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The effects of live parental infant-directed singing on infants, parents, and the parent-infant dyad: A systematic review of the literature

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ABSTRACT

Singing to infants is widely accepted as an enjoyable, positive, and beneficial interaction between the parent and infant across cultures. Whilst the literature suggests that live infant-directed singing impacts the infant, the parent doing the singing and the dyad in powerful ways, no systematic review of the evidence has yet been conducted. To this end, this systematic review identified 21 studies that investigated the effect of live parental infant-directed singing. These impacts were categorized as either being directly related to the infant, the parent, or the parent-infant dyad. Three main themes – one for each of the impact categories considered – were identified using thematic analysis techniques; infant-directed singing impacts on: infants' emotional regulation, provides validation of the parent's role, and promotes affect attunement within the dyad. The findings reinforce the benefits of live parental infant-directed singing for all parties involved, particularly when parents sing to typically developing infants born at full term. In contrast, the findings were inconsistent for pre-term infants. The implications of these findings are discussed.

1. Introduction

Singing, alongside speech and other forms of non-verbal vocalizing, is a tool commonly used by parents and caregivers to respond to infants' needs such as discomfort, hunger, and attachment (Soltis, 2004). In turn, infants express these needs via crying and non-verbal vocalizations that parents find hard to ignore, which encourages parents to actively meet these needs. This dyadic interaction strengthens the parent-infant bond (Figueiredo et al., 2007) and reinforces the infant's attachment to the parent. While this is a very intuitive process, it also relies on adults and infants effectively communicating with and responding to one another. Thus, infant-directed singing (IDSg) is arguably a key component of the parent-infant dyad and the communication within it.

Infant-directed singing (IDSg) typically occurs when a social partner directs song, including melodies sung with and without lyrics, towards an infant and is characterized by consistent pitch, a beat-based tempo, and repetition (Bergeson & Trehub, 2002; Longhi, 2009; Nakata & Trehub, 2011; Trehub, 1990). It is different from infant-directed speech in that speech contains greater variability and

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inconsistencies in both the content and form in which it is constructed (Bergeson & Trehub, 2007). However, like infant-directed speech, infants show an attentional preference for IDSg over adult-directed singing (aged 4–7-months old; Trainor, 1996). However, by around 12-months of age, this preference for IDSg over adult-directed singing is no longer consistent across the literature (Hayashi et al., 2001; Newman & Hussain, 2006). In light of these mixed findings suggesting that there may be key developmental periods in which IDSg has the greatest impact on infants and to ensure we provide a comprehensive account of the impact of live IDSg by parents to their infant during infancy, this systematic review focuses on infants from birth to 18 months as the receivers of parent-led IDSg.

The way in which adults communicate with infants has been differentiated from the way in which they communicate with older children and adults. For example, Bergeson and Trehub (1999) found that when mothers sang to their infant children, they did so in a higher pitch than when they sang to their preschool children. Similarly, Trehub et al. (1997) found that IDSg typically has a slower tempo than adult-directed singing. Trainor et al. (1997) identified a number of acoustic parameters related to voice quality and musical structure that differed in infant-present and infant-absent conditions. Parents sang lullabies and play-songs at a higher pitch, with a greater variation in pitch and with longer inter-phrase pauses when singing to their infants, compared to the infant-absent condition. These infant-directed song versions were also rated as being more ‘loving’ than those delivered in an infant-absent condition (Trainor, 1996). These singing characteristics are appealing and memorable for infants (Margulis, 2013), and are preferred over other types of sounds (Vouloumanos & Werker, 2007; Standley & Madsen, 1990; Trainor, 1996; Tsang et al., 2017), such as other female voices and music, likely because a mother’s voice signals non-aggressive behaviors and safety (Trainor et al., 1997).

There are some similarities between infant-directed speech and IDSg. For example, infant-directed speech is also characterized by having a high pitch and slow tempo (Fernald, 1985). Both infant-directed speech and singing appear to impact infants’ physical and emotional states. However, the literature suggests that infants have different responses to each of these stimuli (e.g., Corbeil et al., 2013; Costa-Giomi, 2014; Costa-Giomi & Ilari, 2014; Sambeth et al., 2008; Trehub et al., 2016; Tsang et al., 2017). Differences have been found in indicators of infant engagement and attention between infant-directed speech and IDSg (Arias & Peña, 2016; Filipa et al., 2013; Nakata & Trehub, 2004), with infant-directed speech producing more bodily movements and vocalizations in infants (Arias & Peña, 2016). Thus, whilst there are some similarities between the characteristics of infant directed speech and IDSg, the impact of these two communication methods on infants may be different.

While IDSg is directed towards the infant, the dyadic nature of the interaction itself suggests the impact of IDSg extends to the parent doing the singing and the dyad itself. Indeed, given the benefits of IDSg for the infant, parents must receive feedback that ensures the continuance of this behavior. For example, Fancourt and Perkins (2017) found that IDSg conducted daily was associated with lower levels of postnatal depression in mothers, as well as enhanced maternal wellbeing and self-esteem. Fancourt and Perkins (2017) interpreted these results in terms of a model proposed by Fancourt et al. (2014) that sought to provide a framework for research into music and psychoneuroimmunology. Of relevance to IDSg, Fancourt et al. (2014) identified four components of music that affect human adults: the sound of the music, the physical act of singing, the social aspect of singing, and the personal response to the music. Thus, IDSg provides opportunities for parents to both enjoy singing in its own right, and in its facilitation of social engagement between parent and infant. Furthermore, IDSg provides opportunities for meaningful and reciprocal parent-infant interactions (De l’Etoile, 2006a). When infants feel that their needs are being met, and their parents feel successful in meeting these needs, the relationship itself is strengthened.

Infants’ ability to indicate their needs, and the ability for parents to respond appropriately, is essential for the survival of the infant. IDSg also provides opportunities to strengthen the parent-infant bond which, in turn, is beneficial for child development (Bicking Kinsey & Hupcey, 2013). While there is some evidence that parent-led IDSg may have the power to calm infants, increase parents’ affect, and promote bonding within the parent-infant dyad, there is currently no systematic review of this evidence. The systematic review presented here, addresses this gap in the literature by drawing together the research on IDSg in order to develop a holistic and comprehensive understanding of the impact that IDSg has on infants, parents and the parent-infant dyad. Therefore, the research question for this systematic review is: What impact does live IDSg, conducted by a parent towards their infant aged birth to 18 months, have on the: 1) infant, 2) parent (as singer), and 3) parent-infant dyad?

2. Method

To answer the research question, a systematic search and review of the literature was conducted. Three databases were searched: ERIC, PsychINFO, and PubMed. The abstracts of the articles in each database were identified using the search terms outlined in Table 1. The terms varied due to the constraints of each database; however, each search contained keywords that centered on three key concepts: live singing, by a parent, to the infant. The searches were limited to results in the English language and works that were accessible up until June 2021. This aimed to capture all relevant works related to IDSg. No works that met our criteria as detailed in Table 2 were identified prior to 2001. Lastly, theses and dissertations (n = 1) that were available in the databases were included in

Table 1
Search terms used.

PsycINFO	ERIC	PubMed
((((singing or “infant-directed singing”) and (infant or baby or toddler)) not prenatal) and (mother or father or parent or caregiver)).ab.	ab(Singing) AND ab(infant OR baby OR toddler) AND ab(mother OR father OR parent OR caregiver)	Singing + (infant or baby or toddler) + (mother or father or parent or caregiver)

Table 2
Inclusion and exclusion criteria.

	Inclusion criteria	Exclusion criteria
Stage 1	The article presents an analysis of primary or secondary empirical data. The infant is less than 18 months old. The article focusses on infant-directed singing.	The singing was recorded and then shown to the infant. The singing was performed by someone other than a parent or caregiver. The singing was performed within a group/class setting.
Stage 2	The singing of interest was performed live by an individual parent or caregiver. The receiver of the live singing was an individual infant. The article reported one or more outcomes of infant directed singing related to the infant, the parent or caregiver, or the parent-infant dyad.	The singing was conflated with other activities, such as rocking and speech, making it difficult to identify specific effects of infant-directed singing. The nature and properties of the singing, the context, and/or prevalence rates were described or reported, without reference to an outcome. The singing of interest was only performed prior to birth. The singing of interest was performed by the infant.

addition to peer-reviewed articles in an attempt to reduce the effect of publication bias.

2.1. Screening process

The database searches returned a total of 198 records. After the removal of duplicates ($n = 16$), 182 unique articles were identified and subject to the screening process. Consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009), the screening process was conducted in two stages: title and abstract screening, and eligibility testing (see Table 2 for the inclusion and exclusion criteria). It was our goal from the start of this project to conduct a comprehensive review of the impact of parents' IDSg on their infant in contexts that resemble as close as possible to infants' and parents' everyday experiences and thus, our eligibility criteria included an examination of only parent-led live IDSg. We recognize that, in so doing, our review excludes the pioneer lab-based studies that were reviewed in our Introduction which offered invaluable insights on IDSg in pre-recorded contexts (e.g., Bergeson & Trehub, 1999; Standley & Madsen, 1990; Trainor, 1996; Trehub et al., 1997; Vouloumanos & Werker, 2007). Our eligibility criteria also focuses on IDSg to infants from birth to 18 months because we expected that there may be key developmental periods in which IDSg would have the greatest impact on infants (i.e., early infancy), but also wanted to be as inclusive as possible so that we provided a comprehensive account of the impact of live IDSg by parents to their infant during infancy. Our age range was capped at 18 months of age to maximize the likelihood that our review would isolate the

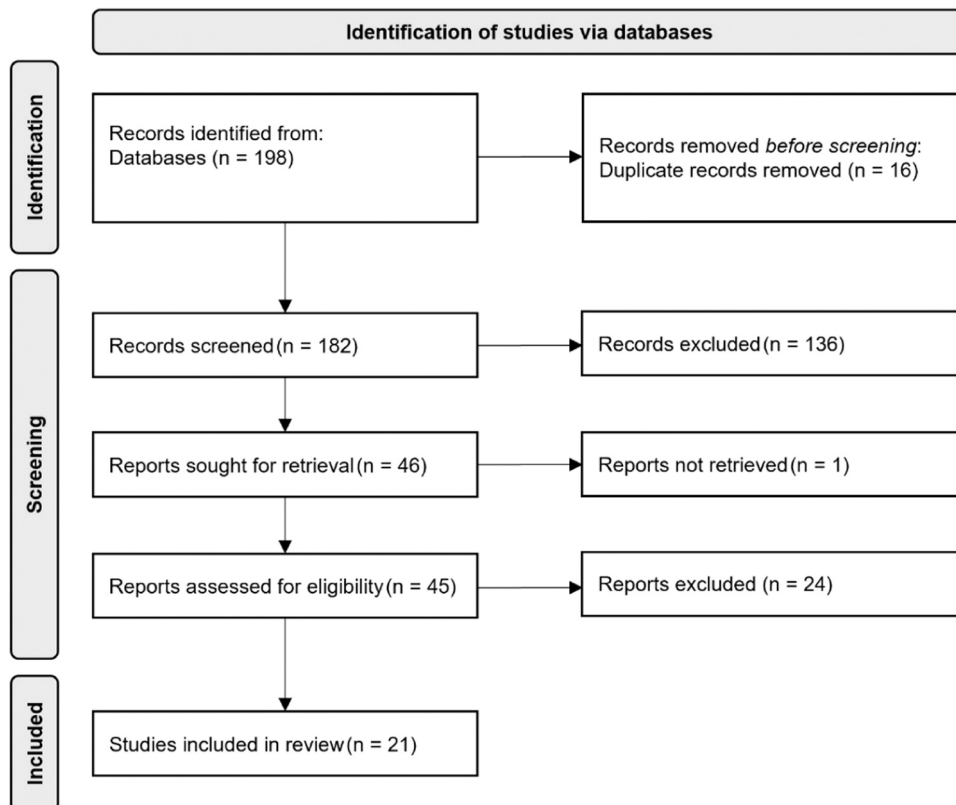


Fig. 1. PRISMA Flow Diagram.

effects of parent-led IDSg on infants as the receivers of parent-led IDSg since, as infants' communicative repertoire increases with age, we expected that singing would be a joint endeavour rather than being parent-led. Consistent with our expectations that it would be difficult to isolate the effects parent-led IDSg on older infants, only one article included in our final sample included infants older than 12 months of age. At the conclusion of the title and abstract screening, 46 records remained and were downloaded for full-text eligibility testing. At this stage, one study was excluded due to the inability to access the full-text version of the record following multiple requests to the author as well as via our institution's inter-library loan service.

In the second stage, 24 studies were excluded as they did not meet the inclusion/exclusion criteria outlined in Table 2 (i.e., because they described the temporal qualities of IDSg, the singing was conducted by someone other than a caregiver such as a music therapist). We also excluded studies where specific IDSg outcomes could not be identified, for example due to a focus on the combination of IDSg with other activities such as rocking. Thus, at the conclusion of the screening process 21 articles remained. In addition, the reference lists of the included articles were screened, however no new records were identified. As a result, a total of 21 articles were included for review (see Fig. 1).

2.2. Data analysis

Study characteristics of each record were extracted, including the sample characteristics (e.g., pre-term vs full-term infants, sample size), methodological details (e.g., design, song type), and key findings (see Table A1). The 21 studies were sorted into three categories depending on whether the reported outcomes were related to the infant, the parent, or the parent-infant dyad. Of these, 15 studies reported outcomes that spanned more than one category (see Table 3). A thematic analysis approach (Braun & Clarke, 2006) was then used to identify themes and sub-themes within the three outcome categories. This analysis approach involved coding the data based on key characteristics of the study findings and collating these codes based on commonalities, to identify themes and sub-themes that represent the main ways that IDSg impacts on the infant, parent, and parent-infant dyad as reported in the literature (see Table A2).

Note. Percentages add to more than 100% because most studies related to two or more categories.

3. Results

A total of 21 studies were identified for inclusion in this review. The majority (18) of the studies were conducted using a quantitative methodology. While the sample sizes ranged from 4 to 391 dyads, the median sample size was 31, indicating that the majority of the sample sizes were relatively small. Mothers were the parent of interest in all but one study which also included a small number of father participants ($n = 4$; Cirelli & Jurewicz, & Trehub, 2020). This was often due to parental arrangements and the commitment required to engage in the study. No other caregiver roles (e.g., foster parents) were represented. As a result, our review necessarily focusses on the impact of mother-led live IDSg on the infant, the mother, and the mother-infant dyad.

As the literature suggests that preterm infants have different developmental needs and therefore may respond to IDSg differently (e.g., Haslbeck & Bassler, 2018), the summary of the studies presented in Table A1 has been separated into two sections: studies conducted on preterm infants prior to 37 weeks gestational age, and studies conducted on infants born at term, aged from birth to 18 months. These sections reflect the age of the infants at the time the original study was conducted. Most of the included studies ($n = 15$) investigated the impact of IDSg for typically developing infants born at full term; and all but two studies investigated infants between the age of birth and 12 months. However, the current sample also investigated the impact of IDSg on certain sub-groups of infants, including medically stable preterm infants ($n = 4$), preterm infants with an identified brain injury ($n = 1$), and infants with Down Syndrome aged 3–9 months ($n = 1$). Studies of preterm infants took place within hospital settings and focused on physiological and physical responses, whilst the studies on infants born at term, tended to focus on behavioral responses, and were conducted at home, in a lab setting or through an online questionnaire.

Almost all studies ($n = 19$) included an evaluation of the response of infants to IDSg, while over half of the studies ($n = 13$) commented on the impact of IDSg on the dyadic relationship. Finally, just 8 studies reported on the impact of IDSg on caregivers. Many of the included studies investigated the impact of IDSg on more than one outcome category, perhaps reflecting the multidimensional nature of IDSg.

3.1. Infant

All of the studies that reported on the impact of IDSg on infants ($n = 19$), found that IDSg by parents impacted on infants' emotional regulation. Parents used IDSg to alter infants' levels of arousal in different ways, likely associated with the nature of the song. An infant's level of arousal suggests whether they are active, alert, and attentive, or relaxed and calm.

Table 3
Distribution of articles across the three outcome categories.

	Infant	Parent	Parent-infant dyad
Definition	The impact of IDSg is directly related to the infant.	The impact of IDSg is directly related to the parent doing the singing.	The impact of IDSg is directly related to the parent-infant dyad and what is gained from the strength of this relationship.
Percentage of sample	90%	38%	62%

The majority of these studies reported that IDSg impacts infants' arousal via specific indicators such as infant body movement, vocalizations, attention and affect. Arousal was measured both using physical responses, such as the evaluation of vocalizations and arm/leg movements (Arias & Peña, 2016; Carvalho et al., 2019; De l'Etoile, 2006b; De l'Etoile, 2015; Ghazban, 2014; Shenfield et al., 2003), and physiological responses, such as skin conductivity (Cirelli & Jurewicz, & Trehub, 2020). IDSg was found to impact on the infant in different ways, depending on the function of the singing: reducing distress, promoting a sense of calm, inducing sleep, and directing attention. Indeed, Baker and Mackinlay (2006) found that when mothers chose lullabies to sing to their infant this was done so with purpose, including as a cue for bedtime, to soothe the child or to match the emotional state of the child. Furthermore, the responses of preterm infants suggested that IDSg had different and more diverse impacts for this group than infants born at term.

IDSg was found to impact on the affect of infants as investigated in 15 of the identified studies (Arias & Peña, 2016; Arnon et al., 2014; Baker & Mackinlay, 2006; Blumenfeld & Eisenfeld, 2006; Carvalho et al., 2019; Cirelli & Trehub, 2020; Creighton et al., 2013; De l'Etoile, 2006b; De l'Etoile, 2012; De l'Etoile, 2015; Epstein et al., 2021; Filippa et al., 2013; Ghazban, 2014; Jover et al., 2019; Pixley, 2015). Many of these studies ($n = 10$) investigated the impact of IDSg on infants' behavioral responses, with a predominant focus on lullaby songs. For example, IDSg resulted in reduced motor activity, stillness and quiet (Arias & Peña, 2016; De l'Etoile, 2006b; Jover et al., 2019), fewer infant vocalizations compared to infant-directed speech (Arias & Peña, 2016; Carvalho et al., 2019), or more smiling (Cirelli & Trehub, 2020). Overall, these articles concluded that singing to infants positively influences infants' affect. Another cohort of these studies ($n = 5$) evaluated the effect of IDSg on infants' emotional regulation through measuring infants' physiological responses, such as autonomic stability, heart rate, or oxygen saturation. Four out of these five studies which evaluated physiological response investigated the impact of IDSg on preterm infants, and the findings in this population were less consistent. One of these studies, by Arnon et al. (2014) concluded improved autonomic stability, whereas Epstein et al. (2021) concluded that IDSg produced physiological instability. Filippa et al. (2013) found that, compared to the baseline condition, infants had higher heart rates and levels of oxygen saturation when sung to by their mothers (maternal choice of song), demonstrating that infant-directed vocalizations may stimulate the preterm infant. In contrast Ghazban (2014) who studied 8–10-month-old infants concluded that IDSg of play songs decreased physiological arousal. If we consider the impact of IDSg on infants born at term these studies consistently highlight that IDSg is associated with infants being in a state responsive to the intended function of the song.

Some studies ($n = 5$) specifically investigated the impact of IDSg on infant distress concluding that IDSg reduced distress in infants. Two qualitative studies concluded that infants who were sung to regularly spent less time crying (Persico et al., 2017; Robertson & Detmer, 2019), whilst Cirelli, and Jurewicz, and Trehub (2020) found that skin conductance decreased significantly in more soothing song renditions. This was further explained by Cirelli and Trehub (2020), who compared the immediate effect of familiar songs, unfamiliar songs and talking to distressed infants. Songs, in particular familiar songs, were more effective at reducing infant distress than talking. This, they suggested, may be due to the repetitive and temporal characteristics of singing. Similarly, Shenfield et al. (2003) found that IDSg regulated infant stress levels as measured by salivary cortisol level. Infants with lower baseline cortisol levels showed modest increases, while those with higher baseline levels of cortisol demonstrated modest decreases, suggesting that IDSg has a moderating effect on levels of stress that is tailored to each infant's needs for regulatory support.

Another aspect of emotional regulation is the impact of IDSg on infants' sleep. Filippa et al. (2013) concluded that IDSg maintained preterm infants in an active sleep state at the time of singing, whereas infant-directed speech more often produced a quiet attentive state. In contrast, Persico et al. (2017) designed an intervention study whereby mothers were invited to sing to their child during pregnancy. They found that almost all (97.6%) of the mothers in this study continued to sing to their infant after birth and that those parents who sang to their infants reported less stress in relation to their children's night awakenings at 1 month. Furthermore, at 2 months, mothers who sang to their infants reported that their child had significantly fewer waking episodes at night than the control group. These two studies suggest that IDSg helps infants to experience longer periods of and greater quality sleep.

The impact of IDSg on infant attention was investigated by seven studies. These studies found that IDSg captures the attention of the infant (Arias & Peña, 2016; Cirelli & Trehub, 2020; Cirelli & Jurewicz, & Trehub, 2020; Creighton et al., 2013; De l'Etoile, 2006b, De l'Etoile, 2015; Ghazban, 2014). Cirelli, and Jurewicz, and Trehub (2020) compared the impact of soothing IDSg with playful ways of engaging in IDSg (using nursery rhymes) with infants. They concluded that infants were significantly more attentive to their parents during playful renditions suggesting that some songs promote attention more than others. This is likely through altering infants' levels of arousal, with certain levels of arousal required to maintain attention (de l'Etoile, 2015). Thus, parents may utilize different forms of song depending on the purpose of the IDSg and the intended infant response.

The findings regarding emotional regulation were less consistent in the studies investigating infants born preterm ($n = 5$). Blumenfeld and Eisenfeld (2006) identified no impacts of maternal singing on infant's feeding duration, velocity and intake, while Arnon et al. (2014) and Filippa et al. (2013) found that IDSg had a significant impact on infants' physiological response. However, the findings of the study by Arnon et al. (2014) must be read with caution as they excluded a significant portion of infants who had a sensitivity to their parents' voice at pretest, possibly influencing their findings. Carvalho et al. (2019) found that infants had a reduced number of vocalizations in the IDSg condition compared to both baseline and speaking conditions, concluding that this was reflective of increased attention when the mother is singing (maternal choice). The increased attention potentially points to the effect that IDSg has in supporting emotional regulation, but the study does not assess this directly. In contrast, Epstein et al. (2021) concluded that IDSg (lullabies) had a negative impact on the emotional regulation of preterm infants with a severe brain injury, as singing induced physiological and behavioral instability in the infants. The inconsistencies in the findings suggest that, although the findings typically reflected positive associations, drawing conclusions must be made with a high degree of caution when considering the impact of IDSg on preterm infants' emotional regulation. However, the literature consistently finds that singing to typically developing infants born at term generally supports infants' emotional regulation which is demonstrated in a variety of ways.

3.2. Parent

The second aspect of this systematic review was to determine the impact of IDSg on parents. Eight studies reported findings on the impact that IDSg had on the parent doing the singing. These articles described that engaging in IDSg validated their role as a mother in three ways: increasing their confidence in their ability to read and respond to the needs of their infant, facilitating their infants' learning and development, and enhancing maternal wellbeing. All three of the qualitative studies included in this review explicitly focused on the impact of IDSg on the parent, however the studies also commented on the parents' perceptions of the impact of their IDSg on their infant, and on their views of how IDSg impacted on the dyad, likely reflecting IDSg as a key parenting tool.

All three studies utilizing interview methodology concluded that IDSg contributed to the role of the mother being validated, focusing on two different components. Firstly, two of these studies, reported that the ability to identify and respond to their infants' cues led mothers to be confident in their role of mother as primary carer (Baker & Mackinlay, 2006; Creighton et al., 2013). Mothers in the study by Baker and Mackinlay's (2006) sang lullabies that they perceived their children to have previously responded to or that matched their child's current emotional state. Similarly, the use of lullabies to indicate bedtime and to facilitate the bedtime routine through the repetition of a small number of songs demonstrated the ability and confidence that mothers felt to be able to identify their children's needs and care for them, fulfilling the traditional role of mother. Furthermore, Creighton et al. (2013) found that mothers felt satisfied when they were able to support their child to regulate their emotions, whether that be to make their child happy, relaxed, or ready for sleep. Being able to effectively meet the needs of their child using IDSg provided evidence and validated the sense of being a good mother.

The third study which utilized interviews concluded that IDSg validated the role of mothers as mothers used IDSg as a teaching tool. IDSg was used to teach the infant about their culture and encourage language development (Pixley, 2015). The mothers in Pixley's study seemed to engage in this type of IDSg more as their child got older which, Pixley argued, was because the infants became more active participants as they developed. Both the lyrical and melodic aspects of IDSg were utilized to teach infants about their culture, religion, and history. For example, one of the mothers referred to singing folk songs from Slovenia because it was a way of exposing their child to parts of Slovenian culture while living in New York. The mothers also described using IDSg to specifically support their child's language development. This was done through repetition of words and phrases, as well as drawing on and narrating the current surroundings of the parent and infant, with IDSg providing a way to attach words to objects. Pixley concluded that this purposeful use of IDSg, meant that mothers were fulfilling the role of mother as educator.

Finally, all eight of the studies that investigated the impact of IDSg on the parent established an association between IDSg and mothers' emotional wellbeing. This was explored in different ways. Fancourt and Perkins (2018) investigated how parents' singing habits were associated with their mental health. Parents who sung to their infants daily reported higher levels of self-esteem and bonding, and lower levels of depression, compared to parents who sung less often. Other studies focused on different components of emotional wellbeing, such as maternal stress and anxiety (Arnon et al., 2014; Cirelli & Jurewicz, & Trehub, 2020; Persico et al., 2017), expression of emotion (Creighton et al., 2013; Pixley, 2015), and mothers' positive affect (Arnon et al., 2014; Baker & Mackinlay, 2006; Creighton et al., 2013; Pixley, 2015). This suggests that the act of singing to their infant provides parents with enhanced wellbeing, providing encouragement for parents to continue engaging in IDSg, validating their role as caregiver.

3.3. Parent – infant dyad

This systematic review found that IDSg promotes affect attunement within the dyad which, in turn, strengthens the parent-infant bond and infant attachment. This was consistent across the 13 studies that reported on the impact of IDSg explicitly on the dyad, or on both partners. The reciprocal exchange between parent and infant during IDSg provides opportunities for shared experiences, mutual responses, and simultaneous exchanges (Carvalho et al., 2019; Creighton et al., 2013; Jover et al., 2019; Longhi, 2009; Persico et al., 2017; Pixley, 2015). IDSg promotes face-to-face interactions between the parent and infant (De l'Etoile, 2012; Robertson & Detmer, 2019). These interactions provide opportunities for connection (Persico et al., 2017; Pixley, 2015) that bring positive experience to the dyadic relationship, with Creighton et al. (2013) postulating that there was a 'pleasure in proximity' that was created through IDSg believed to promote bonding within the dyad.

All thirteen articles discussed the impact of IDSg on the dyadic relationship between infants and their parents in relation to indicators of mutuality and reciprocity (broadly construed, see Provenzi et al. (2018)). This review found that infants' affect corresponded to (i.e., mirrored) their parents' affect during IDSg as reported in six studies (Arnon et al., 2014; Baker & Mackinlay, 2006; Cirelli & Jurewicz, & Trehub, 2020; Creighton et al., 2013; Epstein et al., 2021; Pixley, 2015), although not all studies could establish a causal link between the dyadic partners. Five studies concluded that IDSg was correlated to positive affect in both the parent and infant, promoting a quiet, calm state in both partners (Arnon et al., 2014; Baker & Mackinlay, 2006; Cirelli & Jurewicz, & Trehub, 2020; Creighton et al., 2013; Pixley, 2015). In contrast, for preterm infants with a severe brain injury, IDSg resulted in increased levels of distress for both partners (Epstein et al., 2021). While this shared affect was negative, it still indicates affect mirroring in which the emotions of both the infant and parent are informed and shared by the other. Evidence of affect mirroring is supported by the physiological data collected by Cirelli et al. (2020) who found that arousal, when measured by skin conductance, decreased sharply for both parents and infants during soothing singing interactions. This reciprocal relationship regarding arousal, they argued, demonstrates affect attunement and strengthening of the parent-infant bond.

Both partners within the dyad were found to respond to the other during IDSg: the flow of the singing of the adult is altered in response to the infant's reactions and needs; and infants' reactions vary in response to their parents' singing. In this review six studies reported that caregivers responded to infants' reactions and needs. For example, Pixley (2015) found that parents reported that their

singing was in direct response to their infant's reactions and preference, whilst [Carvalho et al. \(2019\)](#) and [Longhi \(2009\)](#) observed mothers adjusting the temporal structure of songs to reflect their infant's response. Similarly, parents who engaged in IDSg were found to be more emotionally responsive to their infants and attuned to their infants' needs ([Baker & Mackinlay, 2006](#); [Creighton et al., 2013](#); [Pixley, 2015](#); [Robertson & Detmer, 2019](#)). Just as parents alter their IDSg in accordance with their child's response, infants also respond to their parents' IDSg ([Carvalho et al., 2019](#); [Longhi, 2009](#)), for example via increased attention, indicating that both parent and infant are attuned to one another during IDSg.

IDSg thus promotes reciprocated interactions. There were two studies that concluded that IDSg promotes face-to-face interactions within the dyad ([De l'Etoile, 2012](#); [Robertson & Detmer, 2019](#)) and three studies that concluded it resulted in simultaneous exchanges representing a shared moment ([Carvalho et al., 2019](#); [Jover et al., 2019](#); [Longhi, 2009](#)). [Carvalho et al. \(2019\)](#) found that infants tended to engage in more overlapping, simultaneous exchanges in a singing scenario than in a talking scenario, which was often represented by turn-taking interactions. Infants as young as three months of age participated in IDSg with their parents by making rhythmic head, hand, leg, and body movements on the beats that were emphasized by their parents ([Longhi, 2009](#)), highlighting the joint participation in the moment. These studies argued that these shared moments provided time for bonding.

There were four studies that highlighted a sense of pleasure and satisfaction through IDSg as a bonding moment ([Baker & Mackinlay, 2006](#); [Creighton et al., 2013](#); [Fancourt & Perkins, 2018](#); [Pixley, 2015](#)) as it provided a way for them to connect with their infant. For example, [Creighton et al. \(2013\)](#) highlighted that parents' who sang to their infants took pleasure in spending time with their infant. This was supported by the conclusion drawn by three studies ([Creighton et al., 2013](#); [Persico et al., 2017](#); [Pixley, 2015](#)), all of whom concluded that this shared experience provides an opportunity for connection between dyadic partners. These findings suggest that IDSg provides opportunities for interactions and shared moments that support the dyadic relationship which promotes the parent-infant bond.

4. Discussion

One main theme that represented the most common way in which IDSg impacts each of the categories - the infant, parent, and parent-infant dyad was identified: emotional regulation, validation of role, and mutuality and reciprocity (respectively). These themes manifested in different ways depending on the dyadic partner of interest, the characteristics of the infant, and the purpose of the singing, each of which were captured by the sub-themes identified. The following section further contextualizes these themes within the wider body of literature and considers the impact of IDSg for non-typically developing infants. Finally, the limitations and future directions are discussed.

4.1. The influence of IDSg on the infant, parent, and dyad

Firstly, this systematic review found that, for most infants, IDSg by a parent had a calming influence on infant arousal. The repetition, temporal structure, and predictability of IDSg may contribute to the ability of this singing to regulate infant arousal ([Cirelli & Jurewicz, & Trehub, 2020](#); [Shenfield et al., 2003](#)) and, by extension, support emotional regulation. The relationship of IDSg to arousal broadly aligns with an earlier study utilizing recorded music ([Nakata & Trehub, 2004](#)) which found that presentations of recorded singing elicited more physical stillness compared to recorded talking. The association between IDSg and infants' emotional regulation is further supported by the ubiquity and ancient use of lullabies by caregivers for soothing infants. IDSg promotes infants' self-regulation via co-regulation between parent and infant. In early infancy this co-regulation is facilitated by the parent who responds to their infants' cues in appropriate ways to calm and soothe the infant ([Murray et al., 2015](#)). Thus, IDSg both supports emotional regulation within the immediate moment, as well as developing the infant's ability to regulate their emotions independently.

Secondly, both IDSg and infant-directed speech have been found to engage and maintain infants' attention. [Arias and Peña \(2016\)](#) found that six-to-eight-month-olds responded to their parents live singing of a song of their choice with more sustained attention and stillness, and to their mother's infant-directed speech with more vocalizations, movement, and shorter visual contacts. These characteristics were argued to be simultaneous in singing but reflected turn-taking in the speech condition. Thus, unlike the infant-directed speech literature, there was no reference to the acquisition of language in the current study sample. Instead, improved face-to-face interactions were of interest. Direct gaze is associated with neural coupling between adults and infants, which in turn creates a platform for engagement and learning ([Leong et al., 2017](#)). These synchronous relationships and instances of joint attention, present during IDSg, were identified as serving the purpose of communicating affect, with indicators of mutuality and reciprocity, contributing to the promotion of the parent-infant bond and infant attachment.

Lastly, IDSg supports maternal wellbeing, providing opportunities for mothers to enhance their ability to be sensitive and responsive to their infant. This characterization supports the conceptualization of singing interactions as part of the general group of social interactions between infants and parents that in ecological systems theory ([Bronfenbrenner, 2005](#)) are considered to drive child development, and that are fundamentally dyadic. This also explains the greater impact of singing interactions when the parent was able to control the characteristics of the singing, as opposed to being assigned a style of singing of a particular song (see e.g., [Cirelli & Jurewicz, & Trehub, 2020](#); [de L'Etoile, 2006b](#)). In the scenarios where the parents were not able to choose the song the ability of the caregiver to be responsive to the infant's state may have been compromised. This may have restricted the ability for the parent to mirror affect or change song in response to the infants' needs, impacting on the interactions observed. The impact of the choice of song may be an area for future research.

4.2. The influence of IDSg on preterm infants

In contrast to typically developing infants, the impact of IDSg on medically unstable or preterm infants was inconsistent. Of the five articles which examined parent initiated infant-directed singing on pre-term infants (Arnon et al., 2014; Blumenfeld & Eisenfeld, 2006; Carvalho et al., 2019; Epstein et al., 2021; Filippa et al., 2013), three studies (Arnon et al., 2014; Carvalho et al., 2019; Filippa et al., 2013) concluded positive impacts, each with strict inclusion criteria, one study (Blumenfeld & Eisenfeld, 2006) with no impact and one study (Epstein et al., 2021) with negative impacts on the infant. The medical voice intervention literature has predominantly focused on the physiological effects of the human voice, particularly on prenatal or hospitalized infants for whom physical caretaking is impractical (Arnon et al., 2014; Filippa et al., 2013; Loewy et al., 2013; Picciolini et al., 2014; Provenzi et al., 2018). It has included investigations of a range of voice interventions, including speech, singing, and non-verbal vocalizing, provided by parents, musicians, or clinicians, live or recorded. Research, which has mostly concluded that voice interventions have a positive influence on this vulnerable population, has been undertaken in many areas including the autonomic system (Arnon et al., 2014); physiological events, such as oxygen saturation, number of critical events, and behaviors (Filippa et al., 2013); feeding and sleep (Loewy et al., 2013); and cognition and neurodevelopment (Picciolini et al., 2014; Provenzi et al., 2018). For example, singing to infants has been found to reduce pain during medical procedures (Ullsten et al., 2017). Whilst not conclusive, the findings of this review suggest that IDSg is a potentially valuable intervention in the care of preterm or otherwise medically fragile infants, offering a way to establish and maintain the early parent-infant bond and infant attachment with infants who often cannot be handled, held, or rocked. These potential links between IDSg and attachment in pre-term infants warrant further investigation.

4.3. Limitations, considerations, and future directions

Despite the studies identified in the current review focusing on IDSg, none of the studies explicitly defined 'singing'. While the definition may seem intuitive, some definitions include any melodic vocalization (e.g., with made-up words – a common feature of IDSg), while others only include singing with words. This means that they may have been measuring different phenomena. Additionally, several studies excluded significant proportions (15–30%) of their participant pool due to infant fussiness or discomfort. While infant fussiness is a common problem in infant research, none of these studies discussed the characteristics of those who were excluded. Infant fussiness, or negative affect, may be associated with demographic or behavioral characteristics that are relevant to the study of IDSg. Furthermore, the included studies typically employed convenience samples, sometimes of very small numbers ($n < 20$) and there was a lack of demographic data reported meaning that it was difficult to contextualize and generalize the findings. Indeed, none of the included studies claimed to have recruited a representative sample with sampling often focused on middle class Caucasian mothers – and indeed, none focused on fathers. One study found that mother's education significantly predicted infant vocalization at baseline and that during the study, infants of less-educated mothers were significantly less likely to vocalize in response to their mothers than infants of more-educated mothers (Carvalho et al., 2019). This review does not provide information about the characteristics of parents and infants who may respond differently to IDSg (e.g., ethnicity, socioeconomic status, gender). The small sample sizes, particularly in studies with large ranges in the age of infants examined (e.g., Baker & Mackinley, 2006), and the diverse methodologies used in the studies reviewed here makes it difficult to discuss the impact of parent-led live singing on infants across infancy. The focus of all but one of the included studies on infants 12 months of age and younger suggests that the impact of parent-led live IDSg is likely to be most significant during the first year of an infant's life. However, further research with consistent methodologies, larger sample sizes and equal numbers in particular age range windows are needed to isolate how the impact of parent led live IDSg changes with changes in infants' communicative and behavioural repertoires.

This review focused on singing provided by parents only, on the basis that the parent–infant dyadic relationship is an especially powerful setting for generative mechanisms such as interpersonal interactions. In the majority of studies this parent was the biological mother. However, it may be that musical interactions are also beneficial between other pairs of actors, such as infants and teachers in early learning settings, or infants and music therapists in hospitals. Exploring the early childhood education setting may be particularly valuable, as many infants spend significant time in these settings with caregivers who perform a quasi-parental function. Similarly, fathers also suffer from mental distress and may experience the same benefits of IDSg as have been identified for mothers. Gender differences in caregiver communication broadly – and singing specifically – is an underexplored area within which there are still many unanswered questions amenable to scholarly enquiry.

It was surprising that our review did not identify any studies that were conducted prior to 2003 that met our eligibility criteria. Upon further review of prior studies, we note that many focused on characterizing IDSg (e.g., Trehub, 1987; Trehub et al., 1993) or examined infants' music perception or responses to IDSg using pre-recorded stimuli (e.g., Bergeson & Trehub, 1999; Standley & Madsen, 1990; Trainor, 1996; Trehub, 1987; Trehub et al., 1986; 1997; Vouloumanos & Werker, 2007), rather than focusing on the impact of IDSg on infants as per the goal of our review. While we recognize that our strict inclusion criteria of only including live IDSg limited the date range of the articles included in our review, we achieved our main goal of this review which was to conduct a comprehensive investigation of the impact of parent-led IDSg on infants in live contexts, which is most representative of the context in which parent-led IDSg occurs in infants' everyday lives.

Furthermore, the only developmental disability included in the study of infants born at term was with infants with Down Syndrome (De L'Etoile, 2015). Given the differences in the impacts of IDSg for non-typically developing infants, it would be valuable to investigate the role of IDSg for infants with other common developmental or physical disabilities, to determine whether IDSg has therapeutic properties for vulnerable populations. Lastly, one of the main limitations of the literature is the lack of perspective in relation to development across time. IDSg could have effects beyond the moment in which the singing is delivered. The dominance of

Table A1
Summary of studies included in the systematic review.

Study	Sample Characteristics (N, Infant Age)	Design	Measures	Key Findings
Studies with preterm infants born prior to 40 weeks gestational age ($n = 5$)				
Arnon et al. (2014)	86 dyads Postmenstrual age of 32–36 weeks. <i>Excluded infants with brain injury or sensitivity to mother's voice at pretest</i>	KC vs. KC + IDSg Song type: Mothers' choice of Familiar lullabies	Physiological parameters (Maternal and Infant): HR, respiratory rate and oxygen saturation Anxiety (Maternal) Behavioral state (Infant)	No condition differences in infant HR, oxygen saturation and respiratory rate IDSg improved autonomic stability (HRV) IDSg reduced maternal anxiety levels (calming) No condition differences in infants' behavioral state
Blumenfeld and Eisenfeld (2006)	11 dyads 31–40 weeks gestational age	IDSg vs. No IDSg Song type: Mixed; Mothers' choice	Feeding duration (Infant) Feeding velocity (Infant) Feeding intake (Infant)	No impact of IDSg on infant feeding characteristics
Carvalho et al. (2019)	36 dyads 30–34 weeks gestational age (chronological age 4–81 days)	KC (Baseline) vs. IDSg vs. Speech Within-dyad Song type: mothers' choice; asked to hum an original melody without words	Behavioral state (Infant)	Infant vocalizations: KC > Speech > IDSg suggesting IDSg associated with increases in infant drowsiness Infants responded more promptly to mothers' IDSg than speech Infants' vocalizations more overlapping, simultaneous exchanges with IDSg Mothers adapted the flow of IDSg in response to infant vocalizations which may promote bonding
Epstein et al. (2021)	35 dyads Preterm infants born before 32 weeks with severe brain injury in NICU	SSC vs. SSC + IDSg (+ music therapist providing support via voice or guitar to attune the music to infants cues) Within-dyad Song type: mothers' choice of lullaby	Physiological state incl. HRV (Infant) Behavioral responses (Infant) Anxiety (Maternal) Physiological vital signs (Maternal)	IDSg + music therapist produced physiological and behavioral instability in infants IDSg + music therapist increased maternal anxiety
Filippa et al. (2013)	18 dyads Preterm neonates in NICU	Baseline vs. IDSg vs. Speech Within-dyad Song type: Not described; mothers' choice	Heart rate and oxygen saturation (Infant) Number of adverse incidents (Infant) Sleep and alert states (Infant)	IDSg and Speech showed increases in infants heart rate and oxygen saturation relative to Baseline IDSg maintained infants in an active sleep state
Studies with infants born full term, aged from birth to 18 months ($n = 16$)				
Arias and Peña (2016)	26 dyads 6–8-month-old infants	Silence vs. ID Speech vs. IDSg Within-dyad Song type: Mothers' choice of play song e.g. "Twinkle twinkle little star"	Attention (Infant gaze) Linguistic and non-linguistic vocalizations (Infant) Body movements (Infant) EEG (Infant brain activity) Infant-directed prosody, pauses and exclamations (Mother) Facial gestures and large body movements (Mother) Temperament (Infant; Infant Behavior Questionnaire (IBQ) completed by mothers)	IDSg associated with increases in infants' sustained attention, stillness, and quiet Infants made fewer but longer visual contacts in response to IDSg than ID speech
Baker and Mackinlay (2006)	16 dyads 6-weeks to 18-months-old	Qualitative interviews to evaluate a lullaby education programme Song type: Mothers' choice of lullaby	Mother's responses to interview questions <i>Note: This study presented a significant bias as mothers were informed of the benefits of IDSg at the start of the study</i>	Lullabies calmed mother and infant IDSg provided a sense of assurance that mothers were "good mothers" making them more confident in their maternal abilities and more attuned to their infants' cues IDSg provided a time for bonding
Cirelli, and Jurewicz, and Trehub (2020)	29 dyads 8–11-months-old	Playful IDSg vs. Soothing IDSg Within-dyad Laboratory study Song type: "Twinkle Twinkle Little Star"	Skin conductivity (arousal; Mother and Infant) Attention to caregiver (Infant) Rhythmic gestures (Mother)	Infants' attention to mother: Playful IDSg > Soothing IDSg Skin conductance of mothers and infants: Playful IDSg < Soothing IDSg

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Table A1 (continued)

Study	Sample Characteristics (N, Infant Age)	Design	Measures	Key Findings
		alternating playful and soothing renditions	Smiling (Infant) Acoustic features of singing (Mother)	
Cirelli and Trehub (2020)	140 dyads 8-month-olds (70 dyads) 10-month-olds (70 dyads)	Familiar song vs. Unfamiliar song vs. Speech Within-dyad 'still face' procedure to elicit infant distress then compared infants' responses to reunion phases across the conditions. Song type: Familiar and unfamiliar (to infant) favourite song	Attention to caregiver (Infant) Smiling (Infant) Negative Affect (Infant) Skin conductance (Infant) Distress and arousal were measured using both behavioral and physiological measures (Infant)	Familiar songs were best at capturing infants' attention, calming infants, and promoting infants' smiling IDSg (regardless of type) reduced infant distress
Creighton et al. (2013)	23 dyads 5–8-months-old	IDSg Interactions vs. Non-Singing Play Interactions Between Dyads Song type: Mixed lullabies and play songs	Interviews on mothers' subjective experiences of interactions with their infants involving either IDSg or non-singing play Interviews coded using thematic analysis	IDSg facilitates infants' emotional regulation IDSg captures infants' attention IDSg makes infants' happy and relaxed IDSg helped mother to calm, clear their minds Shared spiral of happiness, independently and enhanced by the shared experience IDSg encourages mothers to respond to infant's cues and thus, is associated with mothers feeling they can meet their infants' needs – giving "good mother" status
De l'Etoile (2006b)	60 dyads 6–9-months-old	6 within-dyad conditions: mother sings assigned song "Twinkle Twinkle Little Star", mother sings song of their choosing, stranger sings assigned song, infant engagement with a book, a toy, and pre-recorded music Song type: Lullaby plus song of mother's choice	Cognitive, physical, and vocal behavior (Infant) Coded from video using the IBRS-R	IDSg associated with infants' moderate degree of positive cognitive behavior and low positive physical behavior IDSg by mothers produced moderate levels of arousal in infants (level required to maintain attention) IDSg by stranger produced the highest levels of infants' attention
De l'Etoile (2012)	32 dyads (16 dyads incl. mothers with depression; 16 dyads incl. mothers without depression) 3–9-months-old	IDSg by mother vs. IDSg by stranger Song type: Both sang lullaby "Twinkle, Twinkle, Little Star"	Eye gaze (Infant) Affect (Infant) Coded from video using the IBRS-R	IDSg (mother and stranger) increased face-to-face engagement allowing infants to self-regulate, even when mothers have depression. No significant effect of maternal depression on infant response to IDSg
De l'Etoile (2015)	31 dyads (16 dyads incl. infants with Down Syndrome; 15 dyads incl. typically developing infants) 3–6 months-old 6–9 months-old	IDSg responses in younger vs older infants with vs without Down Syndrome Song type: Mothers' choice (familiar song)	Eye gaze (Infant) Affect (Infant) Coded from video using the IBRS	IDSg increased infants' sustained attention IDSg induced a calm curious state No difference between infants with and without Down Syndrome
Fancourt and Perkins (2018)	391 dyads 4–40-weeks old	Mothers completed online questionnaire indicating the frequency of IDSg and scales related to depression and wellbeing. Song type: Not specified. Mothers' choice.	Mothers reported frequency of IDSg and listening to music Mothers' self-report: Edinburgh Post-Natal Depression Scale Warwick-Edinburgh Mental Wellbeing Scale Rosenberg Self-esteem Scale Questions on their perception of the mother-infant bond	Engaging in IDSg daily was significantly associated with fewer symptoms of maternal depression and increased maternal wellbeing, self-esteem, and improved mother-infant bond.
Ghazban (2014)				

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Table A1 (continued)

Study	Sample Characteristics (N, Infant Age)	Design	Measures	Key Findings
	Experiment 1: 20 dyads Mean age 10.3 months Experiment 2: 20 dyads 9.5 – 10.8-months-old	Both experiments used Face-to-Face/ Still-face paradigm Withing-dyad Experiment 1 compared speaking vs singing as a way to calm a distressed infant. Song type: Mothers' choice (familiar); mixed play song and lullabies Experiment 2 compared familiar lullabies and lively play-songs as a way to calm a distressed infant	Physiological arousal (Infant) Affect (Infant) Attention (Infant)	Experiment 1 IDSg reduced distress in infants (physiological state) whereas speaking increased distress. IDSg elicited more sustained attention than speaking. Experiment 2 IDSg of play songs decreased physiological arousal, regulated negative affect quicker than lullabies IDSg of play songs promoted visual attention and reduced movement more so than lullabies.
Jover et al. (2019)	23 dyads 6.53-months-old (mean age)	IDSg mother vs. Silence Within-dyad Song type: Short French nursery rhyme	Motor activity (hands, feet and head; Infant)	IDSg associated with reduced infant motor activity reflective of a calm state
Longhi (2009)	4 dyads 3–4-months-old (Time 1) and 7–8-months-old (Time 2)	Maternal IDSg across time Song type: Mothers' choice (tended to be playsongs)	Non-verbal behavior (Infant, Mother) Microanalysis of the temporal structure of IDSg	Infants responded rhythmically according to mothers' musical structuring Mothers adjusted the temporal structure of songs in response to the interaction with the infant at each developmental timepoint
Persico et al. (2017)	168 dyads (83 dyads with Intervention; 85 dyads as Control) 0–3-months-old	IDSg Intervention vs. No IDSg Control The intervention group received teaching and encouragement to sing lullabies to their infants (both in pregnancy and postnatally) at antenatal classes whereas the control group did not receive this advice at their antenatal classes. 81/83 dyads in the intervention group reported continuing singing regularly 1 month after birth. By contrast 8% of women in the control group reported singing lullabies daily antenatally and after birth. Song type: Lullabies	Mothers reported on infant behavior MIBS was used to assess mother- to-infant bond at 48-hours after birth and 3 months later Mothers self-perceived maternal stress	In the first month, mothers in the intervention group reported fewer episodes of infant crying, fewer waking episodes at night, and fewer reports of colic Perceived maternal stress was reduced in the singing intervention group At three months, postnatal bonding was significantly stronger in the singing group (lower MIBS score)
Pixley (2015)	16 dyads 0–12-months-old	Phenomenological research study using interviews and follow-up diary entry of types of musical engagement Song type: Mothers' choice, mixed.	Interview Diary entry of a musical engagement (predominantly reported to be IDSg)	IDSg was calming for infant and mother IDSg served the purpose of mother expressing emotion Mothers believed that IDSg was a way to promote language development or teach cultural awareness IDSg was identified as a way for the mother and child to connect Mothers reported that their singing was often in direct response to their infant's reactions and preferences IDSg was viewed as a way to "tune-in" to the infant
Robertson and Detmer (2019)	45 dyads (21 dyads w/ Intervention; 24 dyads as Control) Birth – 6-weeks-old	IDSg Intervention vs Control Intervention group participated in a music intervention that promoted the singing of lullabies Control group had no contact with researchers prior to evaluation Song type: Lullabies	Mothers reported on infants' crying behaviors weekly At 6-weeks-old the mother-infant interaction was video recorded for 4 min then analyzed using the Edinburgh Postnatal Depression Scale	Infants exposed to regular IDSg were reported to spend less time crying IDSg intervention associated with mothers reporting higher levels of responsiveness (attention to needs), warmth, and eye contact (social connection), when talking and singing No condition differences in postnatal depression
Shenfield et al. (2003)				

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Table A1 (continued)

Study	Sample Characteristics (N, Infant Age)	Design	Measures	Key Findings
	24 dyads 5–7-months-old	Effect of IDSG on cortisol levels Within-dyad Study conducted in a laboratory Song type: Singing or humming, mothers choice (most chose ply-song)	Cortisol levels (in saliva; Infant)	IDSG by mother regulated cortisol levels (infant stress levels). Infants with lower baseline cortisol levels showed modest increases, while those with higher baseline levels showed modest decreases

Note. HR = Heart Rate. HRV = Heart Rate Variability. IBRS-R = Infant Behavior Rating Scales – Revised. IBQ = Infant Behavior Questionnaire. IDSG = Infant-directed singing. KC = Kangaroo care. SSC = Skin-to-skin contact. MIBS = Mother-Infant Bonding Scheme. EEG = Electroencephalography. NICU = Neonatal Intensive Care Unit.

cross-sectional data observed in the current review sample indicates that, while immediate behavior changes have been studied, impacts on child development – an ongoing process in which time plays an important role – resulting from IDSG has not yet been examined across the life course. Research into the longer-term associations between IDSG and parent-infant bonding, parental well-being and infant emotional regulation, would be a valuable contribution to knowledge.

Table A2

Codes and themes identified in the systematic review.

Main theme	Sub theme	Code	References
Infant (n = 19)			
Emotional regulation	Affect	Vocalize less	Arias & Peña, 2016;Carvalho et al., 2019
		Reduced motor activity	Arias & Peña, 2016; de l'Etoile, 2006b;Jover et al., 2019
		Calm, curious state	Arias & Peña, 2016;Baker & Mackinlay, 2006;Cirelli & Trehub, 2020;Creighton et al., 2013; de l'Etoile 2012; de l'Etoile, 2015; Ghazban, 2014;Pixley, 2015
	More smiling	Cirelli & Trehub, 2020	
	Physiological response	Arnon et al., 2014;Blumenfeld & Eisenfeld, 2006;Epstein et al., 2021;Filippa et al., 2013;Ghazban, 2014	
Signs of distress		Less crying / colic / distress	Cirelli & Trehub, 2020;Persico et al., 2017;Robertson & Detmer, 2019
		Reduced skin conductivity/salivary cortisol level	Cirelli & Jurewicz, & Trehub, 2020;Shenfield et al., 2003
Moderates arousal Attention		Sleep state	Filippa et al., 2013;Persico et al., 2017
		Moderate positive cognitive behavior Maintains attention of infant	de l'Etoile, 2006b Arias & Peña, 2016;Cirelli & Trehub, 2020;Cirelli & Jurewicz, & Trehub, 2020;Creighton et al., 2013; de l'Etoile, 2006b; de l'Etoile, 2015;Ghazban, 2014
Parent (n = 8)			
Validate the role of the mother/parent	Confidence in meeting their infant's needs	Feeling of being a 'good mother'	Baker & Mackinlay, 2006;Creighton et al., 2013
	Mother as educator	Confident in maternal role	Baker & Mackinlay, 2006
		IDSG is used as a teaching tool to impart culture and promote language development	Pixley, 2015
	Enhanced maternal wellbeing		Being effective at calming baby, calms mother
Increased stress in baby, increased maternal stress Reduced stress and anxiety levels			Epstein et al., 2021 Arnon et al., 2014;Cirelli & Jurewicz, & Trehub, 2020;Persico et al., 2017
Dyad (n = 13) Behavioural and Affect Co-regulation	Reciprocal relationship	Mothers' wellbeing Expressed emotions through IDSG	Creighton et al., 2013;Fancourt & Perkins, 2017 Pixley, 2015
		Mirrored affect	Arnon et al., 2014;Baker & Mackinlay, 2006;Cirelli & Jurewicz, & Trehub, 2020;Creighton et al., 2013;Epstein et al., 2021; Pixley, 2015
	Communicative routines	Caregivers respond to infants' reactions and needs	Baker & Mackinlay, 2006;Carvalho et al., 2019;Creighton et al., 2013;Longhi, 2009;Pixley, 2015;Robertson & Detmer, 2019
		Promotes face-to-face interactions Simultaneous exchanges	de l'Etoile, 2012;Robertson & Detmer, 2019 Carvalho et al., 2019;Jover et al., 2019;Longhi, 2009;
	Mother-Infant bond	Sense of pleasure and satisfaction through shared moments Provides connection through shared experience	Baker & Mackinlay, 2006;Creighton et al., 2013;Fancourt & Perkins, 2018;Pixley, 2015 Creighton et al., 2013;Persico et al., 2017;Pixley, 2015

Note. IDSG = infant-direct singing.

4.4. Conclusion

Whilst caution in interpretation of the findings is required because the parent singing literature is surprisingly small, the reviewed studies suggest that IDSg has a range of positive effects for infants, parents, and the parent-infant dyad. Short-term benefits were identified in a range of areas including emotional regulation, validation of the mother role, and affect attunement between parent and infant. These benefits are promoted through cyclical reinforcement whereby parents' singing attracts infants' attention, placing infants into a calm, attentive state which, in turn, supports the singers' mental wellbeing. These shared exchanges appear to set the stage for a cascade of effects to begin, promoting the development of the infant, responsiveness of the parent and strength of the dyad. Ultimately, IDSg by parents communicates social and emotional information that teaches infants about themselves, their family, and the world around them.

Data Availability

No data were used for the research described in the article.

Appendix

Appendix Tables A1 and A2.

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