rigor [19].

For this review, we chose to include studies that met the following criteria: (1) prospective and longitudinal; (2) published between 2000 and early 2025; (3) quasi-experimental, epidemiological, clinical or intervention design (relevant reviews were not included as part of our synthesis, but were mentioned when useful for further reading). To limit the scope of our review, we decided to exclude topics related to screen-use. This is an rapidly expanding literature that has been extensively reviewed elsewhere (for a review, see [20]).

We performed a search of electronic databases (MEDLINE, Web of Sciences, PsychINFO and Google Scholar). The electronic search was based on the following concepts: (1) terms related to early language development and language processing in early life (e.g., language learning, language comprehension, language delay, parent-child interaction) (2) terms related to parenting practices related to early language development (e.g., child-directed speech, infant-directed speech, motherese, parentese, child-directed singing), and 3) terms related to early language interventions (e.g., book reading, parenting practices). We started by including meta-analyses and review articles to identify the topics of interest. When topics were identified, we sometimes performed a secondary search including more specific search teams (e.g., onomatopoeia, mind-mindedness, mental-state talk).



Fig. 1. Tips to stimulate language development for parents of young children based on this scoping review. This Figure has been visually improved with the use of ChatGPT.

We focused on typical early language development and only included atypical development or literature on language disorder(s) when it contributed to the evidence on typical language development. While we only included studies between 2000 and 2025, some seminal papers from before 2000 were included in this scoping review, for instance papers in which a concept was introduced for the first time. Additionally, we only included peer-reviewed articles, written in English.

To minimize the number of references included, we adopted a process of selecting references in case multiple references covered the same topic or finding. First, systematic reviews and meta-analyses were given preference. If no review or meta-analysis was available, we continued by selecting the most recent publication. Only seminal papers were excluded from this process.

The literature was divided into three sections to ease reading: 1) How, 2) What, and 3) When to talk to infants. In the first part, we synthesized the literature on topics such as infant-directed speech, parental sensitivity, and turn-taking. In the second part, we review the content of interactions with infants and young children in relation with language development. Here, we synthesized the literature on topics including onomatopoeia, diminutives, reduplications, and mental state talk. In the third part, we discuss the timing of interactions with infants and young children. Here, the following topics were included: language stimulation during pregnancy, book reading, and child-directed singing. No review protocol was developed for this scoping review.

3. Results

3.1. How to interact with infants

The way we speak with infants and young children matters for their language development. In this section, we review the properties and benefits of infant-directed speech, the importance of facial cues and (parental) responsiveness for language development.

3.1.1. Infant-directed speech (IDS)

Most parents and other caregivers naturally adjust their communication when interacting with an infant [21–23]. This distinctive mode of speech has been called ‘babytalk’ or ‘motherese’/‘parentese’, and more appropriately just infant-directed-speech (IDS) [24]. IDS is used across many languages, with both commonalities and differences in features of IDS across cultures [22]. The amount of speech directed to infants differs across cultures, and is larger in urban than in rural populations [18]. The IDS adaptation occurs even if parents think they do not use it [25] and is adapted to the specific age and linguistic knowledge of the child [26,27].

While talking to infants, adults typically talk a bit slower [26], use a more melodic voice with exaggerated patterns of stress and intonation (prosody) [21,22], and keep longer pauses between utterances [28]. While pitch contours are generally more variable in IDS [29] the rhythm of speech is more regular in IDS, with especially a more regular spacing of stressed syllables [30]. While languages differ with regards to which unit is most important for rhythmic organization (e.g. stressed syllables vs. syllables), the more regular spacing of stressed syllables in IDS has also been found in so-called ‘syllable-timed’ languages such as Spanish [31].

Besides being important for regulating emotion [32] and enhancing attention [33], the use of infant-directed speech has been hypothesized to be beneficial for language acquisition [34]. Indeed, frequent exposure to IDS in infancy has been related to enhanced language development [35,36]. IDS helps infants to segment words from the continuous speech stream [37,38], and is beneficial for word recognition [39]. EEG research indicates that infant-directed speech enhances infants’ speech processing in the brain [e.g.,40,41,42].

Several studies have examined what properties of infant-directed speech are specifically beneficial for language acquisition. The prosody of IDS used by caregivers, especially the pitch contours and pitch

variability, is associated with individual infants’ language outcomes (see [43] for a meta-analysis). Speech rate also matters, as a mother’s slower speaking rate if their child is 7 months is related to the vocabulary of the child at 2 years [42]. The more regular spacing of stressed syllables in IDS can be beneficial for word-segmentation [44].

It is currently still debated why these properties of infant-directed speech are attracting attention and enhance learning. Recent hypotheses are for example that the more variable pitch contours of IDS might enhance surprisal to an optimal degree, increasing the saliency of speech [29,45]. At the same time, the more regular placement of especially stressed syllables enhances prosodic stress patterns in IDS. The rhythmic synchronization between the slower stressed syllable rate and the faster syllable and sound rates might serve to help children to parse linguistic units at different time scales (sounds, syllables, words), with the slower and more regular speech rhythm resulting in more optimal processing for the developing infant brain [46–50].

To conclude, adults automatically adapt their speech when talking to infants. This infant-directed way of speaking, talking slower and more regularly, with more pitch variation, seems to be beneficial for language acquisition processes. When parents are in (sensitive) interaction with their child, they will adapt their speech to their child’s needs.

3.1.2. Show your face

About forty years ago, Kuhl and Meltzoff [51] conducted a seminal study in which infants saw two simultaneously talking faces and the authors investigated which of the two visual speech streams infants attended. Specifically, 4- to 5-month-olds saw two talking faces, presented side-by-side, each repeatedly producing a particular vowel. While these competing visual speech streams (i.e., the talking faces provided articulatory lipread cues) were played, a single auditory vowel – that matched one of the two visual streams – was delivered. Infants preferred to look at the visual speech stream that matched the vowel they were hearing, indicating that they detected the correspondence between seen and heard speech. This effect has proven to be quite robust, and seems to surface already at around 2 months of age [52].

Interestingly, young infants are primarily focused on the eyes of the talker, but between 4 and 8 months of age, infants shift their attention to the mouth. In general, the moving mouth of a talker is assumed to provide an important cue on which infants can rely to disambiguate the incoming auditory speech signal [e.g.,53], but at around twelve months of age, infants (when exposed to their native language) seem to shift their attention back to the eyes which now become a relevant social cue [e.g.,53,54,55].

Other work in this area has focused on infant brain responses to congruent audiovisual speech versus incongruent audiovisual speech. In congruent speech, the visual speech stream matches the auditory stream, whereas in incongruent speech, the lip movements do not match the auditory stream. In general, the infant brain (at 5 months of age) indeed seems to be sensitive to audiovisual speech congruency when stimuli are syllables [56] or short sentences [57]. Moreover, brain response of six-month old infants also differs for congruent and incongruent audiovisual speech [58], although at that age, the brain response to unimodal versus audiovisual speech appears to be comparable [59]. These results indicate, that – within the first 6 months after birth – the infant brain already appears to be sensitive to the correspondence between auditory speech and the lipread signal.

Taken together, seeing the mouth and eyes of a speaker may have perceptual advantages for young infants. Depending on the developmental stage the infant is in, the main area of interest in a talking face is represented by the speaker’s eyes or mouth. Based these results, it may be beneficial for language development to provide an infant with opportunities to actively scan a talking face to allow the infant to focus their attention on whichever portion of the face that – at that particular time during development – can maximally support infant speech perception. However, adults who are interacting with an infant should not be too concerned with the exact portion of their face that is available

for the infant to see.

3.1.3. *Be sensitive*

To stimulate language learning, infants and toddlers need an interaction partner that is *in tune* with their needs and interests. Stimulating, sensitive interactions are characterized by *contingency* – a prompt and meaningful exchange [60,61]. For example, if an infant points at a toy and the parent remarks “That is a toy truck. What sound does it make?”, this is a contingent response because it is occurring directly after the infant’s action of pointing (it is prompt) and it relates to the infant’s behavior (it is meaningful). The nature of sensitive/contingent interactions changes with the age of the child, since the child becomes more active in the interaction over development [62]. While contingency in the newborn phase is more focused on *synchrony* – the match between parent and infant affect and behavior [63,64], contingent interactions after the first 6 months are more focused on the ability of the parent to follow their child’s behavior and respond meaningful and promptly to their actions [60]. Despite the different focus of contingent responses over development, all sensitive interactions between a parent and a young child are thought to create moments of shared attention, often referred to as “joint attention”, which is paramount for language learning [65].

A large body of research underscores the importance of parental sensitivity during interaction for language learning in the first two years of life (for a review, see [60]). For instance, maternal sensitivity has been found to predict the timing of children’s achievement of language milestones – the more sensitive the mother, the earlier the child achieved important milestones [61]. Importantly, the opposite also seems to be true: parental intrusiveness, an interaction style characterized by negative affect, controlling behaviors and overstimulation, has been shown to be related to worse language outcomes, such as poorer expressive language development [66,67] and slower vocabulary growth [68]. In contrast to sensitive, contingent interactions, intrusive interactions may disrupt moments of shared attention between parent and infant, which, in turn, may negatively affect language learning [65].

In sum, creating moments of shared (joint) attention by being sensitive to the child’s needs and interests is of key importance for language learning in the first 1000 days. Since the behavior and involvement of the child during interactions drastically changes over development, from passive to more active, different age periods require different skills from parents in facilitation optimal language learning during interaction.

3.1.4. *Take turns*

A rich social context of interaction is paramount for optimal early language learning. One important aspect of this rich context is an interaction partner to take turns with. Turn-taking is the process in which a parent and infant verbally respond to each other, even when the infant uses vocalization instead of actual words. Early turn-taking between an infant and an adult are called proto-conversations. Proto-conversation can be described as a structured, (nonlinguistic) vocal exchange between infants and their parents (or another person) [69,70]. Proto-conversations are reported to already develop around the age of 2–5 months [71] and some studies even reported to have observed proto-conversations in newborns, in the first few weeks after birth [e.g., 72].

Research has shown that conversational turn-taking and proto-conversations are associated with better language development. For instance, Donnelly and Kidd [73] found a longitudinal association between growth in infant turn-taking and growth in infant vocabulary, supporting the notion that these two skills mutually influence each other over development. Brain research also found that more frequent proto-conversations during a mother-infant interaction (at 4–6 months) was linked to higher neural synchrony between mother and infant [74].

Taken together, taking turns is an important element of a rich social context that can stimulate language development in young children.

Parents are encouraged to take part in turn-taking, or proto-conversation, from birth onwards.

3.2. *What to say to infants?*

Another important characteristic of interacting with infants to enhance language development is the content of the interaction. Some parents may adjust their vocabulary to include simpler words or even refer to objects with self-made words (e.g., “the woof woof” for dog). In this section we discuss whether this type of “baby-talk” is beneficial for the developing infant or whether it is better to use unadjusted vocabulary. Additionally, we discuss how asking questions within an interaction with an infant can stimulate attention and language learning.

3.2.1. *Baby-talk: to do or not to do?*

Infant-directed speech, as mentioned before, is thought to elicit a social response by slowing down the speed, simplifying the syntax, and increasing melodic intonation, all of which help to improve social communication. In addition to the way we speak to infants, many people also adjust their language *content* to the infant-listener. This concept of adjusting the language content is often referred to as ‘baby-talk’. Across languages, lexical items associated with ‘baby-talk words’ are distinguished by onomatopoeia, diminutives and reduplications [23,75,76]. Creating a term that imitates or sounds similar to the sound that the word is describing is known as onomatopoeia (e.g., ‘woof’ for ‘dog’ or ‘vroom’ for ‘car’), whereas the meaning of ‘small’ or ‘little’ is created by a diminutive (e.g., kitty, minibus, duckling). In reduplication, (part of) the root, stem, word or even the whole word is repeated exactly or with a slight change, such as ‘woof-woof’, ‘easy-peasy’ or ‘super-duper’.

Whether baby-talk words have an influence on language development has been a source of debate [23,75,77]. The sound characteristics of onomatopoeia make these baby-talk words easy to produce and to perceive [78,79]. This allows infants to be part of a simple conversation early on (e.g., “What does the doggie say?” “Woof”; [78]), giving them a reserve option for communication if they cannot produce the official word yet [80]. Furthermore, these onomatopoeia help children to form early mappings between a word form and its meaning [78]. However, the role of iconic words, with a resemblance with word form and word meaning (such as onomatopoeia), in word learning might be more difficult than supposed (for a review, see [80]). One study that explicitly tested the relationship between input characteristics and language development found that while iconic words in the input were not associated with vocabulary development, diminutives and reduplication in input were [81]. Note, however, that reduplication and diminutives most often co-occur with iconicity [82].

The use of reduplication and diminutives in the input has been found to help word segmentation [83,84], possibly because of sound regularities in the speech input. This gives the infant anchor points for word segmentation and further vocabulary development [84]. In a similar way, frequent repetitions of particular words within child-directed speech result in better word learning [85,86].

In conclusion, the use of baby-talk can be beneficial at particular stages in development where infants are starting to learn that speech word forms map to meaning (develops between 6 and 12 months; note that there are major individual differences) and can help them to segment words (develops between 6 and 9 months; again, note that there are major individual differences), thus bootstrapping their further language development. Parents do not have to be discouraged to use baby-talk but could be stimulated to create an age-appropriate, language-rich environment for their child.

3.2.2. *Asking questions*

Asking questions plays a significant role in shaping language development as it encourages children to speak more, which is associated with better language outcomes [87–89]. Often referred to as “conversation-eliciting speech,” or “clarification requests”, so-called WH-words,

including “what,” “where,” “when,” “who,” and “why,” are frequently used by caregivers to engage their child into conversations. Additionally, the concept of “clarification requests” adds another dimension to the interactive dynamics, highlighting the significance of seeking clarification (i.e., asking questions) to enhance mutual understanding.

The ability to ask and answer questions is an important aspect of children's language development and has been studied extensively [e.g.,87,88,90]. WH-questions are especially interesting since they may directly boost vocabulary development by motivating young children to respond verbally [91]. Importantly, even if a child is unable to respond verbally yet (i.e., at younger age), research has shown that asking questions and using WH-words can still be beneficial [92]. In fact, studies have shown that infants can already understand WH-questions, long before they can produce them themselves [93].

Many parents naturally ask questions to their child, even from a young age. Studies on frequency with which parents ask their children WH-questions have revealed that, at least in Western societies, parents ask their children WH-questions from a very young age, and that this frequency increases throughout early life [89]. For example, Pan, Imbens-Bailey [94] discovered an increase in both quantity and variety of questions asked by mothers of 14- to 32-month-olds.

The use of WH-questions by parents is associated with many benefits for language development. For example, children who are exposed to more WH-questions are better able to understand and produce these kinds of questions themselves [e.g.,87,88,90]. This, in turn, may elicit a richer language environment for these children (e.g., they may get more response from their conversation partner). According to research on shared book-reading interactions between mothers and toddlers, children who hear a higher frequency of WH-questions have increased vocabularies on average [95,96]. Research of Ninio [96] also indicated a relationship between the proportion of maternal WH-questions and vocabulary productivity, with more WH-questions being associated with larger infants' productive vocabulary. Rowland, Pine [88] demonstrated that acquisition of WH-questions could be accurately predicted based on the frequency with which specific WH-words and verbs occurred in the toddler's input by examining over 300 h of naturalistic audio data from two-year-olds and their mothers.

Taken together, it has been demonstrated that incorporating WH-words and clarification questions into daily interactions with infants and young children has a critical, positive role on early language development. Parents are advised to use WH-words and ask questions in daily conversations, from an early age on, even if their child is still too young to verbally respond to the question.

3.2.3. Mental state talk

Mental state talk refers to individual utterances and terms to describe abstract, invisible referents like desires (e.g. want/need; “Do you want the ball?”), cognitions (e.g. think/know; “Do you think Jack will win the race?”), beliefs and emotions (e.g. happy, sad; “I can see that you're excited to see Grandma”) about the self, child, other individuals or events [97]. Mental state talk that explicitly references the infant's mental state is termed, “mind-mindedness” [98], and when appropriate, accurately reflects the infants' mental state. Even when infants do not yet understand abstract mental states, emotion and mental state talk is a significant proportion of parent-infant conversation [97,99].

Earlier parent mental state talk and mind-mindedness seem predictive of later rather than concurrent language abilities [100,101], mental state language and emotion understanding [102]. Mother desire talk (e.g., “Do you want the toy?”) may be a particularly salient predictor of positive outcomes [102]. Similarly, frequency of maternal mind-minded comments that are attuned to the child's mental state at age 16 months was related to child internal-state language at 20 months [103]. Maternal mental state talk is thought to teach the child that mental state talk is important and promotes high-quality interactions that are sensitive, while also accurately scaffolding learning by labeling and verbalizing the mental state of the infant or other. Other research suggests

parent use of emotion words [104,105] and emotion word training [106] may foster children's learning of emotion labels, by helping children form meaningful categories of emotion. Finally, valence-consistent context for emotion experiences (e.g., “your smile tells me you are good and happy”) may aid learning of emotion and mental state language [107].

Through promoting child mental state talk and emotion language, parent emotion and mental state talk as well as mind-mindedness become important for positive socioemotional outcomes such as more advanced theory of mind, i.e., the ability to understand others' mental states and perspectives; [108,109,110] for emotion socialization, including prosocial behaviors [e.g.,111,112]. Labelling of emotions is related to effective emotion regulation, social skills and school-readiness [113].

Parents increase their use of mental state language, emotion words and appropriate mind-minded comments across infancy, toddlerhood and early childhood as children become more communicative partners [99,107,114,115]. Activities such as storybook telling and joint play encourage the use of mental state talk events [115]. In infancy, mental state talk is most helpful when referencing the mind in the here-and-now (e.g., “Your sister looks sad”), to better target the infant's focus of attention [116]. Emotions and mental states are less concrete and more abstract than early learned neutral words (e.g. “flower”). As a result, infants learn emotion and mental state language words later. Before 2-years of age, references to emotions (pleasure, distress) and desire terms (specifically “want”) seem to be the mental state terms most frequently used by parents [117,118]. When children are preverbal, parents respond to infant communicative skills of facial expressions and gestures. At this developmental stage, desires and emotions may provide more tangible reference to mental states because they are often accompanied by facial expressions and/or actions. By 18 months of age, infants use simple affective and desire language e.g. “happy” and “want”. Cognitive states such as thoughts and knowledge require meta-representation to understand, and therefore such terms are more frequently used by parents in later toddlerhood [119,120].

In sum, the use of emotion and mental state talk is associated with, not only aspects of child language development, but a range of socio-emotional developmental outcomes that are important for child social and academic success. Parents are advised to engage in developmentally appropriate emotion and mental state conversations across the first two years of life.

3.3. When to talk to infants?

There is major variability in the language input children receive in their early years. One contributing factor to this variability is the level of parental awareness regarding the importance of initiating conversations and engaging with their child, both in terms of the child's age and the timing within daily routines. Here, we show that meaningful interaction can already commence as early as during pregnancy. We further examine research findings pertaining to the frequency of daily conversations and the influence of established routines on language development in early childhood.

3.3.1. Start during pregnancy

The introduction to spoken language does not start from birth, but, instead, first exposure to language and speech-related attention, memory and learning already starts in utero [121]. From gestational age week 32 onward, the fetus exhibits temporal lobe fMRI-based activation [9] and engages in prenatal attention-related behavior (manifested as decreased arm and head movements or shift in heart rate) in reaction to the maternal voice [122–124]. Furthermore, the fetus demonstrates the ability to discriminate between different voices and sounds [125] and forms prenatal memory-traces of voice differentiation in the neonatal period [126]. Newborns already recognize their parents' voice, especially their mother's [127], and discriminate their native language from

languages with a different rhythm [128,129].

Importantly, the quantity of speaking or singing to the fetus may have short and long-term impact on parent-infant bonding, infant's behavior and language development. For instance, infants exposed to maternal singing of lullabies during pregnancy experienced fewer crying episodes, less infantile colic and fewer awakenings during the night in the neonatal period [130]. This study additionally revealed stronger mother-infant bonding and less maternal stress in the prenatal singing group as compared to the control group [130]. It is important to recognize that maintaining vocal contact with a fetus (or preterm infant), should also involve their fathers, siblings, nurses, and other caregivers [131]. Furthermore, longitudinal research showed that the frequency of maternal intentional speaking to the fetus between 6 and 9 months of pregnancy was positively associated with communicative and language development at 18 months of postnatal age [14]. These findings underscore the enduring impact of prenatal auditory experiences on both short- and long-term aspects of infant development.

Since the quantity and quality of prenatal communication have lasting implications for the unborn child, special care should be given to those women that are more at-risk for implicated prenatal communication. Research has demonstrated, for example, that pregnant women experiencing mood-related symptoms tended to report reduced instances of talking and singing to their unborn child, in comparison to healthy pregnant women [132]. This may bring offspring of mothers that experiences prenatal depression and/or anxiety at a disadvantage. Singing lullabies during pregnancy has been reported to benefit women in terms of relaxation, feeling closer to their infants, and providing an additional tool for communication in the early newborn period [133]. These findings underscore the importance of maternal speech and singing in prenatal development and highlight the potential for these activities to mitigate the impact of maternal mood-related symptoms, for both the mother and the unborn child. Importantly, the detrimental effects of maternal mental health issues are not confined to the prenatal period. Several studies have found higher risk for language delay in infants born to mothers with postpartum depression (for a review, see [134]).

Taken together, the fetal brain is ready to process audio-input, such as parental speech, from the start of the third trimester of pregnancy onward. While many parents intuitively talk to their unborn child, they are often not aware of the profound impact of talking on early language development and attachment of the child after birth. Talking and singing to the unborn child during pregnancy should therefore be stimulated by health care professionals working with expectant parents. Special care should be given to those women that are at-risk for implicated prenatal communication, such as women with prenatal mood and anxiety disorders.

3.3.2. Daily conversations

Communicating with (unborn) infants and young children does not have to take place during set times but can be done during daily tasks, everyday routines, and conversations. It does not matter if the child cannot (verbally) respond yet, as children develop receptive language abilities before their verbal or expressive language develops [135]. Receptive language is the internal processing and understanding of language. As receptive language continues to increase, expressive language begins to slowly develop. The impact of everyday conversations on language development depends on both the quantity and the quality of the conversations and words used. A recent meta-analysis showed that both quantity and quality are important for language development in early life, but that the effect of word quality was more robust than for word quantity [7]. Additionally, research has shown that the quality of language input matters for child vocabulary skills, even when quantity of language input was taken into account [26].

Both the quantity and quality of language can be integrated into everyday routines. Naturally occurring family routines, such as mealtime, can provide a predictable structure and an emotional climate that

supports early language development [136]. Importantly, different activities may promote varying features of child-directed talk. For example, several studies have investigated how different types of toys promote interacting with infants and young children. Here, studies reported that electronic toys (as compared to traditional, non-electronic toys) elicited lower quality and quantity of language input from parents towards their child during play sessions [137] and lower general interaction quality [138], suggesting that play with electronic toys should be discouraged. However, more research is necessary before strong conclusions about electronic toys in general can be drawn, for instance research in bilingual families or families with low socioeconomic status. Additionally, the type and content of the electronic toy should also be given more consideration. For instance, there is evidence that toddlers may learn more novel words from electronic books versus print books [139].

In sum, both the quantity and the quality of words that young children are exposed to in daily life matter for language development. Family routines, such as mealtimes, (nature) walks, and grocery shopping can be good opportunities for parents to have daily conversations with their child (even if their child is not yet able to speak). Including regular free play sessions in daily family routine, preferably with non-electronic toys, can also invite young children to engage in language learning.

3.3.3. Book reading

Joint book reading, or the shared experience of reading a (illustrated) book together, can be a crucial tool for promoting family communication and stimulating language development. Indeed, several elements of book reading make it a particularly important activity. For instance, compared to mealtime and free play activities, book reading scored highest on word richness [140]. While reading, parents often use words and concepts that are not frequently used or encountered in daily language. Furthermore, in books, words are often repeated in a varied context (i.e. pictures, events, surrounding words), which helps children to infer the meaning of words [141,142]. Research suggests that shared reading helps develop the predictive brain [143], and enhances neural synchrony between child and parent [144]. Interestingly, parents talked more with their infants on days that they were prompted to read to their infants, compared to a typical day [145]. Together, these benefits make shared book reading a great activity for parents to stimulate language development.

While there is clear evidence on the beneficial effect of shared (picture) book reading for language development in children [e.g.,141,146,147,148], there has also been controversy about at what age shared book reading should be initiated. Young infants, before the age of 6 months, may not be able to benefit from shared reading yet, for instance due to immature attention systems [149]. Moreover, many parents find it unnecessary or even uncomfortable to read to preverbal infants as they cannot keep attention for long and do not give clear verbal responses yet. It is however good to realize that from around 6–9 months infants already know the meaning of many common words [150]. Accumulating research has shown that it is already beneficial to read to infants as young as 8–9 months of age [e.g.,147,151,152]. For example, frequency of shared book reading at 9 month-olds was related to language skills at 18 months, and this association was not mediated by the attention skills of the 9-months olds [153]. Whether it is also beneficial to read to younger infants is still an open question, since there are only very few studies on the benefits of shared book reading that included infants younger than 9 months. One study, by Karrass and Braungart-Rieker [152], showed that shared book reading at 8 months, but not at 4 months, was related to better language abilities later in life (12–18 months). However, shared reading at 4 months did predict shared reading at 8 months, suggesting that early shared reading may help establish reading routines that continue as infants develop the cognitive ability to take full advantage from active engagement with books [152]. Additionally, studies have found that the earlier parents

started shared book reading with their child, the better the subsequent language abilities of the child [154,155]. Because these analyses were correlational, they cannot establish whether there is an optimal age for initiating shared reading or whether the observed association between early shared reading and language development may be partly attributable to parental reading ability [156].

It has, however, been shown that shared book reading with young infants can prompt the use of a wider vocabulary. For example, Wu and colleagues video-recorded mothers while they were playing with and reading to their 6-month-old infant. Already at 6 months, mothers used a more diverse vocabulary when they were reading compared to when they are playing with their infant, and diversity of vocabulary was related to vocabulary at 18 months [157]. Based on these findings, we could argue that reading from birth is beneficial. However, more research is still necessary to draw firm conclusions on the potential benefits of shared book reading before the age of 9 months.

There are several ways in which parents can share a book with their young children – they could read a book *to* their child (passive) or *with* the child (interactive). Research has suggested that the latter type of reading, interactive reading, is more effective in increasing child's later vocabulary as compared to typical (or passive) reading [158]. Interactive reading has also been coined *dialogic reading*, which is a specific approach to shared book reading that has been described as an interactive reading technique in which the parent asks questions, points to pictures and provides informative feedback to the child [159]. A meta-analysis showed that dialogical reading has a positive impact on a wide range of language skills, increases child enjoyment of reading and improves later reading motivation and that it may have positive effects on parent-child attachment [158]. Note that the studies analyzed in this meta-analysis did not have active control groups, with control groups just reading as usual without any intervention.

Sharing a book with a preverbal infant in an interactive way may not come natural to all parents. In fact, observational studies have shown that many parents do not apply interactive reading techniques spontaneously [160,161]. In contrast, a more recent study explored the use of different types of dialogical reading techniques in parents of 12-month-olds and found that parents of young children do, in fact, used some strategies spontaneously while they omitted others [162]. For instance, all parents in the study used Wh-questions and Yes/No-questions while reading. However, when zooming in on the Wh-questions, it turned out that none of the parents used any When-questions or Why-questions. They mostly used Where- and What-questions, followed by Who- and How-questions. Parents also used very few repeating, recall, and completion as strategies [162]. A meta-analysis by Dowdall, Melendez-Torres [163] concluded that parent's use of interactive reading strategies can be enhanced with intervention and that, subsequently, child language development was improved (as compared to no intervention). Shorter, less intensive interventions were found to be less effective. Another meta-analysis on the effectiveness on shared reading interventions for parents found only small effects [164]. Importantly, the meta-analysis of Noble and colleagues established that while the effectiveness of a shared reading intervention compared to a passive control group (i.e., no intervention) was robust, there was no difference with active control groups (for example a group training in visuo-motor skills). This suggests that, especially for less intensive interventions, the established effects are non-specific [164].

Taken together, research clearly showed that shared (picture) book reading is beneficial for child language development, already from an early age. Even preverbal infants, as young as 8 months, may benefit from reading books with their parents and other caregivers. Even though there is no clear evidence for benefits of shared book reading before 8 months, parents could still be promoted to start reading habits as early as possible. When reading, parents can be encouraged to engage their child by asking questions and pointing to pictures (even if the child is preverbal and no response is expected). Importantly, research showed that many parents do not apply interactive reading techniques

spontaneously and training them seems to improve this skill. However, not all interventions were found effective, especially those that were short and less intensive.

3.4. Practical implications: How to inform parents?

3.4.1. Informed parent, better language development?

Several studies have shown that a better-informed parent is related to more supportive parenting strategies and better child language outcomes. One study in parents of low social-economic status, for instance, showed that parental knowledge one week after birth was associated with the amount of supportive parenting (responding to cues, fostering social-emotional and cognitive growth) at 9 months of age – higher parental knowledge was associated with higher amount of these supportive parenting strategies [165]. But is training parents to implement better strategies to support child language development an effective way to improve long-term outcomes in the child? A meta-analysis by Roberts, Curtis [166] of 76 studies found that training of parents indeed improved language outcomes in the child. It also improved parental use of language support strategies. Moreover, several studies have confirmed mediation effects of parental knowledge on the association between parental training and child language outcomes [e.g.,167]. Taken together, more parental knowledge seems to indeed lead to better language outcomes in the child, and interventions to improve parental strategies to support language development can be effective for both parent and child outcomes.

3.4.2. Just giving tips may not be enough

Improving parenting strategies can be done in many ways and numerous programs and interventions have been developed over the years. These vary from low-intensity community programs targeting everyone to intensive interventions for at-risk parents. A meta-analysis of shared picture book reading interventions for child language development showed that these type of interventions were effective in improving child expressive and receptive language, and in improving caregiver book-sharing competence [163]. Importantly, the results indicated that the doses of the program mattered: the shorter and less intense, the smaller the effect [163]. However, another meta-analysis on shared book reading interventions concluded that the effect of the interventions was negligible when only looking at those studies with an active control group, suggesting that the effect of the intervention can be best described as a non-specific effect [164]. Few studies have investigated the delivery type of the language interventions for parents. A study by Huebner and Meltzoff [168] showed that interventions to improve parental strategies to improve language development seem more effective when provided in-person (as compared to video-guided or self-guided training). Furthermore, evidence of the effectiveness of low-intensity community programs seems limited. For instance, a large randomized controlled trial evaluating a low-intensive population-wide primary care literacy promotion and book distribution program did not yield the anticipated benefits to literacy and language nor enhanced uptake of literacy activities [169]. Another low-intensive population-based intervention targeted at slow to talk toddlers also showed little evidence for improvement in the children [170]. Taken together, research seems to suggest that more intensive interventions, provided in-person are more effective in improving parenting strategies and child language outcomes. However, the downside of more intensive interventions is that they are often more expensive and therefore less accessible. In practice, an intensive intervention cannot be given to each parent. More research on language interventions, their implementation and their cost-effectivity are necessary.

3.4.3. Families living in poverty

Professionals should attune their training and tips to the situation of the family. The child's range of experiences, for instance, may be influenced by their caregiver's economic situation or socioeconomic

position [171,172]. For some families it may not be possible to buy books or toys to stimulate language development or to visit new and stimulating locations, such as a Zoo or a museum. When reaching out to parents to inform them about language stimulating practices, we should be mindful of these individual differences. Importantly, we should communicate that expensive books and trips are not necessary for successful language acquisition. Young children will learn from interaction, regardless of whether this takes place in a public park or at a museum. Still, policy should be focused on overcoming poverty-related barriers for families, especially those with young children. Research from the Baby's First Years study (<https://www.babysfirstyears.com/>), for instance, showed that an unconditional cash intervention (giving cash to low-income families) was associated with purchasing more infant-specific goods (like books and toys) and mothers spending more time on early learning activities with their infants [173].

4. Conclusion

The aim of this review was to provide an overview of evidence-informed practices to stimulate and enhance language development in the first 1000 days. Our synthesis of the current literature emphasizes that the first 1000 days are an extremely important period for language development and that stimulating language development should already start during pregnancy. Importantly, many factors that are central for language development are intervenable and therefore useful targets for public health policy and early prevention. This review is accompanied by a selection of evidence-informed tips for enhancing language development in the first 2 years of life, including pregnancy, based on the synthesized literature (see Fig. 1). These tips, together with this scoping review, can be used to provide professionals and policy makers with better evidence-informed tools to support and inform parents. Increased parental knowledge may, in turn, improve language development of young children. However, our review also showed that just providing parents with tips may not be enough. Targeted interventions and community programs should be developed and evaluated to implement these tips into practice. Importantly, professionals should focus on empowering parents but be mindful of stressing parents when providing training and tips. The joy of parent-child interaction should remain key.

CRedit authorship contribution statement

M.I. van den Heuvel: Writing – review & editing, Writing – original draft, Visualization, Methodology, Conceptualization. **T.M. Snijders:** Writing – review & editing, Writing – original draft. **M. Baart:** Writing – review & editing, Writing – original draft. **E. Turk:** Writing – review & editing, Writing – original draft. **M.M.E. Zandbergen:** Writing – review & editing, Writing – original draft. **M. McLean:** Writing – review & editing, Writing – original draft. **M. Sitskoorn:** Writing – review & editing, Funding acquisition.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors did not use any generative AI or AI-assisted technologies. Fig. 1 has been visually improved (icons added) with the use of ChatGPT.

Declaration of competing interest

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Data availability

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

References

- [1] E. Donolato, et al., Research review: language and specific learning disorders in children and their co-occurrence with internalizing and externalizing problems: a systematic review and meta-analysis, *J. Child Psychol. Psychiatry* 63 (5) (2022) 507–518.
- [2] E. Rose, et al., Long-term relations between children's language, the home literacy environment, and socioemotional development from ages 3 to 8, *Early Educ. Dev.* 29 (3) (2018) 342–356.
- [3] T. Flensburg-Madsen, E.L. Mortensen, Language development and intelligence in midlife, *Br. J. Dev. Psychol.* 37 (2) (2019) 269–283.
- [4] R.E. Durham, et al., Kindergarten oral language skill: a key variable in the intergenerational transmission of socioeconomic status, *Research in Social Stratification and Mobility* 25 (4) (2007) 294–305.
- [5] A. Pace, et al., Measuring success: within and cross-domain predictors of academic and social trajectories in elementary school, *Early Child. Res. Q.* 46 (2019) 112–125.
- [6] L.-C. Girard, et al., Physical aggression and language ability from 17 to 72 months: cross-lagged effects in a population sample, *PLoS One* 9 (11) (2014) e112185.
- [7] N.J. Anderson, et al., Linking quality and quantity of parental linguistic input to child language skills: a Meta-analysis, *Child Dev.* 92 (2) (2021) 484–501.
- [8] E. Turk, et al., Functional connectome of the fetal brain, *J. Neurosci.* 39 (49) (2019) 9716–9724.
- [9] R. Jardri, et al., Assessing fetal response to maternal speech using a noninvasive functional brain imaging technique, *Int. J. Dev. Neurosci.* 30 (2) (2012) 159–161.
- [10] S.N. Graven, J.V. Browne, Auditory development in the fetus and infant, *Newborn Infant Nurs Rev* 8 (4) (2008) 187–193.
- [11] R. Lim, A.M. Brichta, Anatomical and physiological development of the human inner ear, *Hear. Res.* 338 (2016) 9–21.
- [12] E. Borsani, et al., Correlation between human nervous system development and acquisition of fetal skills: an overview, *Brain Dev.* 41 (3) (2019) 225–233.
- [13] B.S. Kisilevsky, J.A. Low, Human fetal behavior: 100 years of study, *Dev. Rev.* 18 (1) (1998) 1–29.
- [14] A.D. Vedova, V. Tomasoni, A. Imbasciati, Mother-fetus communicative relationship: a longitudinal study on 58 primiparae and their children during the first eighteen months, *J. Prenat. Perinat. Psychol. Health* 20 (3) (2006) 249–262.
- [15] L. Schreiber, *A Solid Start for Every Child: The Netherlands Integrates Medical and Social Care, 2009–2022*, Trustees of Princeton University, 2022.
- [16] E.A.P. Steegers, et al., A good start for all children: integrating early-life course medical and social care through solid start, the Netherlands' nationwide action programme, *Health Policy* 152 (2025) 105219.
- [17] S. Reilly, C. McKean, Creating the conditions for robust early language development for all-part 1: evidence-informed child language surveillance in the early years, *Int. J. Lang. Commun. Disord.* 58 (6) (2023) 2222–2241.
- [18] A. Cristia, A systematic review suggests marked differences in the prevalence of infant-directed vocalization across groups of populations, *Dev. Sci.* 26 (1) (2023) e13265.
- [19] A.C. Tricco, et al., PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation, *Ann. Intern. Med.* 169 (7) (2018) 467–473.
- [20] E. Swider-Cios, A. Vermeij, M.M. Sitskoorn, Young children and screen-based media: the impact on cognitive and socioemotional development and the importance of parental mediation, *Cogn. Dev.* 66 (2023) 101319.
- [21] A. Cristia, Input to language: the phonetics and perception of infant-directed speech, *Lang. Linguist. Compass* 7 (3) (2013) 157–170.
- [22] A. Fernald, et al., A cross-language study of prosodic modifications in mothers' and fathers' speech to preverbal infants, *J. Child Lang.* 16 (3) (1989) 477–501.
- [23] M. Soderstrom, Beyond babytalk: re-evaluating the nature and content of speech input to preverbal infants, *Dev. Rev.* 27 (4) (2007) 501–532.
- [24] M. Saxton, What's in a name? Coming to terms with the child's linguistic environment, *J. Child Lang.* 35 (3) (2008) 677–686.
- [25] A.G. Ramirez, E. Herbst, R.M. Golinkoff, Maternal beliefs about infant-directed speech misalign with interactions with their infants, *Front. Dev. Psychol.* 1 (2023).
- [26] M.L. Rowe, A longitudinal investigation of the role of quantity and quality of child-directed speech in vocabulary development, *Child Dev.* 83 (5) (2012) 1762–1774.
- [27] G. Genovese, et al., Infant-directed speech as a simplified but not simple register: a longitudinal study of lexical and syntactic features, *J. Child Lang.* 47 (1) (2020) 22–44.
- [28] B. Ludusan, et al., Learnability of prosodic boundaries: is infant-directed speech easier? *J. Acoust. Soc. Am.* 140 (2) (2016) 1239.

- [29] O. Räsänen, S. Sakouros, M. Soderstrom, Is infant-directed speech interesting because it is surprising? – linking properties of IDS to statistical learning and attention at the prosodic level, *Cognition* 178 (2018) 193–206.
- [30] V. Leong, et al., The Temporal Modulation Structure of Infant-Directed Speech, 2017.
- [31] J. Pérez-Navarro, et al., Local temporal regularities in child-directed speech in Spanish, *J. Speech Lang. Hear. Res.* 65 (10) (2022) 3776–3788.
- [32] A. Fernald, Approval and disapproval: infant responsiveness to vocal affect in familiar and unfamiliar languages, *Child Dev.* 64 (3) (1993) 657–674.
- [33] ManyBabiesConsortium, Quantifying sources of variability in infancy research using the infant-directed-speech preference, *Adv. Methods Pract. Psychol. Sci.* 3 (1) (2020) 24–52.
- [34] C. Farwell, C. Snow, C. Ferguson, Talking to children: language input and acquisition, *Language* 55 (1979) 449.
- [35] A. Weisleder, A. Fernald, Talking to children matters: early language experience strengthens processing and builds vocabulary, *Psychol. Sci.* 24 (11) (2013) 2143–2152.
- [36] N. Ramírez-Esparza, A. García-Sierra, P.K. Kuhl, Look who's talking: speech style and social context in language input to infants are linked to concurrent and future speech development, *Dev. Sci.* 17 (6) (2014) 880–891.
- [37] E.D. Thiessen, E.A. Hill, J.R. Saffran, Infant-directed speech facilitates word segmentation, *Infancy* 7 (1) (2005) 53–71.
- [38] M.S. Schreiner, N. Mani, Listen up! Developmental differences in the impact of IDS on speech segmentation, *Cognition* 160 (2017) 98–102.
- [39] L. Singh, et al., Influences of infant-directed speech on early word recognition, *Infancy* 14 (6) (2009) 654–666.
- [40] G.P. Haden, et al., Newborn infants differently process adult directed and infant directed speech, *Int. J. Psychophysiol.* 147 (2020) 107–112.
- [41] K.H. Menn, et al., Natural infant-directed speech facilitates neural tracking of prosody, *NeuroImage* 251 (2022) 118991.
- [42] D. Raneri, et al., Change in maternal speech rate to preverbal infants over the first two years of life, *J. Child Lang.* 47 (6) (2020) 1263–1275.
- [43] M. Spinelli, M. Fasolo, J. Mesman, Does prosody make the difference? A meta-analysis on relations between prosodic aspects of infant-directed speech and infant outcomes, *Dev. Rev.* 44 (2017) 1–18.
- [44] S. Curtin, T.H. Mintz, M.H. Christiansen, Stress changes the representational landscape: evidence from word segmentation, *Cognition* 96 (3) (2005) 233–262.
- [45] C. Kidd, S.T. Piantadosi, R.N. Aslin, The goldilocks effect in infant auditory attention, *Child Dev.* 85 (5) (2014) 1795–1804.
- [46] U. Goswami, Speech rhythm and language acquisition: an amplitude modulation phase hierarchy perspective, *Ann. N. Y. Acad. Sci.* 1453 (1) (2019) 67–78.
- [47] K.H. Menn, C. Männel, L. Meyer, Does electrophysiological maturation shape language acquisition? *Perspect. Psychol. Sci.* 18 (6) (2023) 1271–1281.
- [48] M.L. Nencheva, C. Lew-Williams, Understanding why infant-directed speech supports learning: a dynamic attention perspective, *Dev. Rev.* 66 (2022) 101047.
- [49] T.M. Snijders, K.H. Menn, Maturation constraints on tracking of temporal attention in infant language acquisition, in: L. Meyer, A. Strauss (Eds.), *Rhythms of Speech and Language*, Cambridge University Press, Cambridge, 2026, pp. 664–686.
- [50] L.E. Hahn, P. Fikkert, T. Benders, Music in first language acquisition, in: D. Sammler (Ed.), *The Oxford Handbook of Language and Music*, Oxford University Press, 2026.
- [51] P.K. Kuhl, A.N. Meltzoff, The bimodal perception of speech in infancy, *Science* 218 (4577) (1982) 1138–1141.
- [52] M.L. Patterson, J.F. Werker, Two-month-old infants match phonetic information in lips and voice, *Dev. Sci.* 6 (2) (2003) 191–196.
- [53] D.J. Lewkowicz, A.M. Hansen-Tift, Infants deploy selective attention to the mouth of a talking face when learning speech, *Proc. Natl. Acad. Sci. USA* 109 (5) (2012) 1431–1436.
- [54] F. Pons, L. Bosch, D.J. Lewkowicz, Twelve-month-old infants' attention to the eyes of a talking face is associated with communication and social skills, *Infant Behav. Dev.* 54 (2019) 80–84.
- [55] T. Bastianello, et al., Infant looking preferences towards dynamic faces: a systematic review, *Infant Behav. Dev.* 67 (2022) 101709.
- [56] E. Kushnarenko, et al., Electrophysiological evidence of illusory audiovisual speech percept in human infants, *Proc. Natl. Acad. Sci.* 105 (32) (2008) 11442–11445.
- [57] D.C. Hyde, et al., Neural signatures of face–voice synchrony in 5-month-old human infants, *Dev. Psychobiol.* 53 (4) (2011) 359–370.
- [58] N. Altvater-Mackensen, T. Grossmann, The role of left inferior frontal cortex during audiovisual speech perception in infants, *NeuroImage* 133 (2016) 14–20.
- [59] N. Altvater-Mackensen, T. Grossmann, Modality-independent recruitment of inferior frontal cortex during speech processing in human infants, *Dev. Cogn. Neurosci.* 34 (2018) 130–138.
- [60] L.R. Masek, et al., Where language meets attention: how contingent interactions promote learning, *Dev. Rev.* 60 (2021) 100961.
- [61] C.S. Tamis-LeMonda, M.H. Bornstein, L. Baumwell, Maternal responsiveness and children's achievement of language milestones, *Child Dev.* 72 (3) (2001) 748–767.
- [62] M.H. Bornstein, et al., Maternal responsiveness to young children at three ages: longitudinal analysis of a multidimensional, modular, and specific parenting construct, *Dev. Psychol.* 44 (3) (2008) 867–874.
- [63] R. Feldman, C.W. Greenbaum, Affect regulation and synchrony in mother–infant play as precursors to the development of symbolic competence, *Infant Ment. Health J.* 18 (1) (1997) 4–23.
- [64] R. Feldman, Mother-infant synchrony and the development of moral orientation in childhood and adolescence: direct and indirect mechanisms of developmental continuity, *Am. J. Orthop.* 77 (4) (2007) 582–597.
- [65] M. Tomasello, M.J. Farrar, Joint attention and early language, *Child Dev.* 57 (6) (1986) 1454–1463.
- [66] M. Bruce, et al., Expressive language in infancy and toddlerhood: the roles of child temperament and maternal parenting behaviors, *Dev. Psychobiol.* 64 (6) (2022) e22287.
- [67] A.R. Clincy, W.R. Mills-Koonce, Trajectories of intrusive parenting during infancy and toddlerhood as predictors of rural, low-income African American boys' school-related outcomes, *Am. J. Orthop.* 83 (2–3) (2013) 194–206.
- [68] E.P. Pungello, et al., The effects of socioeconomic status, race, and parenting on language development in early childhood, *Dev. Psychol.* 45 (2) (2009) 544–557.
- [69] V. Nguyen, et al., A systematic review and Bayesian meta-analysis of the development of turn taking in adult–child vocal interactions, *Child Dev.* 93 (4) (2022) 1181–1200.
- [70] H.C. Hsu, A. Fogel, Stability and transitions in mother–infant face-to-face communication during the first 6 months: a microhistorical approach, *Dev. Psychol.* 39 (6) (2003) 1061–1082.
- [71] M. Gratier, et al., Early development of turn-taking in vocal interaction between mothers and infants, *Front. Psychol.* 6 (2015) 1167.
- [72] S. Dominguez, et al., The roots of turn-taking in the neonatal period, *Infant Child Dev.* 25 (3) (2016) 240–255.
- [73] S. Donnelly, E. Kidd, The longitudinal relationship between conversational turn-taking and vocabulary growth in early language development, *Child Dev.* 92 (2) (2021) 609–625.
- [74] T. Nguyen, L. Zimmer, S. Hoehl, Your turn, my turn. Neural synchrony in mother–infant proto-conversation, *Philos. Trans. R. Soc. B* 378 (1875) (2023) 20210488.
- [75] C.A. Ferguson, Baby talk in six languages, *Am. Anthropol.* 66 (6) (1964) 103–114.
- [76] C.E. Snow, The development of conversation between mothers and babies, *J. Child Lang.* 4 (1) (1977) 1–22.
- [77] C.E. Laing, A phonological analysis of onomatopoeia in early word production, *First Lang.* 34 (5) (2014) 387–405.
- [78] C. Laing, A role for onomatopoeia in early language: evidence from phonological development, *Lang. Cogn.* 11 (2) (2019) 173–187.
- [79] D. Massaro, M. Perlman, Quantifying iconicity's contribution during language acquisition: implications for vocabulary learning, *Front. Commun.* 2 (2017).
- [80] A.K.S. Nielsen, M. Dingemanse, Iconicity in word learning and beyond: a critical review, *Lang. Speech* 64 (1) (2021) 52–72.
- [81] M. Ota, N. Davies-Jenkins, B. Skarabela, Why choo-choo is better than train: the role of register-specific words in early vocabulary growth, *Cogn. Sci.* 42 (6) (2018) 1974–1999.
- [82] V. Mattes, Iconicity in the lexicon, *Stud. Lang.* 41 (4) (2017) 813–842.
- [83] V. Kempe, et al., Diminutives facilitate word segmentation in natural speech: cross-linguistic evidence, *Mem. Cogn.* 35 (4) (2007) 762–773.
- [84] M. Ota, B. Skarabela, Reduplication facilitates early word segmentation, *J. Child Lang.* 45 (1) (2018) 204–218.
- [85] J.F. Schwab, C. Lew-Williams, Language learning, socioeconomic status, and child-directed speech, *Wiley Interdiscip. Rev. Cogn. Sci.* 7 (4) (2016) 264–275.
- [86] J.F. Schwab, C. Lew-Williams, Repetition across successive sentences facilitates young children's word learning, *Dev. Psychol.* 52 (6) (2016) 879–886.
- [87] E. Hoff-Ginsberg, Some contributions of mothers' speech to their children's syntactic growth, *J. Child Lang.* 12 (2) (1985) 367–385.
- [88] C.F. Rowland, et al., Determinants of acquisition order in wh-questions: re-evaluating the role of caregiver speech, *J. Child Lang.* 30 (3) (2003) 609–635.
- [89] M.L. Rowe, K.A. Leech, N. Cabrera, Going beyond input quantity: wh-questions matter for toddlers' language and cognitive development, *Cogn. Sci.* 41 (S1) (2017) 162–179.
- [90] A. Goodwin, D. Fein, L.R. Naigles, Comprehension of Wh-questions precedes their production in typical development and autism Spectrum disorders, *Autism Res.* 5 (2) (2012) 109–123.
- [91] V. Valian, L. Casey, Young children's acquisition of wh-questions: the role of structured input, *J. Child Lang.* 30 (1) (2003) 117–143.
- [92] L. Vernon-Feagans, et al., How early maternal language input varies by race and education and predicts later child language, *Child Dev.* 91 (4) (2020) 1098–1115.
- [93] A. Seidl, G. Hollich, P.W. Jusczyk, Early understanding of subject and object Wh-questions, *Infancy* 4 (3) (2003) 423–436.
- [94] B.A. Pan, et al., Communicative intents expressed by parents in interaction with young children, *Merrill-Palmer Q.* 42 (2) (1996) 248–266.
- [95] T. Tardif, et al., Baby's first 10 words, *Dev. Psychol.* 44 (2008) 929–938.
- [96] A. Ninio, Picture-book reading in mother–infant dyads belonging to two subgroups in Israel, *Child Dev.* 51 (2) (1980) 587–590.
- [97] V. Slaughter, C.C. Peterson, M. Carpenter, Maternal mental state talk and infants' early gestural communication, *J. Child Lang.* 36 (5) (2009) 1053–1074.
- [98] E. Meins, et al., Rethinking maternal sensitivity: mothers' comments on infants' mental processes predict security of attachment at 12 months, *J. Child Psychol. Psychiatry Allied Discip.* 42 (5) (2001) 637–648.
- [99] P.J. Reschke, et al., Links between parent–child conversations about emotions and changes in children's emotion knowledge across early childhood, *Child Dev.* 95 (1) (2024) 82–97.
- [100] J. Olson, E. Masur, Mothers' talk about perceptions, wants, feelings, and thoughts during play: general or specific relations to infants' internal state vocabularies and gender? *Language Learning and Development* 16 (2) (2020) 196–209.

- [101] J. Laranjo, A. Bernier, Children's expressive language in early toddlerhood: links to prior maternal mind-mindedness, *Early Child Dev. Care* 183 (7) (2013) 951–962.
- [102] M. Taumoepeau, T. Ruffman, Mother and infant talk about mental states relates to desire language and emotion understanding, *Child Dev.* 77 (2) (2006) 465–481.
- [103] E. Longobardi, P. Spataro, C. Colonnese, Maternal communicative functions and mind-mindedness at 16 months as predictors of children's internal and non-internal language at 20 months, *Infant Behav. Dev.* 50 (2018) 52–63.
- [104] L.F. Barrett, The theory of constructed emotion: an active inference account of interoception and categorization, *Soc. Cogn. Affect. Neurosci.* 12 (11) (2017) 1833.
- [105] K. Hoemann, F. Xu, L.F. Barrett, Emotion words, emotion concepts, and emotional development in children: a constructionist hypothesis, *Dev. Psychol.* (2019), <https://doi.org/10.1037/dev0000686>.
- [106] M. Ogren, C.M. Sandhofer, Emotion words link faces to emotional scenarios in early childhood, *Emotion* 22 (1) (2022) 167–178.
- [107] M.L. Nencheva, D.I. Tamir, C. Lew-Williams, Caregiver speech predicts the emergence of children's emotion vocabulary, *Child Dev.* 94 (3) (2023) 585–602.
- [108] R.T. Devine, C. Hughes, Family correlates of false belief understanding in early childhood: a Meta-analysis, *Child Dev.* 89 (3) (2018) 971–987.
- [109] V. Tompkins, et al., The relation between parents' mental state talk and children's social understanding: a meta-analysis, *Soc. Dev.* 27 (2) (2018) 223–246.
- [110] C.A. McMahon, A. Bernier, Twenty years of research on parental mind-mindedness: empirical findings, theoretical and methodological challenges, and new directions, *Dev. Rev.* 46 (2017) 54–80.
- [111] C.A. Brownell, et al., Socialization of early prosocial behavior: parents' talk about emotions is associated with sharing and helping in toddlers, *Infancy* 18 (2013) 91–119.
- [112] J. Drummond, et al., Here, there and everywhere: emotion and mental state talk in different social contexts predicts empathic helping in toddlers, *Front. Psychol.* 5 (2014).
- [113] P.M. Cole, L.M. Armstrong, C.K. Pemberton, The Role of Language in the Development of Emotion Regulation, American Psychological Association, 2010, <https://doi.org/10.1037/12059-004>.
- [114] A.E. Bigelow, M. Power, H. Dadgar, Maternal mind-mindedness over infants' first three months, *Infant Behav. Dev.* 72 (2023) 101864.
- [115] T. Ruffman, L. Slade, E. Crowe, The relation between children's and mothers' mental state language and theory-of-mind understanding, *Child Dev.* 73 (3) (2002) 734–751.
- [116] M.L. Rowe, C.E. Snow, Analyzing input quality along three dimensions: interactive, linguistic, and conceptual, *J. Child Lang.* 47 (1) (2020) 5–21.
- [117] J.R. Brown, J. Dunn, 'You can cry, mum': the social and developmental implications of talk about internal states, *Br. J. Dev. Psychol.* 9 (2) (1991) 237–256.
- [118] P. Smiley, J. Huttenlocher, *Young Children's Acquisition of Emotion Concepts*, Cambridge University Press, 1989, https://doi.org/10.1007/978-94-015-8484-5_18.
- [119] S. Kristen, et al., Crosslinguistic developmental consistency in the composition of toddlers' internal state vocabulary: evidence from four languages, *Child Dev. Res.* 2014 (1) (2014) 575142.
- [120] E. Becker Razuri, et al., Mental STATE language development: the longitudinal roles of attachment and maternal language, *Infant Ment. Health J.* 38 (3) (2017) 329–342.
- [121] J. Gervain, Plasticity in early language acquisition: the effects of prenatal and early childhood experience, *Curr. Opin. Neurobiol.* 35 (2015) 13–20.
- [122] B.S. Kisilevsky, S.M.J. Hains, Onset and maturation of fetal heart rate response to the mother's voice over late gestation, *Dev. Sci.* 14 (2) (2011) 214–223.
- [123] K.M. Voegtline, et al., Near-term fetal response to maternal spoken voice, *Infant Behav. Dev.* 36 (4) (2013) 526–533.
- [124] V. Marx, E. Nagy, Fetal Behavioural responses to maternal voice and touch, *PLoS One* 10 (6) (2015) e0129118.
- [125] M.E. Carvalho, et al., The impact of maternal voice on the fetus: a systematic review, *Curr. Women's Health Rev.* 15 (3) (2019) 196–206.
- [126] A. Lang, et al., Memory traces formed in utero—newborns' autonomic and neuronal responses to prenatal stimuli and the maternal voice, *Brain Sci.* 10 (11) (2020) 837.
- [127] G.Y. Lee, B.S. Kisilevsky, Fetuses respond to father's voice but prefer mother's voice after birth, *Dev. Psychobiol.* 56 (1) (2014) 1–11.
- [128] J. Mehler, et al., A precursor of language acquisition in young infants, *Cognition* 29 (2) (1988) 143–178.
- [129] B. Mariani, et al., *Prenatal experience with language shapes the brain*, *Sci. Adv.* 9 (47) (2023) ead3524.
- [130] G. Persico, et al., Maternal singing of lullabies during pregnancy and after birth: effects on mother–infant bonding and on newborns' behaviour. Concurrent cohort study, *Women Birth* 30 (4) (2017) e214–e220.
- [131] M. Filippa, in: M. Filippa, P. Kuhn, B. Westrup (Eds.), Early vocal contact: Direct talking and singing to preterm infants in the NICU, in *Early Vocal Contact and Preterm Infant Brain Development: Bridging the Gaps between Research and Practice*, Springer International Publishing, Cham, 2017, pp. 133–150.
- [132] M. Hernandez-Reif, A. Kendrick, D.M. Avery, Pregnant women with depressive and anxiety symptoms read, talk, and sing less to their fetuses, *J. Affect. Disord.* 229 (2018) 532–537.
- [133] M. Carolan, et al., The Limerick lullaby project: an intervention to relieve prenatal stress, *Midwifery* 28 (2) (2012) 173–180.
- [134] S. Alfayumi-Zeadna, et al., The impact of postpartum depression on infant development in the first year of life, *J. Affect. Disord.* 388 (2025) 119558.
- [135] D. Guess, A functional analysis of receptive language and productive speech: acquisition of the plural morpheme, *J. Appl. Behav. Anal.* 2 (1) (1969) 55–64.
- [136] M. Spagnola, B.H. Fiese, Family routines and rituals: a context for development in the lives of young children, *Infants Young Child.* 20 (4) (2007).
- [137] A.V. Sosa, Association of the Type of toy used during play with the quantity and quality of parent–infant communication, *JAMA Pediatr.* 170 (2) (2016) 132–137.
- [138] M.B. Wooldridge, J. Shapka, Playing with technology: mother–toddler interaction scores lower during play with electronic toys, *J. Appl. Dev. Psychol.* 33 (5) (2012) 211–218.
- [139] G.A. Strouse, P.A. Ganeeva, Toddlers' word learning and transfer from electronic and print books, *J. Exp. Child Psychol.* 156 (2017) 129–142.
- [140] S.D. Gest, et al., Language development subcontexts in head start classrooms: distinctive patterns of teacher talk during free play, mealtime, and book Reading, *Early Educ. Dev.* 17 (2) (2006) 293–315.
- [141] S.E. Mol, A.G. Bus, To read or not to read: a meta-analysis of print exposure from infancy to early adulthood, *Psychol. Bull.* 137 (2) (2011) 267–296.
- [142] A.G. Bus, M.H. van Ijzendoorn, A.D. Pellegrini, Joint book reading makes for success in learning to read: a meta-analysis on intergenerational transmission of literacy, *Rev. Educ. Res.* 65 (1) (1995) 1–21.
- [143] S. Wang, O.J.L. Tzeng, R.N. Aslin, Predictive brain signals mediate association between shared reading and expressive vocabulary in infants, *PLoS One* 17 (8) (2022) e0272438.
- [144] Y. Zhai, et al., Neural synchrony underlies the positive effect of shared reading on children's language ability, *Cereb. Cortex* 33 (19) (2023) 10426–10440.
- [145] L.F. Clemens, C.A.T. Kegel, Unique contribution of shared book reading on adult-child language interaction, *J. Child Lang.* 48 (2) (2021) 373–386.
- [146] N. Kartushina, et al., COVID-19 first lockdown as a window into language acquisition: associations between caregiver-child activities and vocabulary gains, *Lang. Dev. Res.* 2 (1) (2022).
- [147] A. Muhinyi, M.L. Rowe, Shared reading with preverbal infants and later language development, *J. Appl. Dev. Psychol.* 64 (2019) 101053.
- [148] A. Rosslund, N. Kartushina, J. Mayor, Associations between shared book reading, daily screen time and infants' vocabulary size, *J. Child Lang.* 52 (4) (2025) 971–983.
- [149] P.K. Kuhl, Brain mechanisms in early language acquisition, *Neuron* 67 (5) (2010) 713–727.
- [150] E. Bergelson, D. Swingley, Early word comprehension in infants: replication and extension, *Lang Learn Dev* 11 (4) (2015) 369–380.
- [151] B.M. Farrant, S.R. Zubrick, Early vocabulary development: the importance of joint attention and parent-child book reading, *First Lang.* 32 (3) (2011) 343–364.
- [152] J. Karrass, J.M. Braungart-Rieker, Effects of shared parent–infant book reading on early language acquisition, *J. Appl. Dev. Psychol.* 26 (2) (2005) 133–148.
- [153] Y. Chen, et al., Contributions of mothers' and fathers' shared book reading with infants at 9 months to language skills at 18 months in ethnically and socioeconomically diverse families, *Infant Child Dev.* 33 (5) (2024) e2516.
- [154] A.C. Payne, G.J. Whitehurst, A.L. Angell, The role of home literacy environment in the development of language ability in preschool children from low-income families, *Early Child. Res. Q.* 9 (3) (1994) 427–440.
- [155] B.D. Debaryshe, Joint picture-book reading correlates of early oral language skill, *J. Child Lang.* 20 (2) (1993) 455–461.
- [156] S.A. Hart, C. Little, E. van Bergen, Nurture might be nature: cautionary tales and proposed solutions, *NPJ Sci. Learn.* 6 (1) (2021) 2.
- [157] S.-C. Wu, O.J.L. Tzeng, S. Wang, Mothers used wider vocabulary and talked to their six-month-old infants more during shared book reading than when they played with toys, *Acta Paediatr.* 113 (1) (2024) 84–90.
- [158] S.E. Mol, et al., Added Value of Dialogic Parent–Child Book Readings: A Meta-Analysis, *Early Educ. Dev.* 19 (1) (2008) 7–26.
- [159] G.J. Whitehurst, et al., Accelerating language development through picture book reading, *Dev. Psychol.* 24 (4) (1988) 552–559.
- [160] P.R. Britto, J. Brooks-Gunn, T.M. Griffin, Maternal reading and teaching patterns: associations with school readiness in low-income African American families, *Read. Res. Q.* 41 (1) (2006) 68–89.
- [161] M. Silvén, A. Ahola, P. Niemi, Early words, multiword utterances and maternal reading strategies as predictors of mastering word inflections in Finnish, *J. Child Lang.* 30 (2) (2003) 253–279.
- [162] C.S. Chang, et al., Revisiting dialogic Reading strategies with 12-month-old infants, *Early Childhood Educ.* J. 51 (8) (2023) 1413–1426.
- [163] N. Dowdall, et al., Shared picture book Reading interventions for child language development: a systematic review and Meta-analysis, *Child Dev.* 91 (2) (2020) e383–e399.
- [164] C. Noble, et al., The impact of shared book reading on children's language skills: a meta-analysis, *Educ. Res. Rev.* 28 (2019) 100290.
- [165] C.Y.Y. Leung, D.L. Suskind, What parents know matters: parental knowledge at birth predicts caregiving behaviors at 9 months, *J. Pediatr.* 221 (2020) 72–80.
- [166] M.Y. Roberts, et al., Association of Parent Training with Child Language Development: a systematic review and Meta-analysis, *JAMA Pediatr.* 173 (7) (2019) 671–680.
- [167] C.Y.Y. Leung, D.L. Suskind, Early parental knowledge and parent-child conversations promote preschool language skills: a randomized controlled trial, *Acad. Pediatr.* 24 (7) (2024) 1062–1067.
- [168] C.E. Huebner, A.N. Meltzoff, Intervention to change parent–child reading style: a comparison of instructional methods, *J. Appl. Dev. Psychol.* 26 (3) (2005) 296–313.
- [169] S. Goldfield, et al., Four-year-old outcomes of a universal infant-toddler shared Reading intervention: the let's read trial, *Arch. Pediatr. Adolesc. Med.* 166 (11) (2012) 1045–1052.

- [170] M. Wake, et al., Outcomes of population based language promotion for slow to talk toddlers at ages 2 and 3 years: let's learn language cluster randomised controlled trial, *BMJ* 343 (2011) d4741.
- [171] S. Tong, et al., Socioeconomic position, maternal IQ, home environment, and cognitive development, *J. Pediatr.* 151 (3) (2007) 284–288.e1.
- [172] D.L. Christensen, et al., Socioeconomic status, child enrichment factors, and cognitive performance among preschool-age children: results from the follow-up of growth and development experiences study, *Res. Dev. Disabil.* 35 (7) (2014) 1789–1801.
- [173] L.A. Gennetian, et al., Effects of a monthly unconditional cash transfer starting at birth on family investments among US families with low income, *Nat. Hum. Behav.* 8 (8) (2024) 1514–1529.