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# Of the importance to reconsider individual variability in infant studies: Family traits do impact turn-taking perception in 6-month-olds

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## Abstract

Turn-taking is a universal pattern of human conversations characterized by a fast exchange of turns between speakers and an avoidance of overlaps. Language is embedded in this conversational skill acquired well before it during infancy, through everyday interactions with caregivers. The earliness of this skill and its link with language allows us to test whether social environment shapes early language development. We therefore study turn-taking perception of 6-month-old infants by measuring their gazes during video presentation of three different conversational situations where the turn is explicitly given, normally taken or taken with an overlap. We studied 51 infants to cover several family and infant characteristics: infants' sex, presence of siblings, and family socioeconomic status (SES). We found that infants looked more at the second speaker when she overlapped the first speaker than in the other situations, but not all infants were equally sensitive. Indeed, infants from high-SES families reacted differently to the three situations, while infants from the two lower

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SES categories did not. Also, only singletons reacted differently by looking more at the second speaker after the overlapping and turn-giving situations, and not after the turn-taking situation. Our results emphasize the importance of early social experiences on language development.

## 1 | INTRODUCTION

If human language fascinates by its way of expressing the most sophisticated thoughts through a system of abstract signs, we cannot understand its main issues without studying its most daily and ordinary use. Language is indeed mostly performed in conversations between several actors following a turn-taking pattern; which has been first described by Sacks et al. (1974) as: speakers rapidly exchange turns whose length and content are not specified in advance, and do so while avoiding overlaps and long pause. Turn-taking has been found in every human cultures, despite some marginal variations (in the average time between two turns for example) (Stivers et al., 2009), and to different degrees in other animal species (Pika et al., 2018), suggesting a cognitive basis as deep as language, if not deeper.

This depth is confirmed by the ontogeny as the first turn-taking interactions occur in infancy well before language production (Murray, 1985). Indeed, infants start to respond vocally in alternation with their parents from their third month (Bloom, 1975; Stern et al., 1975), a pattern that becomes predominant in the following weeks compared to concomitant vocalizations (Ginsburg & Kilbourne, 1988). During these early interactions, infants are already active participants as they themselves anticipate and initiate turns (Gratier et al., 2015). Turn-taking skills continue to increase after 5 months, with infants overlapping less and less (Hilbrink et al., 2015). According to Levinson (2016), the precedence of these pragmatic skills over linguistics skills confirms that language is only a part of a larger whole named “interaction engine,” a universal features from which language develops. However, among studies demonstrating turn-taking skills in the first year, studies on turn-taking perception are rare compare to those on turn-taking production (Augusti et al., 2010; Bakker et al., 2011). As a result, little is known about how infants perceive the different conversational patterns they may witness in their everyday life, and especially whether they perceive differently interactions that differ in their turn transition: a speaker may be selected by the previous one or take the turn, waiting for the turn or interrupting (Sacks et al., 1974). To our knowledge, no study ever investigated the infants' turn-taking perception of these different turn transitions.

Learning to interact according to a turn-taking pattern is of paramount importance for infants. On the one hand, it helps to develop language because infants need the socio-interactional matrix surrounding language to motivate them to engage with it. Kuhl et al. (2003) showed evidence of learning in 9-month-old infants exposed to live sessions with an adult speaker, evidence that was not found when infants were exposed to recorded sessions through a screen or loudspeakers. Moreover, in 8-month-old infants, contingent social interactions (verbal and non-verbal) with mothers promote more complex vocal behavior than non-contingent interactions (Goldstein et al., 2003). This shows that language input alone is not enough to learn

to speak: live human interactions are needed, where the timing of the responses and the link the response have with what precedes it is what matters. On the other hand, turn-taking acts as a rule in our society, and its violation leads to being perceived as “less sociable” (Robinson & Reis, 1989) and as having a “negative and strong personality” (ter Maat et al., 2010). Acquiring these conversation skills early is therefore crucial: young children who are the most accepted by their peers are those able to initiate and maintain coherent speech across interaction contexts (Hazen & Black, 1989). Rejected children perform lengthy turns, interrupt peers and respond noncontingently to requests. This interaction style could be related to a high proportion of interactions involving failed requests observed in their homes (parents do not leave time to their children to respond) (Black & Logan, 1995). The shaping of interaction style by parents is attested as early as 5 months of age, where infants already prefer their mother's level of temporal contingency to other levels, even when the former is rather low (Bigelow, 1998).

Infants' turn-taking skills are therefore shaped by the interactions they experience at home, hence the need to include factors describing the infant's social context in turn-taking studies. Several family and individual characteristics identified as significant predictors of variations in language development could predict variability in turn-taking skills. Family socioeconomic status (SES), defined by a combination of parents' education and profession, is a major example. Indeed, many studies have reported differences in children's language production and perception development from the second year, always in a sense that children from low SES had less vocabulary and syntactic skills than those from high SES (Fernald et al., 2013; Hart & Risley, 2003; Hoff, 2003; Huttenlocher et al., 2010; Rowe, 2008). The birth order is also known as a factor that influence language development, as later-born children have to compete with their older siblings to get parent's attention. Thus, within families, first-born children develop vocabulary and language comprehension faster than later-borns (Berglund et al., 2005; Dunn & Shatz, 1989; Hoff-Ginsberg, 1998; Pine, 1995; Zambrana et al., 2012). More broadly, being singletons or having siblings can be a source of variations across homes in terms of quantity and quality of interactions. Sex is also a well-studied factor in language development literature. Studies show a slight advantage for girls in terms of both production and comprehension of language skills (Berglund et al., 2005; Eriksson et al., 2012; Galsworthy et al., 2000; Zambrana et al., 2012). In addition, sex is known to be a factor that can interact with others, such as SES (Barbu et al., 2015) or presence of siblings (Havron et al., 2019). Infants' studies remain quite silent on this variability, probably due to the researchers' desire to identify and highlight a general pattern of language development (Fernald et al., 2013). Recruiting children is also difficult, expensive, and time-consuming, leading most studies to deal with small sample sizes. In addition to causing false conclusions and replication problems in infant studies (Oakes, 2017; The ManyBabies Consortium et al., 2020), these small sample sizes do not allow to simultaneously explore the contribution of several factors of variability at the same time. Investigating several factors of variability together is nevertheless essential to understand underlying mechanisms and thus to draw a more precise developmental pathway.

Thus, we conducted an experiment to study infants' perception of this conversational trait. It consisted to present three conversational sketches representing different types of turn transitions identified in human conversations (Sacks et al., 1974). We used audiovisual sketches because they combine lexical, syntactic, prosodic, and non-verbal cues together, which corresponds to interactions in naturalistic contexts and which is relevant for an infant who can't yet understand meaning based on lexico-syntactic cues only. We presented a turn-giving situation (one speaker gives the turn to the second by addressing her), a turn-taking situation (one

speaker takes the turn after the previous speaker), and an overlapping situation (one speaker interrupts the first by speaking over her). We measured infants' looking times toward the second speaker during these sketches and hypothesized that these would be influenced by the speaker's behavior, that is, the speaker's way of taking the turn. We thus predicted that infants would look more at the second speaker after the overlapping situation than after the other two, since the former is the only one to present a violation of the turn-taking rule. Given the importance of taking variability factors into account in infant studies and the lack of such consideration in turn-taking studies, we conducted our study on a rather large sample of 51 infants (after exclusion) to cover a wide economic strata with 4 SES-classes (from low to high), to include a relevant number of singletons as well as infants with older sibling(s), as well as a balanced ratio of girls and boys. Six months is the onset of a crucial pragmatic skill for human beings: the ability to manage turns within conversational prototypes. Therefore, we chose this age to investigate the extent to which social experience of 6-month-old infants already shape an important language feature.

## 2 | METHOD

### 2.1 | Ethical note

The present study was conducted according to guidelines laid down in the declaration of Helsinki, with written informed consent obtained from a parent for each infant before any data collection. All procedures involving human in this study were approved by the French ethical committee "Comité de Protection des Personnes" (CPP Ouest V, O15/02-004) within University of Rennes.

### 2.2 | Participants

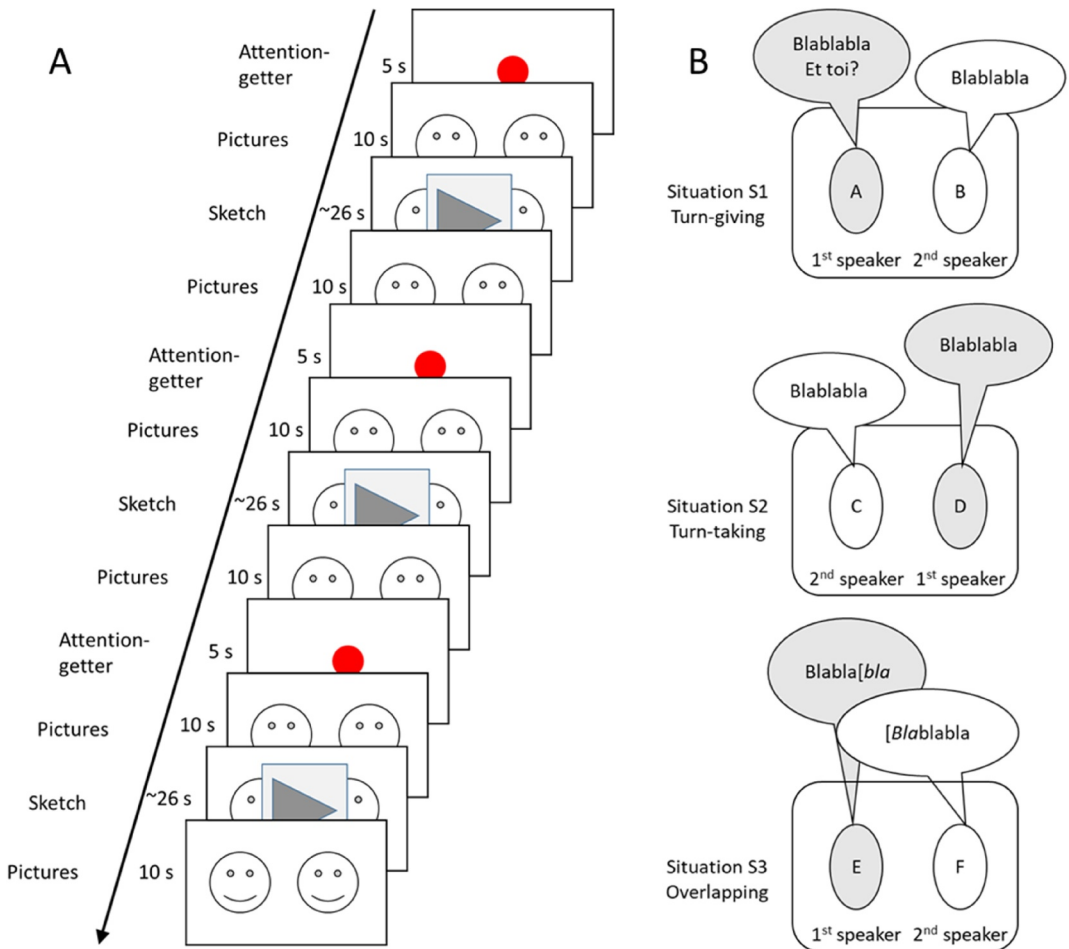
Sixty-five 6-month-old infants participated in our study. Fourteen were excluded for fussing or crying during the experiment (6), due to technical problem (1) or insufficient looking time, that is, looking time on each video <50% or not looking at the pictures (7). Therefore, statistical analyses are based on data from 51 infants (age: mean = 6;9, range = 6;1-6;26). All participants were French monolingual, born fullterm and had not been diagnosed with a developmental disorder at the time of the experiment.

Sociodemographic characteristics considered for the analysis were: the infant's sex (27 girls—24 boys), the presence of siblings in the family (37 with sibling(s)—14 singletons) and the socio-economic status of the family. The latter was estimated using the educational level and the profession of both parents, and was divided into four categories: both parents with high-school level or less (low SES, 12); at least one parent with bachelor degree (undergraduate) (middle SES, 6); one parent with a postgraduate degree (middle-high SES, 12); both parents with a postgraduate degree (high SES, 21).

Families were contacted by mailing. Parents willing to participate came at the lab with their infant. Prior to the infant's participation in the study, parents were informed of its aim and procedure and were asked to sign a consent form.

## 2.3 | Procedure

Set-up: Infants were seated in a car seat into a white cubicle with a screen (24") placed 60 cm in front of them (DELL U2410). A computer (DELL Precision M4600) was connected to the screen to broadcast the test video sequence. A camera (Sony HDR-SR12) placed above the screen was connected to another screen outside the cubicle to allow parents and experimenters to monitor the infant all along the experiment and to end it in case of fussing. The camera also recorded the infant behavior during the video sequence and images were analyzed off-line.



**FIGURE 1** Experimental procedure to assess the perception of turn taking violation in 6-month-old infants. (a) Time scale of a video sequence with three sketches (one for each situation), each preceded and followed by the pictures of the women playing in the sketch. Each batch “pictures-sketch-pictures” was preceded by an attention-getter, that is, a flashing red circle associated with a rebounding sound. (b) Schemes of the three situations. Letters represent different women. In gray the woman speaking first during the sketch, in white the woman speaking second, in italics the overlapping part in situation S3. The first speaker was randomly on the right or on the left side of the screen.

Test (Figure 1): Infants watched a video sequence consisting of three sketches, each preceded and followed by pictures for 10 s. These pictures represented the two women playing in the sketch. Each one being displayed on the side of the screen she appeared during the sketch.

In each sketch, two women told different short non-familiar stories invented for the purpose of the study while watching the camera (i.e., as if they spoke to the infant). Speakers were asked to smile and speak in infant-directed speech to maximize infants' attention to the sketches. Each sketch staged one of three different conversational situations. In the situation 1 (S1), the first speaker told her story, stopped speaking at the end, turned toward the second woman and said "*Et toi ?*" (*And you?*). The second woman then turned back toward the camera and told her story. This situation was called "Turn-giving." It was the only situation where the women looked at each other. In the other situations, they only looked at the camera and therefore at the infant. In the situation 2 (S2), the first speaker told her story and stopped speaking at the end. Then, the second woman started telling her story. This situation was called "Turn-taking." In the situation 3 (S3), the first speaker told her story. Without waiting for the end, the second woman started telling her own story, therefore overlapping the first woman speech for 1.4 s ( $\pm 0.2$ ) on average, that is, during 3–5 words. This situation was called "Overlapping."

Within a video sequence, each sketch staged a different pair of women telling a different pair of stories, so each infant saw 6 women relating 6 different stories. Thirty-six video sequences were built with each situation appearing in various places within the three sketches sequence (i.e., S1 could be seen first, second or third = sketch order), with each pair of women staging one of the three situations (i.e., Pair 1 could play S1, S2 or S3) and with each woman playing first or second speaker role (so with the second speaker on the left or the right side of the screen). Sketches lasted  $<30$  s (mean duration in seconds  $\pm$  SD, S1:  $28.2 \pm 1.2$ ; S2:  $26.7 \pm 2.1$ ; S3:  $23.3 \pm 1.4$ ).

## 2.4 | Measure and statistical analysis

We measured the time each infant spent looking at each woman during the pictures' display. The coding was straightforward since it simply consists of knowing whether the infant was looking at the right or left side of the screen. The coding was conducted visually by A.R and N.D using The Observer XT software (Noldus, 1991): A.R coded  $N = 28$  videos, N.D coded  $N = 15$  videos, and  $N = 8$  videos were coded by both independently (total:  $N = 51$  videos). An inter-observer index was calculated using Kappa de Cohen implemented in The Observer XT software, resulting in  $>0.80$  agreement score.

We then calculated the ratio of time spent looking at the 2nd speaker over the time spent looking at any of the speakers ( $\text{ratio\_LT} = \text{LT speaker 2} / (\text{LT speaker 1} + \text{LT speaker 2})$ ) for each display. Finally, we calculated the difference of these ratios between the picture displayed after the sketch and the picture displayed before ( $\delta\_LT = \text{ratio\_LT AFTER} - \text{ratio\_LT BEFORE}$ ), in order to assess whether the behavior of the 2nd speaker during the sketch had any impact on the infant's looking time toward this person. We chose to use ratios rather than raw data to lower the potential impact of short overall looking time toward both women.

The impact of several experimental and sociodemographic factors on  $\delta\_LT$  was assessed using a linear mixed model (LMM). The infants' identity was assigned as a random factor. Fixed effects were the situation displayed in the sketch (S1, S2 or S3), the sketch order (seen 1st, 2nd



or 3rd), the pair of women (3 pairs), the position of the 2nd speaker (on the left or the right side of the screen), the infant's sex (F or M), the family SES (4 modalities) and the presence of sibling (s) (Yes or No). Interactions between Situation and the other factors were also set as fixed effects into the model. The model was built using lmerTest package (Kuznetsova et al., 2017) in R 3.5.0 (2018) and it was written as follows:

$$\delta\_LT \sim \text{Situation} + \text{Sketch order} + \text{Pair of women} + \text{Position 2 nd speaker} + \text{Sex} + \text{SES} \\ + \text{Sibling} + \text{Situation} : (\text{Sketch order} + \text{Pair of women} + \text{Position 2nd speaker} + \text{Sex} \\ + \text{SES} + \text{Sibling}) + (1|\text{Infant\_id})$$

Post-hoc tests were performed and effect size are given using the emmeans package (Lenth, 2019) in R 3.5.0 (2018).

### 3 | RESULTS

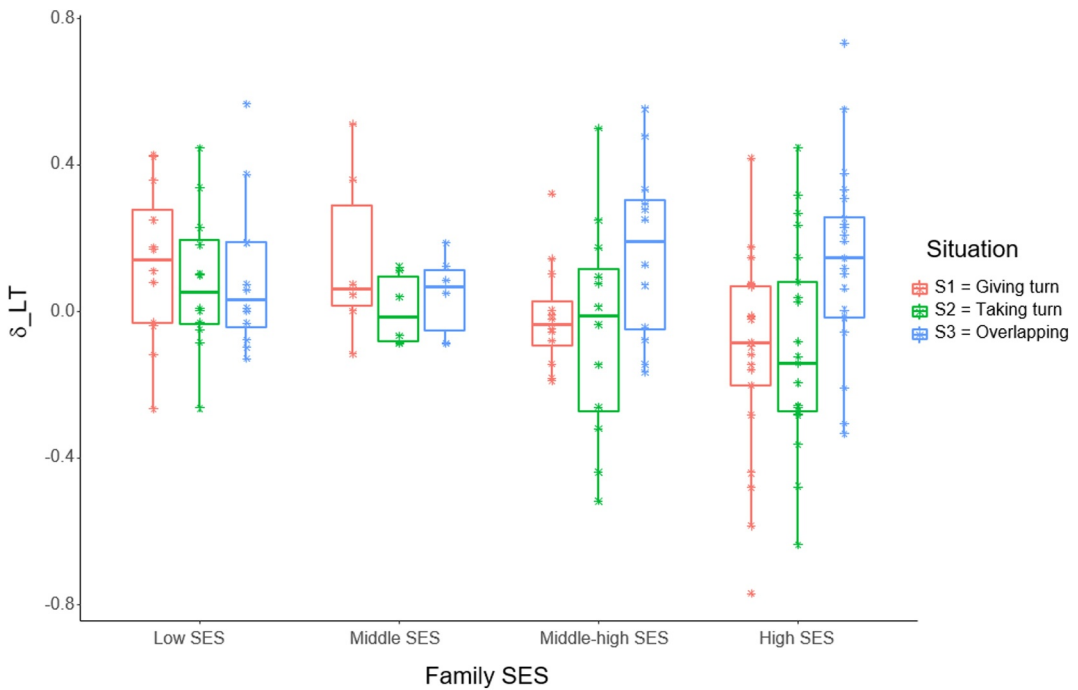
Our analyses revealed that 6-month-olds reacted to turn-taking violation. An influence of the family environment on infants' turn-taking perception before the preverbal period was present: only infants from high-SES family and singletons reacted to overlapping during sketches, with an increased LT toward the second speaker.

The situation factor had a significant effect on the  $\delta\_LT$  when considered alone (LMM, Situation:  $\chi^2 = 12.88$ ,  $df = 2$ ,  $p = .002 < .001$ , Table S1). Furthermore, two sociodemographic factors interacted with the situation factor.

First, family SES had a major impact on infants' reactions to the violation of the turn-taking rule. Indeed, we found a significant interaction between Situation and family SES, assessed through both parent's educational level and profession (LMM, Situation x SES:  $\chi^2 = 14.01$ ,  $df = 6$ ,  $p = .03$ ; Table S1). Only infants from high-SES families reacted differently to the three situations (Figure 2, see Table S2 for post-hoc comparisons). They looked longer at the second speaker after her speech overlapped with the first speaker than in the two other situations respecting the overlap avoidance (S1 vs. S3:  $t.ratio = -3.34$ ,  $df = 80.4$ ,  $p = .008$ , effect size = 1.181; S2 vs. S3:  $t.ratio = -4.11$ ,  $df = 80.6$ ,  $p = .001$ , effect size = 1.445). In addition to these differences between situations, comparisons of  $\delta\_LT$  with zero showed that high-SES infants looked significantly more at the second speaker after the overlapping situation than before (S3:  $t.ratio = 3.06$ ,  $df = 120$ ,  $p = .002$ ). Conversely, high-SES infants looked significantly less at the second interlocutor after the turn-taking situation than before (S2:  $t.ratio = -2.703$ ,  $df = 120$ ,  $p = .008$ ). The  $\delta\_LT$  did not differ from zero in the turn-giving situation. A similar pattern was observed for middle-high-SES infants when comparing S3 (overlapping) to S2 (turn-taking) (S2 vs. S3:  $t.ratio = -2.79$ ,  $df = 81$ ,  $p = .026$ , effect size = 1.434), with infants looking more at the second speaker after the overlapping situation than before (S3:  $t.ratio = 2.467$ ,  $df = 120$ ,  $p = .015$ ). Infants from the other two lower-SES categories did not show different looking reactions between the situations (all  $p > .23$ ). However, the low-SES infants looked longer at the second speaker after the turn-giving situation than before (S1:  $t.ratio = 2.213$ ,  $df = 120$ ,  $p = .029$ ), but the  $\delta\_LT$  did not differ from zero in the two other situations.

Second, whether infants had siblings or not influenced their responses to the different situations. The  $\delta\_LT$  varied significantly between the three situations depending on the presence or absence of sibling(s) (LMM, Situation x Sibling:  $\chi^2 = 9.21$ ,  $df = 2$ ,  $p = .01$ ; Table S1). Post-hoc

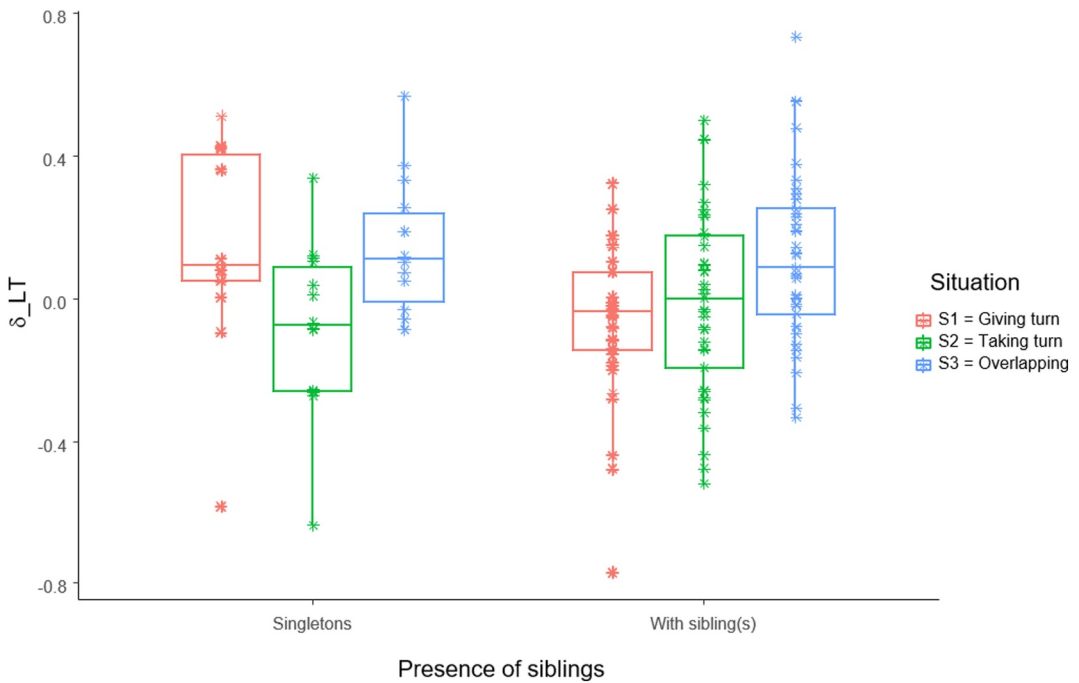




**FIGURE 2** Difference of looking time on the 2nd speaker between before and after the sketch ( $\delta_{LT}$ ) in relation to the situation and the family SES. Bars, 95% confidence intervals (package emmeans (Lenth, 2019)) in R 3.5.0 (2018); crosses, single data points; dots, estimated marginal means for each category; S1 (red), turn-giving; S2 (green), turn-taking; S3 (blue), overlapping; SES, socioeconomic status.

comparisons evidenced that only singletons had different  $\delta_{LT}$  according to the situation (Figure 3, Table S4). Indeed, for these infants,  $\delta_{LT}$  differed significantly between S2 (turn-taking) on one side and S1 (turn-giving) (S1 vs. S2:  $t$ .ratio = 2.88,  $df$  = 80.5,  $p$  = .015, effect size = 1.192) and S3 (overlapping) (S2 vs. S3:  $t$ .ratio = -3.13,  $df$  = 81.2,  $p$  = .014, effect size = 1.334) on the other side. Comparisons of  $\delta_{LT}$  with zero showed that singletons looked longer at the second speaker after the overlapping situation than before (S3:  $t$ .ratio = 2.8,  $df$  = 120,  $p$  = .006). They also looked longer at her after the turn-giving situation than before (S1:  $t$ .ratio = 2.476,  $df$  = 120,  $p$  = .015). When speakers spoke one after the other without any interaction, singletons did not change their looking time on the second speaker. Infants with sibling(s) did not show different looking reactions between the three situations or before and after each situation.

None of the other experimental or socio-demographic factors tested had a significant effect when considered alone (LMM, Sex:  $\chi^2$  = 0.37,  $df$  = 1,  $p$  = .54; Family SES:  $\chi^2$  = 5.6,  $df$  = 3,  $p$  = .13; Siblings:  $\chi^2$  = 1.44,  $df$  = 1,  $p$  = .23; Situations' order:  $\chi^2$  = 1.26,  $df$  = 2,  $p$  = .53, Pair of women:  $\chi^2$  = 3.18,  $df$  = 2,  $p$  = .2; Position of the 2nd speaker:  $\chi^2$  = 1.93,  $df$  = 1,  $p$  = .16). It should be noted that the infant's sex did not influence the looking time toward the second speaker on the pictures whether or not we took the situation into account. Infants' sex did not influence their reaction to turn-taking violation in our study.



**FIGURE 3** Difference of looking time on the 2nd speaker between before and after the sketch in relation to the situation and the presence of sibling(s) in the infant's family. Bars, 95% confidence intervals (package emmeans (Lenth, 2019)) in R 3.5.0 (2018); crosses, single data points; dots, estimated marginal means for each category; S1 (red), turn-giving; S2 (green), turn-taking; S3 (blue), overlapping.

## 4 | DISCUSSION

Our study demonstrated that 6-month-old infants are responsive to turn-taking violation depending on family SES and presence of sibling, but not on sex. On one hand, high and middle-high SES infants looked more at the second speaker after the overlapping situation than after the two other situations (for high SES infants) or just after the turn-taking situation (for middle-high SES). Low and middle-low SES did not show any differences between situations. On the other hand, singletons looked more at the second speaker after overlapping and turn-giving situations compared to turn-taking situation, whereas infants with sibling(s) did not.

We found no difference between boys and girls in their looking time across situations, which was somewhat surprising given the girls' advantage in language production and perception observed later in development. This is probably due to the fact that sex generally has a moderate impact, and often interacts with other factors. Indeed, Barbu et al. (2015) showed that, in children aged 2–6 years old, low SES boys' performances were lower than low SES girls' performances, but that there was no differences between boys and girls in high-SES. Sex can also interact with birth order, as only older brothers seem to influence negatively language skills of later-born children (Havron et al., 2019). Unfortunately, such interactions could not be tested with our sample size, emphasizing the crucial need of very large samples to investigate the many layers of variability factors and their relationships.

However, sibling(s) and family SES influenced the measured responses in the same direction than in the language development literature. Indeed, it is well known that language production

and perception is delayed in children with older sibling(s) or from the lowest family SES (Fernald et al., 2013; Hart & Risley, 2003; Hoff, 2003; Huttenlocher et al., 2010; Rowe, 2008), and here, it was the infants with sibling(s) or from lowest family SES who did not react to turn-taking violation. But beyond a developmental delay, it may simply be a difference in exposure that leads infants to consider all presented conversational situations as legitimate. Infants may in fact be able to distinguish between the different situations without reacting differently—something our experiment was not designed to assess. Furthermore, our results highlight that variability is present much earlier than the first language productions, confirming the developmental precedence of perception over production.

The influence of sibling(s) on language development is probably due to the fact that siblings have to compete to get parents' attention. Indeed, mothers of siblings produce the same amount of utterances during dyadic interactions with one of their children than during triadic interactions with their two children (Jones & Adamson, 1987). The direct consequence is that children with sibling(s) have less focused interactions with their parents than singletons. In addition to a decrease in the quantity of input, the family composition also impact its quality, as in triadic interactions with two siblings the mothers' speech is more focused around the children's activities, whereas it is more about language itself in dyadic interactions (Oshima-Takane & Robbins, 2003). Within a sibling group, first-born children accumulate more focused interactions with their parents compared to later-born children, because they were singletons during a certain amount of time. This can explain why first-born children are ahead in vocabulary and grammar compared to later-born children at the same age (Hoff-Ginsberg, 1998). In contrast, later-born children develop more interactive skills: they are more likely to produce contingent conversational responses (Hoff-Ginsberg, 1998). Interestingly, we showed that, at 6 months, singletons are more responsive to turn-taking violation than same-aged infants with sibling(s). This can be explained by differences in quality and quantity of social interactions they have with their parents, and also by the sources of conversational input for the later-born infants: the sibling as well as the parents. Despite being older than the later-born infant, siblings are likely to be young children who have not yet fully mastered turn-taking as the adults. There could be more interruptions in households with siblings than in households with singletons, leading later-born to consider the overlapping situation as any other type of interactions at 6 months. But singletons were also more responsive to the turn-giving situation in a similar way than to the overlapping situation. One possible explanation could be that, in addition to being less exposed to overlapping situations, they are also less exposed to turn-giving situations. Infants with siblings frequently experience triadic interactions, probably with one parent giving turn to his or her older siblings at the same time as interacting with them. Singletons would not have this exposure, making turn-giving situations as odd as overlapping ones. However, our experimental study cannot confirm this hypothesis, and therefore calls for observational studies in a naturalistic context to test it.

According to Hoff (2003), the influence of SES on early language development could be primarily due to the motivation of high SES parents to talk with their children, rather than the richness of the vocabulary they use in these interactions. Indeed, high SES mothers talk more often to their infants and more with the purpose of eliciting and maintaining conversations through topic-continuing replies than low SES mothers, who talk less often and more in order to orient their infants' behavior (Hoff, 2006). The parents' SES is therefore also a good predictor of purely conversational skills related to turn-taking, which could explain the influence found in our results well before language mastering. Beyond these conversational skills, SES also influences parents' ability to get their infants' attention through what is usually called

motherese, parentese, or infant/child directed speech (IDS or CDS). IDS/CDS is indeed a high-pitched speech employed by adult toward infants/children, with short utterances, exaggerated intonations and more repetitions. This speech style is preferred by children (The ManyBabies Consortium, 2020) and has a key role in language development since it predicts vocabulary acquisition while overheard speech (Adult Directed Speech listen by children) do not (Shneidman et al., 2013). Above all, IDS/CDS vary according to the parents' SES, with higher-SES using it more than the lower-SES (Schwab & Lew-Williams, 2016). Ramírez et al. (2020) even demonstrated that increasing parent's IDS through coaching interventions enhanced the amount of turn-taking between parents and infants as early as 6 months of age. The exposure to IDS could then explain the difference we observed here between higher-SES and lower-SES infants at the same age in turn-taking perception. However, the difference found between middle-high and high SES infants is difficult to interpret, a difference observed once again for the turn-giving situation. Intriguing is also the fact that low-SES infants were responsive to turn-giving situation uniquely and not for example, to a turn-taking violation such as the overlapping situation. Further experimental studies using a larger sample size for these low-SES infants are probably required before interpreting such results. In any case, all this suggests that the turn-giving situation is more ambiguous than others for infants. It may be explained by the structure of the situation as it is the only one to be overtly triadic, with the two speakers looking at each other for a brief moment. Also, one may ask whether this situation is not rarer than the other two in the set of interactions from which infants extract the rules governing conversations.

The disparity in interactions directed toward infants between families is arguably the primary source of inequality, and undoubtedly one of the most important if cumulative effects are considered. Therefore, considering a greater diversity in large samples is crucial both from a theoretical and an applied point of view. By revealing differences notably due to family characteristics as early as 6 months in a language development milestone, our study, like many others, stresses the need to consider sociodemographic factors in infant studies (Golinkoff et al., 2018).

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## CONFLICT OF INTEREST STATEMENT

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## REFERENCES

- Augusti, E., Melinder, A., & Gredebäck, G. (2010). Look who's talking: Pre-verbal infants' perception of face-to-face and back-to-back social interactions. *Frontiers in Psychology, 1*, 161. <https://doi.org/10.3389/fpsyg.2010.00161>
- Bakker, M., Kochukhova, O., & von Hofsten, C. (2011). Development of social perception: A conversation study of 6-12- and 36-month-old children. *Infant Behavior and Development, 34*(2), Article 2. <https://doi.org/10.1016/j.infbeh.2011.03.001>

- Barbu, S., Nardy, A., Chevrot, J.-P., Guellaï, B., Glas, L., Juhel, J., & Lemasson, A. (2015). Sex differences in language across early childhood: Family socioeconomic status does not impact boys and girls equally. *Frontiers in Psychology*, 6. <https://doi.org/10.3389/fpsyg.2015.01874>
- Berglund, E., Eriksson, M., & Westerlund, M. (2005). Communicative skills in relation to gender, birth order, childcare and socioeconomic status in 18-month-old children. *Scandinavian Journal of Psychology*, 46(6), Article 6. <https://doi.org/10.1111/j.1467-9450.2005.00480.x>
- Bigelow, A. E. (1998). Infants' sensitivity to familiar imperfect contingencies in social interaction. *Infant Behavior and Development*, 21(1), 149–162. [https://doi.org/10.1016/S0163-6383\(98\)90060-1](https://doi.org/10.1016/S0163-6383(98)90060-1)
- Black, B., & Logan, A. (1995). Links between communication patterns in mother-child, father-child, and child-peer interactions and children's social status. *Child Development*, 66(1), 255. <https://doi.org/10.2307/1131204>
- Bloom, K. (1975). Social elicitation of infant vocal behavior. *Journal of Experimental Child Psychology*, 20(1), 51–58. [https://doi.org/10.1016/0022-0965\(75\)90025-9](https://doi.org/10.1016/0022-0965(75)90025-9)
- Dunn, J., & Shatz, M. (1989). Becoming a conversationalist despite (or because of) having an older sibling. *Child Development*, 60(2), 399–410. <https://doi.org/10.2307/1130985>
- Eriksson, M., Marschik, P., Tulviste, T., Almgren, M., Pérez-Pereira, M., Wehberg, S., Umek, L., Gayraud, F., Kovačević, M., & Gallego, C. (2012). Differences between girls and boys in emerging language skills: Evidence from 10 language communities. *British Journal of Developmental Psychology*, 30(2), 326–343. <https://doi.org/10.1111/j.2044-835X.2011.02042.x>
- Fernald, A., Marchman, V. A., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science*, 16(2), 234–248. <https://doi.org/10.1111/desc.12019>
- Galsworthy, M. J., Dionne, G., Dale, P. S., & Plomin, R. (2000). Sex differences in early verbal and non-verbal cognitive development. *Developmental Science*, 3(2), 206–215. <https://doi.org/10.1111/1467-7687.00114>
- Ginsburg, G. P., & Kilbourne, B. K. (1988). Emergence of vocal alternation in mother-infant interchanges. *Journal of Child Language*, 15(2), 221–235. <https://doi.org/10.1017/S0305000900012344>
- Goldstein, M. H., King, A. P., & West, M. J. (2003). Social interaction shapes babbling: Testing parallels between birdsong and speech. *Proceedings of the National Academy of Sciences*, 100(13), 8030–8035. <https://doi.org/10.1073/pnas.1332441100>
- Golinkoff, R. M., Hoff, E., Rowe, M. L., Tamis-LeMonda, C., & Hirsh-Pasek, K. (2018). Talking with children matters: Defending the 30 million word gap. *Brookings*. <https://www.brookings.edu/blog/education-plus-development/2018/05/21/defending-the-30-million-word-gap-disadvantaged-children-dont-hear-enough-child-directed-words/>
- Gratier, M., Devouche, E., Guellaï, B., Infanti, R., Yilmaz, E., & Parlato, E. (2015). Early development of turn-taking in vocal interaction between mothers and infants. *Frontiers in Psychology*, 6. <https://doi.org/10.3389/fpsyg.2015.01167>
- Hart, B., & Risley, T. R. (2003). The early catastrophe. The 30 million word gap by age 3. *American Educator*, 27(1), 4–9.
- Havron, N., Ramus, F., Heude, B., Forhan, A., Cristia, A., Peyre, H.; the EDEN Mother-Child Cohort Study Group, Kaminski, M., Larroque, B., Lelong, N., Lepeule, J., Magnin, G., Marchand, L., Nabet, C., Pierre, F., Slama, R., Saurel-Cubizolles, M. J., Schweitzer, M., Annesi-Maesano, I., ... Thiebaugeorges, O. (2019). The effect of older siblings on language development as a function of age difference and sex. *Psychological Science*, 30(9), 1333–1343. <https://doi.org/10.1177/0956797619861436>
- Hazen, N. L., & Black, B. (1989). Preschool peer communication skills: The role of social status and interaction context. *Child Development*, 60(4), 867–876. <https://doi.org/10.2307/1131028>
- Hilbrink, E. E., Gattis, M., & Levinson, S. C. (2015). Early developmental changes in the timing of turn-taking: A longitudinal study of mother-infant interaction. *Frontiers in Psychology*, 6. <https://doi.org/10.3389/fpsyg.2015.01492>
- Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development*, 74(5), 1368–1378. <https://doi.org/10.1111/1467-8624.00612>
- Hoff, E. (2006). How social contexts support and shape language development☆. *Developmental Review*, 26(1), 55–88. <https://doi.org/10.1016/j.dr.2005.11.002>

- Hoff-Ginsberg, E. (1998). The relation of birth order and socioeconomic status to children's language experience and language development. *Applied PsychoLinguistics*, 19(4), 603–629. <https://doi.org/10.1017/S0142716400010389>
- Huttenlocher, J., Waterfall, H., Vasilyeva, M., Vevea, J., & Hedges, L. V. (2010). Sources of variability in children's language growth. *Cognitive Psychology*, 61(4), 343–365. <https://doi.org/10.1016/j.cogpsych.2010.08.002>
- Jones, C. P., & Adamson, L. B. (1987). Language use in mother-child and mother-child-sibling interactions. 12.
- Kuhl, P. K., Tsao, F.-M., & Liu, H.-M. (2003). Foreign-language experience in infancy: Effects of short-term exposure and social interaction on phonetic learning. *Proceedings of the National Academy of Sciences*, 100(15), 9096–9101. <https://doi.org/10.1073/pnas.1532872100>
- Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest package: Tests in linear mixed effects models. *Journal of Statistical Software*, 82(13). <https://doi.org/10.18637/jss.v082.i13>
- Lenth, R. (2019). Emmeans: Estimated marginal means, aka least-squares means. R package version 1.4.3.01.
- Levinson, S. C. (2016). Turn-taking in human communication – origins and implications for language processing. *Trends in Cognitive Sciences*, 20(1), 6–14. <https://doi.org/10.1016/j.tics.2015.10.010>
- Murray, L. (1985). Emotional regulations of interactions between two-month-olds and their mothers. *Social Perception in Infants*, 177–197.
- Noldus, L. P. J. J. (1991). The observer: A software system for collection and analysis of observational data. *Behavior Research Methods, Instruments, & Computers*, 23(3), 415–429. <https://doi.org/10.3758/BF03203406>
- Oakes, L. M. (2017). Sample size, statistical power, and false conclusions in infant looking-time research. *Infancy*, 22(4), 436–469. <https://doi.org/10.1111/infa.12186>
- Oshima-Takane, Y., & Robbins, M. (2003). Linguistic environment of secondborn children. *First Language*, 23(1), 21–40. <https://doi.org/10.1177/0142723703023001002>
- Pika, S., Wilkinson, R., Kendrick, K. H., & Vernes, S. C. (2018). Taking turns: Bridging the gap between human and animal communication. *Proceedings of the Royal Society B: Biological Sciences*, 285(1880), Article 1880. <https://doi.org/10.1098/rspb.2018.0598>
- Pine, J. M. (1995). Variation in vocabulary development as a function of birth order. *Child Development*, 66(1), 272. <https://doi.org/10.2307/1131205>
- Ramírez, N. F., Lytle, S. R., & Kuhl, P. K. (2020). Parent coaching increases conversational turns and advances infant language development. *Proceedings of the National Academy of Sciences*, 117(7), 3484–3491. <https://doi.org/10.1073/pnas.1921653117>
- Robinson, L. F., & Reis, H. T. (1989). The effects of interruption, gender, and status on interpersonal perceptions. *Journal of Nonverbal Behavior*, 13(3), 141–153. <https://doi.org/10.1007/BF00987046>
- Rowe, M. L. (2008). Child-directed speech: Relation to socioeconomic status, knowledge of child development and child vocabulary skill\*. *Journal of Child Language*, 35(1), 185–205. <https://doi.org/10.1017/S0305000907008343>
- Sacks, H., Schegloff, E. A., & Jefferson, G. (1974). A simplest systematics for the organization of turn-taking for conversation. *Language*, 50(4), 696–735. <https://doi.org/10.2307/412243>
- Schwab, J. F., & Lew-Williams, C. (2016). Language learning, socioeconomic status, and child-directed speech. *Wiley Interdisciplinary Reviews. Cognitive Science*, 7(4), 264–275. <https://doi.org/10.1002/wcs.1393>
- Shneidman, L. A., Arroyo, M. E., Levine, S. C., & Goldin-Meadow, S. (2013). What counts as effective input for word learning? *Journal of Child Language*, 40(3), 672–686. <https://doi.org/10.1017/S0305000912000141>
- Stern, D. N., Jaffe, J., Beebe, B., & Bennett, S. L. (1975). Vocalizing in unison and in alternation: Two modes of communication within the mother-infant dyad. *Annals of the New York Academy of Sciences*, 263(1), 89–100. <https://doi.org/10.1111/j.1749-6632.1975.tb41574.x>
- Stivers, T., Enfield, N. J., Brown, P., Englert, C., Hayashi, M., Heinemann, T., Hoymann, G., Rossano, F., de Ruiter, J. P., Yoon, K.-E., & Levinson, S. C. (2009). Universals and cultural variation in turn-taking in conversation. *Proceedings of the National Academy of Sciences*, 106(26), 10587–10592. <https://doi.org/10.1073/pnas.0903616106>
- ter Maat, M., Truong, K. P., & Heylen, D. (2010). How turn-taking strategies influence users' impressions of an agent. In J. Allbeck, N. Badler, T. Bickmore, C. Pelachaud, & A. Safonova (Eds.), *Intelligent virtual agents* (Vol. 6356, pp. 441–453). Springer Berlin Heidelberg. [https://doi.org/10.1007/978-3-642-15892-6\\_48](https://doi.org/10.1007/978-3-642-15892-6_48)



- The ManyBabies Consortium. (2020). Quantifying sources of variability in infancy research using the infant-directed-speech preference. *Advances in Methods and Practices in Psychological Science*, 3(1), 24–52. <https://doi.org/10.1177/2515245919900809>
- The ManyBabies Consortium, Frank, M. C., Alcock, K. J., Arias-Trejo, N., Aschersleben, G., Baldwin, D., Barbu, S., Bergelson, E., Bergmann, C., Black, A. K., Blything, R., Böhlend, M. P., Bolitho, P., Borovsky, A., Brady, S. M., Braun, B., Brown, A., Byers-Heinlein, K., Campbell, L. E., & Soderstrom, M. (2020). Quantifying sources of variability in infancy research using the infant-directed-speech preference. *Advances in Methods and Practices in Psychological Science*, 3(1), 24–52. <https://doi.org/10.1177/2515245919900809>
- Zambrana, I. M., Ystrom, E., & Pons, F. (2012). Impact of gender, maternal education, and birth order on the development of language comprehension: A longitudinal study from 18 to 36 months of age. *Journal of Developmental & Behavioral Pediatrics*, 33(2), 146–155. <https://doi.org/10.1097/DBP.0b013e31823d4f83>

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