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Brief report

Joint attention abilities in Brazilian preterm and full-term infants

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ABSTRACT

Joint attention abilities of preterm and full-term Brazilian infants were assessed at 12- and 18-months, age corrected for prematurity. Results showed that preterm infants displayed significantly lower levels of correct responses to others' bids for joint attention at both time-points, compared to full-term infants. Both groups improved their responding to joint attention from 12 to 18 months of age. Contrastingly, prematurity did not impact infants' initiating joint attention behaviors, which remained stable over time for both groups. Findings were discussed in terms of the specific mental processes involved in distinct behavioural dimensions of joint attention.

Premature birth, occurring before 37 weeks of complete gestation, accounted for approximately 10.6 % of all livebirths worldwide in 2014 (Chawanpaiboon et al., 2019). Ample evidence suggests that premature infants are at elevated risk for cognitive impairment (e.g., de Jong, Verhoeven, & van Baar, 2012; Sansavini et al., 2010; Wolke et al., 2015), emotional and behavioral problems (e.g., de Jong et al., 2012; Jones, Champion, & Woodward, 2013; Potijk, de Winter, Bos, Kerstjens, & Reijneveld, 2016), and disturbances in social communication (e.g., Jones et al., 2013; Landry, 1995; Landry, Denson, & Swank, 1997; Olafsen et al., 2006; Wong, Huertas-Ceballos, Cowan, Modi, & Medicines for Neonates Investigator Group, 2014).

Joint attention, or the infants' ability to coordinate their visual attention towards an object or event with others (Bakeman & Adamson, 1984; Tomasello, 1995), is a pivotal socio-cognitive milestone that has been related to infants' subsequent language acquisition (e.g., Colonnesi, Stams, Koster, & Noom, 2010; Morales et al., 2000; Mundy & Gomes, 1998), social competence (e.g., Sheinkopf, Mundy, Claussen, & Willoughby, 2004; Vaughan Van Hecke et al., 2007), and Theory of Mind (Charman et al., 2000; Nelson, Adamson, & Bakeman, 2008; Sodian & Kristen-Antonow, 2015). Although the emergence of joint attention is often situated at around 9 months of age (Bakeman & Adamson, 1984; Flom, Deák, Phill, & Pick, 2004; Gaffan, Martins, Healy, & Murray, 2010), it is during the second year of life that this capacity becomes more frequent in infants' behavioral repertoire during their social interactions (Mundy et al., 2007). The occurrence of two main types of behaviors is typically investigated: responding to joint attention (RJA) – or the infants' ability to follow the direction of others' gaze or pointing gestures – and initiating joint attention (IJA) – that comprises infants' own initiatives to share the social experience of an object/event with others, by using eye contact, showing or pointing gestures (Mundy & Gomes, 1998; Mundy, Card, & Fox, 2000,). Infants' joint attention behaviors are often distinguished from the use of gaze or gestures to regulate adults' behavior for instrumental purposes (e.g., to elicit aid in reaching for a toy), also known as initiating behavioral requests (IBR), or infants' ability to respond to the adults' requests (e.g., give a toy to the adult), known as

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responding to behavioral requests (RBR) (e.g., Mundy et al., 2007,).

Previous investigations reported impairments in joint attention skills in premature infants, compared to their full-term peers (e.g., Garner, Landry, & Richardson, 1991; Kmita, Kiepura, & Majos, 2014; Landry, 1995; Olafsen et al., 2006). In turn, other studies found a negative effect of preterm birth specifically on infants' ability to respond to joint attention bids (but not on their initiating joint attention behaviors) (Rowell, 2014; Sperotto, 2015), or observed no differences between preterm and full-term infants (De Schuymer, De Groote, Beyers, Striano, & Roeyers, 2011). However, empirical evidence of joint attention in preterm infants comes mostly from high-income countries. Thus, less is known about the development of this capacity in preterm infants living in other settings that are likely to pose additional environmental risks (e.g., poverty, low parental education, poor caregiving conditions), which may, in conjunction with prematurity, further hinder infants' developmental outcomes (Bradley et al., 1994; Brumberg & Shah, 2015).

In 2014, Brazil registered an estimated preterm birth rate of approximately 11 %, featuring in the rank of the ten countries with the largest number of preterm births worldwide (Chawanpaiboon et al., 2019). However, some national population-based studies suggested a slightly higher prevalence of preterm deliveries, ranging from 11.4%–12.3% (Cavalcante et al., 2017; do Carmo Leal et al., 2016; Passini et al., 2014; Victora et al., 2008). More importantly, an increase of preterm birth has been observed in the last decades (Barros et al., 2005; Chawanpaiboon et al., 2019; Guimarães et al., 2017; Santos et al., 2011; Silveira et al., 2008), making it a critical challenge for the Brazilian scientific community. In addition, previous studies in Brazil showed that spontaneous preterm birth was associated with women living in socially-disadvantaged conditions (e.g., poorer education level, inadequate prenatal care, poverty) (do Carmo Leal et al., 2016; de Sadovsky et al., 2018; Silveira et al., 2010), as well as a higher prevalence of suspected developmental delay observed in preterm infants from lower income families (Halpern et al., 2008). Thus, assessing samples from settings characterized by higher social inequality and environmental risks (e.g., Brazil) may inform us on how preterm infants' developmental outcomes, particularly joint attention, may be affected (or not) by the different socioeconomic backgrounds.

To our knowledge, no previous study compared the longitudinal trajectories of joint attention skills in preterm and term infants in Brazil. Thus, the present work aimed to examine the development of joint attention abilities in a sample of preterm and full-term Brazilian infants, during the second year of life.

Participants were 17 preterm infants (13 boys, 76.5 %) and 16 full-term infants (9 boys, 56.3 %) assessed at 12 and 18 months (for the former group, age corrected for prematurity). Preterm infants' mean gestational age was 32 weeks ($SD = 2.73$), with an averaged birth weight of 1720 g ($SD = 650$). Two infants were born at 26 and 28 gestational weeks, whereas the remaining preterm infants ranged from 30 to 36 complete weeks of gestation. Their 5-min Apgar scores were ≥ 7 ($M = 8.65$; $SD = 1.00$) and hospitalization lasted between 3 and 135 days ($M = 36.12$; $SD = 33.72$). On the other hand, the full-term group had, on average, 39 weeks of gestation ($SD = 1.34$) and their mean birth weight was 3219 g ($SD = 397$). In addition, full-term infants had a 5-min Apgar score $\geq$ 8. Table A1 displays information on the medical and sociodemographic characteristics of the sample. Groups did not differ on infant sex, age at testing on both time-points, birth order, family income, and maternal education.

For all participants, inclusion criteria were prenatal surveillance and Brazilian Portuguese as spoken language at home. In turn, infants were excluded if they had a genetic disorder, a diagnosis of vision/ hearing problems and/or intellectual disability, retinopathy of prematurity in the case of the preterm group, or mothers were younger than 18 years at their infant's birth.

Preterm infants were recruited in a publicly funded hospital in the city of São Paulo, whereas the recruitment of full-term infants occurred by local advertising (e.g., social media, personal contacts). All participants were from the metropolitan region of the city of São Paulo. Mothers were informed of the study goals and procedures to be carried out, after which they gave their written permission, consenting their infants to participate. Assessments were conducted in individual sessions in a university lab facility, for approximately 2 h each. This study was approved by the ethical boards of the hospital and the university involved in this study.

Infants were assessed for joint attention abilities at 12 and 18 months, with the entire procedure videotaped for subsequent behavioral coding. An evaluation of the infants' current level of development was also conducted using the Bayley Scales of Infant and Toddler Development – 3rd Edition (Bayley, 2005). The cognitive scale was used and developmental scores were adequate to age norms for all infants and at both assessments (12-months: preterm group – $M = 109.41$; $SD = 16.00$; full-term group – $M = 116.25$; $SD = 17.46$; 18-months: preterm group – $M = 105.59$; $SD = 11.44$; full-term group – $M = 120.63$; $SD = 15.37$). Both groups presented similar level of cognitive development at 12-months, $t(31) = -1.17$, $p = .249$, whereas at 18-months full-term infants performed significantly better compared to preterm infants, $t(31) = -3.20$, $p = .003$.

The Early Social Communication Scales (ESCS; Mundy et al., 2003) are an observational procedure in which the infant interacts with a tester, aimed at measuring infants' socio-communicative behaviors from 8 to 30 months of age. The procedure was carried out on a quiet room and free of distractions, where the infant seated on the parent's lap at a table facing the tester who presented several toys and objects (e.g., wind-up mechanical toys, balloon, book, colorful posters, plastic jar, pop-up puppet), in order to elicit infant's spontaneous initiatives to interact and response to the tester's communicative bids (please see Fig. A1). Two mutually exclusive categories of socio-communicative behaviors were of interest in this study: Joint Attention Behaviors – comprising Responding to Joint Attention (RJA) and Initiating Joint Attention (IJA) – and Behavioral Requests – composed of Responding to Behavioral Requests (RBR) and Initiating Behavioral Requests (IBR) (Mundy et al., 2003, 2007). RJA assesses the infant's capacity to follow the others' direction of gaze or pointing gestures and is expressed in terms of percentage of infant's correct answers, by looking at where the tester was pointing to and gazing (pictures in a book and posters hang on the wall), regarding the total number of trials. On the other hand, IJA measures the frequency of behaviors spontaneously produced by the infant to initiate joint attention with the tester (for example, eye contact, pointing and showing gestures). In turn, RBR evaluates the ability to follow commands (e.g., give a toy upon the tester's verbal and gestural request), whereas IBR measures how many times the infant uses eye contact and gestures such as pointing, reaching and giving to elicit tester's assistance in obtaining a toy/object (Mundy & Gomes, 1998; Mundy et al., 2000,). A randomly selected 21 % of the ESCS videos was coded for reliability purposes by two observers who were blind to the study goals, infant birth status and age of assessment. Inter-rater agreement revealed to be adequate across ESCS variables (Cohen's Kappa was .74 for RJA and .79 for RBR; average measure intraclass correlations were .99 for IJA and .86 for IBR).

Differences in joint attention (RJA and IJA) and behavioral requests (RBR and IBR) were examined using two-way mixed-design ANOVAs, testing Group (Preterm vs. Full-Term) as the between-subjects factor, and Age (12-months vs. 18-months) as the within-subjects factor. Whenever it was necessary, post-hoc analyses were run using either independent- or paired-samples *t*-tests. We opted for retaining possible outliers in the analyses since it might capture the real inter-individual variability present in development since younger ages, as a result of several environmental and individual influences.

Table A2 presents the descriptive statistics of ESCS variables as well as the results from the ANOVAs. A main effect of group emerged for RJA, $F(1, 31) = 9.94$, $p = .004$, $\eta^2_p = .243$, such that preterm infants showed significantly lower levels of correct responses to tester's bids for joint attention at 12 months, $t(31) = -2.48$, $p = .019$, $d = 0.87$, and 18 months, $t(22.42) = -2.35$, $p = .028$, $d = 0.80$ (see Fig. A2). Likewise, a main effect of age was detected, $F(1, 31) = 36.84$, $p = < .001$, $\eta^2_p = .543$, with both groups expressing better RJA performance at 18 months than at 12 months – preterm group: $t(16) = -3.93$, $p = .001$, $d = 1.09$; full-term group, $t(15) = -5.11$, $p < .001$, $d = 1.09$. Finally, no group by age interaction was found, $F(1, 31) = 0.10$, $p = .749$, $\eta^2_p = .003$. Regarding initiating joint attention, results revealed no significant main effect of group, $F(1, 31) = 0.08$, $p = .775$, $\eta^2_p = .003$, age, $F(1, 31) = 0.04$, $p = .852$, $\eta^2_p = .001$, or group by age interaction, $F(1, 31) = 0.10$, $p = .755$, $\eta^2_p = .003$ (see Fig. A2). Preterm and full-term infants yielded similar frequency of IJA bids with no significant changes over time.

In what concerns requesting skills, only a main effect of age was found for RBR, $F(1, 31) = 12.92$, $p = .001$, $\eta^2_p = .294$, such that infants in both groups would more successfully comply with the tester's verbal and gestural commands, by giving them the toy, at 18- than at 12-months – preterm group: $t(16) = -2.77$, $p = .014$, $d = 0.72$; full-term group, $t(15) = -2.32$, $p = .035$, $d = 0.71$ (please see Fig. A3). No significant main effect of group, $F(1, 31) = 2.47$, $p = .126$, $\eta^2_p = .074$, or group by age interaction, $F(1, 31) = 0.08$, $p = .781$, $\eta^2_p = .003$, was observed for RBR. However, no main effect of group, $F(1, 31) = 1.83$, $p = .186$, $\eta^2_p = .056$, age, $F(1, 31) = 2.27$, $p = .142$, $\eta^2_p = .068$, or group by age interaction, $F(1, 31) = 0.10$, $p = .754$, $\eta^2_p = .003$, emerged for infants' initiating behavioural requests (Fig. A3).

The stability of ESCS measures across the 12- to 18-month period was also examined. Thus, RJA and IJA at 12-month tended to be associated with infants' performance at 18 months of age, $r = .29$, $p = .052$, and $r = .24$, $p = .085$ (one-tailed), respectively. In turn, RBR performance at 12 and 18 months were significantly correlated, $r = .38$, $p = .014$, whereas no evidence of stability was found for IBR, $r = -.15$, $p = .197$. After controlling for the 18-month Bayley cognitive score, the stability results remained unchanged, except for the RJA association, partial $r = .14$, $p = .215$, one-tailed.

In addition, we also examined the correlation across ESCS dimensions, as well as their association with infants' cognitive performance and length of gestation (Table A3). Thus, RJA and IJA were marginally correlated to each other at 12 months, $r = -.30$, $p = .093$, but no significant association emerged across these two measures of joint attention at 18 months, $r = .21$, $p = .235$. IJA was unrelated to the length of gestation in weeks and Bayley cognitive scores at any age (all *p*-values > .31). In turn, RJA was concurrently associated with infants' cognitive performance either at 12, $r = .41$, $p = .018$, and 18 months assessment, $r = .48$, $p = .005$. Moreover, a marginal association emerged between 18-month RJA and length of gestation, $r = .30$, $p = .085$, but this result turned non-significant when concurrent Bayley cognitive scores were partialled out ($r = .10$, $p = .570$).

In contrast, RBR and IBR variables were significantly associated with each other at 12, $r = .40$, $p = .020$, and 18 months of age, $r = .59$, $p < .001$. Requesting skills were unrelated to infants' length of gestation (all *p*-values > .10), whereas the association with Bayley cognitive scores emerged only at 12-months assessment (all $r \geq .39$, all *p*-values $\leq .026$).

The present study compared preterm and full-term infants' joint attention and behavioral requesting abilities from 12 to 18 months (for the former, age corrected for prematurity). Overall, results showed that premature infants performed worse than their full-term peers in responding to a tester's bids for sharing attention, and this impairment persisted over time. Contrastingly, prematurity had no negative effect on initiating joint attention or behavioral requesting skills (IBR and RBR). Both groups of infants displayed similar frequency of behaviors aimed at engaging the tester in joint attention or eliciting tester's assistance to obtain an object/toy, also without significant changes over time. In addition, infants in both groups complied more with the tester's requests over time.

The fact that preterm and full-term infants differed only in one of the joint attention dimensions corroborates the notion that RJA and IJA may have specific sources of influence (Mundy & Newell, 2007; Mundy et al., 2000, 2007). RJA is believed to involve processes serving attention regulation (e.g., orienting and shifting of attention) and information processing (e.g., spatial location of social stimuli) (Mundy & Newell, 2007; Mundy & Sigman, 2006). In this regard, evidence suggests that premature infants have more problems in regulating their attention (de Jong, Verhoeven, & Van Baar, 2015; Rose, Feldman, & Jankowski, 2001; Weijer-Bergsma, Wijnroks, & Jongmans, 2008) and slower processing of visual information (Rose, Feldman, & Jankowski, 2002) compared to full-term infants. The critical role played by perceptual and attentional processes in the ability to follow others' bids for sharing attention may therefore have contributed to the RJA impairments observed at both time-points for the premature group. Moreover, we also found a robust and consistent correlation between RJA and infant cognitive scores, whereas no such association emerged with IJA. In this regard, the occurrence of IJA is based on infants' current focus of attention while, to engage in RJA, infants must redirect their focus of attention. Thus, we may expect RJA to rely more heavily on cognitive processes (e.g., perceptual skills, information processing, attention control and regulation), such that preterm infants' difficulties become more evident when they need to follow others' focus of attention.

Our results are in line with previous investigations (Olafsen et al., 2006; Sperotto, 2015) that also observed lower levels of RJA in preterm infants around the age of 12 months. Interestingly, a study by De Schuymer et al. (2011) found no differences between preterm and full-term infants in RJA at 14-months (age corrected for prematurity). On the other hand, Sperotto (2015) reported impaired RJA in the preterm group at 18-months – however, it should be noted that this study was conducted according to infants' chronological age and it is possible that this result would fade had age been corrected. Therefore, further research is needed to explore the longitudinal trajectory of RJA development, therefore clarifying whether these difficulties continually characterize premature infants' performance or if and when a full recovery may occur, as well as whether gestational age is a factor for such trajectories. Finally, similarly to previous works (Mundy et al., 2007; Sperotto, 2015), an identical age-related growth pattern for RJA was registered for both groups, with premature and full-term infants alike significantly improving their ability to respond to bids for joint attention from 12 to 18 months.

In turn, our IJA findings were consistent with previous studies (De Schuymer et al., 2011; Rowell, 2014; Sperotto, 2015) that showed no decreased ability to initiate bids for sharing attention in preterm infants, when compared to their full-term peers. Olafsen et al. (2006) observed a beneficial effect of an early intervention program, targeting parental sensitivity at the neonatal period, on preterm infants' IJA behaviors at 12 months, suggesting that this dimension of joint attention is likely modifiable by the quality of early social experience. Thus, IJA bids seem to serve a more social function, comprising executive and motivational processes (Mundy & Newell, 2007; Mundy & Sigman, 2006) and being more susceptible to the affective nature (e.g., Gangi, Ibañez, & Messinger, 2014) and rewarding value of the sharing experience (Nichols, Fox, & Mundy, 2005), as well as the quality of caregiving conditions (e.g., Meins et al., 2011; Osório, Martins, Meins, Martins, & Soares, 2011; Siller & Sigman, 2002). In this regards, the recent meta-analysis by Bilgin and Wolke (2015) showed that despite the challenges associated with caring for a premature infant, mothers of infants born preterm were equally sensitive and responsive to their child's needs, when compared to mothers of full-term infants. This may have contributed to the absence of a negative effect of prematurity on infants' IJA. Lastly, Mundy et al. (2007) found no linear increase in IJA frequency over time, but rather a more flat pattern of development with similar frequencies of IJA behaviors displayed at 12 and 18 months of age.

In what concerns behavioral requesting skills, prior works also reported no significant effect of prematurity on RBR (Olafsen et al., 2006; Sperotto, 2015), as well as an increase in infants' ability to comply with verbal/gestural requests as they get older (Mundy et al., 2007; Sperotto, 2015). Interestingly, in our sample, preterm infants were equally capable (as their full-term peers) of using gaze and gestures to regulate the tester's behavior in order to get their assistance, whereas previous investigations found differences between the groups (De Schuymer et al., 2011; Olafsen et al., 2006; Sperotto, 2015). The small sample size and the presence of some more extreme performances within the preterm group preclude us from drawing any definite conclusions regarding IBR. Though, we may speculate that when taking the initiative (either for social sharing or instrumental purposes), following their own interests and focus of attention, preterm infants are not necessarily in disadvantage compared to their full-term peers. On the other hand, IBR and RBR were significantly correlated at both ages (as opposed to IJA and RJA), which may indicate some common processes underlying infants' individual differences in developing requesting skills (Mundy et al., 2007), and, therefore, a similar effect of prematurity.

The present study expands extant literature investigating joint attention abilities in infants born preterm. Our results are in line with previous research conducted in high-income settings, suggesting that prematurity may jeopardize infants' responding to joint attention, but not initiating joint attention. However, premature infants vary greatly in gestational age, birth weight, and medical complications (March of Dimes, PMNCH, Save the Children, & WHO, 2012), reflecting very different starting points in life. Thus, beyond the fact of being premature, future studies should also explore how perinatal characteristics may contribute to infants' subsequent developmental outcomes, and what environmental factors (e.g., SES, parenting behaviors) may help to mitigate the potential deleterious effect of prematurity.

The small number of participants in each group limits the generalization of our results, such that a replication study with a larger sample size is needed in order to draw more definitive conclusions on the impact of preterm birth on the development of joint attention. In addition, including multiple assessment points, covering the period from the emergence to the consolidation of joint attention, may allow to draw more definite conclusions regarding the impact of prematurity on the developmental trajectory of this socio-cognitive milestone. Finally, the fact that the two groups were recruited from different sites and in different ways may have also had an impact on the results. Indeed, although the preterm and full-term groups were similar in several sociodemographic characteristics, it is possible that some other variables not examined in the present study, such as prenatal care, mother's health during pregnancy, postnatal medical interventions, genetic factors and infants' current level of cognitive functioning, may account for group differences in joint attention. It is important that future studies investigate the potential role of these variables.

In conclusion, our findings have important implications for future investigations further characterizing the links between early socio-communicative abilities and later language acquisition (e.g., De Schuymer et al., 2011; Ulvund & Smith, 1996), or targeting joint attention skills in early intervention programs designed to promote preterm infants' optimal functioning.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CRediT authorship contribution statement

Vera Mateus: Formal analysis, Data curation, Writing - original draft, Funding acquisition. **Elisangela dos Anjos Paula Vieira:** Conceptualization, Investigation, Writing - review & editing, Funding acquisition. **Carla Martins:** Conceptualization, Writing - review & editing. **Paulo Roberto Pachi:** Conceptualization, Writing - review & editing. **Ana Osório:** Conceptualization, Methodology, Supervision, Formal analysis, Data curation, Writing - review & editing, Funding acquisition.

Declaration of Competing Interest

None.

Appendix A

Fig. A1. Illustration of the testing environment.

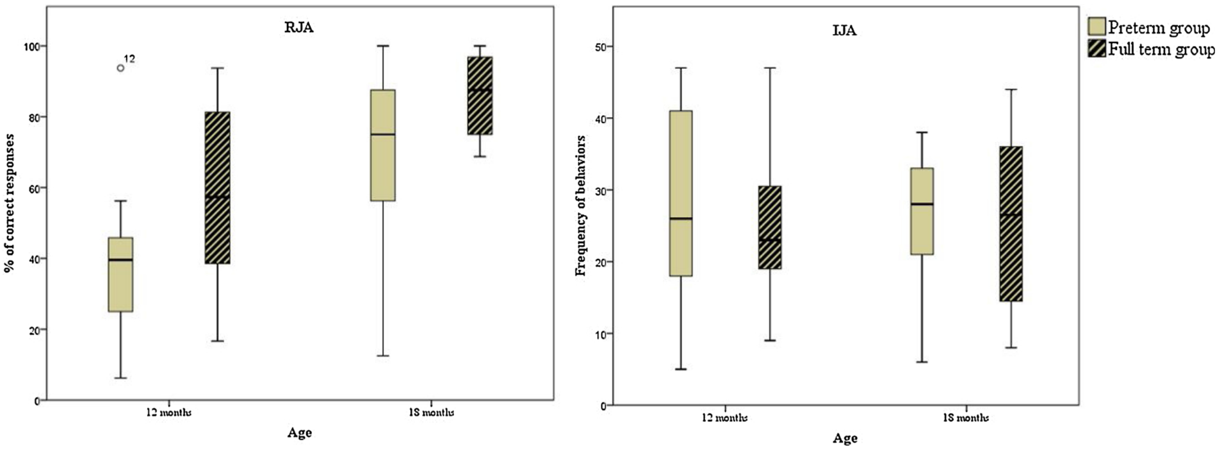

Fig. A2. Boxplots of responding to joint attention (RJA) and initiating joint attention (IJA) data at 12- and 18-months, in preterm and full-term infants.

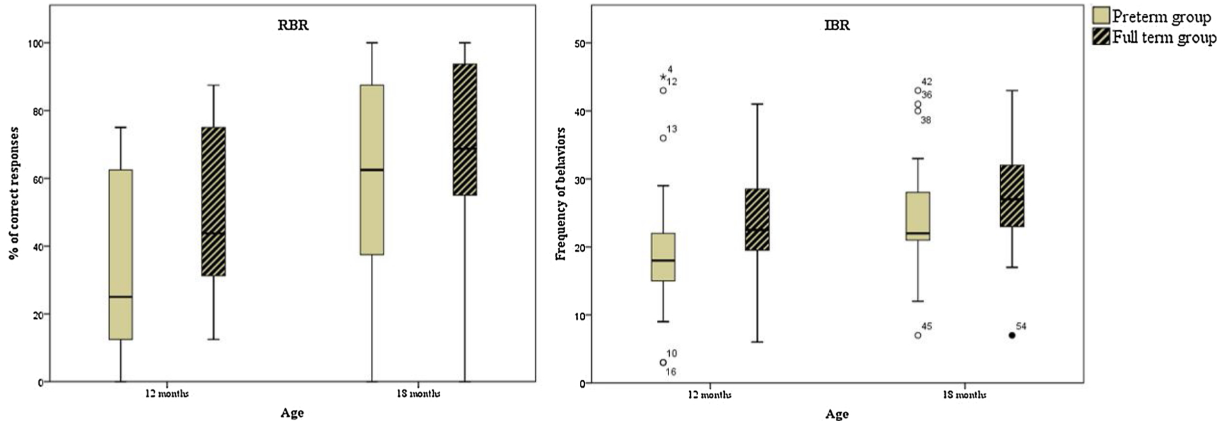

Fig. A3. Boxplots of responding to behavioral requests (RBR) and initiating behavioral requests (IBR) data at 12- and 18-months, in preterm and full-term infants.

Table A1
Characteristics of the sample.

	Preterm infants (n = 17)			Full-term infants (n = 16)			p-value
	n (%)	*Mean* (*SD*)	Min-Max	n (%)	*Mean* (*SD*)	Min-Max	
Medical characteristics							
Gestational age (weeks)		32.16 (2.73)	26 – 36		39.04 (1.34)	37 – 42	< .001[b]
Birthweight (grams)		1720 (650)	870 – 2900		3219 (397)	2500 – 3960	< .001[c]
Apgar score 5th min		8.65 (1.00)	7 – 10		9.47 (0.64)	8 – 10	.016[b]
Hospitalization (days)		36.12 (33.72)	3 – 135				
C-section	12 (70.6)			6 (37.5)			.056[d]
Sociodemographic characteristics							
Sex (boys)	13 (76.5)			9 (56.3)			.218[d]
Age at T1 (12 months)		12.26 (0.23)	11.83 – 12.67		12.15 (0.46)	11.06 – 12.87	.397[c]
Age at T2 (18 months)		18.08 (0.33)	17.50 – 18.57		18.19 (0.42)	17.57 - 18.87	.400[c]
First born	9 (52.9)			11 (68.8)			.353[d]
Family income[a]							.619[d]
≤ 2 national minimum wages	11 (64.7)			9 (56.3)			
> 2 national minimum wages	6 (35.3)			7 (43.7)			
Maternal education							.895[d]
≤ 12 years of schooling	11 (64.7)			10 (62.5)			
> 12 years of schooling	6 (35.3)			6 (37.5)			

[a] Number of national minimum wages of monthly family income. A national minimum wage corresponds to, approximately, 260 USD/ 230 Euro.
[b] Mann-Whitney Test.
[c] *t*-test for independent samples.
[d] Chi-Square Test.

Table A2
Joint attention behaviors at 12 and 18 months in preterm and full-term infants.

	12 months		18 months		Main effects[c]		Interaction[c]
	Preterm *M* (*SD*)	Full-term *M* (*SD*)	Preterm *M* (*SD*)	Full-term *M* (*SD*)	Group	Age	G X A
RJA[a]	39.29 (20.18)	58.46 (24.10)	69.85 (25.59)	85.94 (11.42)	9.94**	36.84***	0.10
IJA[b]	27.12 (13.48)	25.44 (11.28)	25.88 (8.59)	25.75 (11.98)	0.08	0.04	0.10
RBR[a]	35.71 (27.92)	50.26 (25.66)	57.88 (33.25)	69.22 (27.47)	2.47	12.92**	0.08
IBR[b]	19.94 (12.16)	23.81 (9.01)	24.82 (10.05)	27.00 (8.25)	1.83	2.27	0.10

**$p < .01$; ***$p < .001$.
Note: [a]Percentage of correct answers; [b]Frequency of behaviors; [c]*F*-test. RJA = Responding to Joint Attention; IJA = Initiating Joint Attention; RBR = Responding to Behavioral Requests; IBR = Initiating Behavioral Requests.

Table A3
Correlation analyses between joint attention, behavioral requests, cognitive scores and length of gestation.

	1	2	3	4	5	6	7	8	9	10
1. RJA 12-months										
2. RJA 18-months	.29									
3. IJA 12-months	−.30^{+}	−.02								
4. IJA 18-months	−.15	.21	.24							
5. RBR 12-months	.10	.23	.05	−.11						
6. RBR 18-months	−.13	.22	.12	.13	.38*					
7. IBR 12-months	.28	.45**	−.02	−.03	.40*	.24				
8. IBR 18-months	−.35*	.25	.20	.38*	.06	.59***	−.15			
9. BSID 12-months	.41*	.42*	−.05	−.004	.39*	.29^{+}	.50**	−.10		
10. BSID 18-months	.35*	.48**	.001	.05	.28	.07	.41*	.06	.41*	
11. Length gestation (weeks)	.27	.30^{+}	.07	.18	.29	.26	.27	.10	.34^{+}	.46**

$^{+}p < .10$; $*p < .05$; $**p < .01$; $***p < .001$.
RJA = Responding to Joint Attention; IJA = Initiating Joint Attention; RBR = Responding to Behavioral Requests; IBR = Initiating Behavioral Requests; BSID = Bayley Scales of Infant and Toddler Development – 3rd Edition.

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