





Infant-directed communication in Tanna, Vanuatu and Vancouver, Canada

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Abstract

It is known that infant-directed speech (IDS) plays a key role in language development. Previous research, however, has also identified significant variability across societies in terms of how often IDS occurs. For example, some studies report very little IDS in non-western, small-scale societies – including children growing up in small-scale societies in Tanna, Vanuatu. This is surprising given that IDS is widely assumed as a common feature of human caregiving based on research conducted in urbanised populations which are more well-studied. Here, we propose that IDS is only one of a suite of important caregiving behaviours that are produced during interactions with infants, which may vary by culture, perhaps being replaced by other, non-verbal infant-directed behaviours (IDB). We will examine previously collected data consisting of 94 semi-structured 10-min video observations of caregivers and their 18–24 month-old children in rural Tanna, Vanuatu and urban Vancouver, Canada to identify and compare the proportion of time caregivers spend engaging in IDS and IDB during these interactions, both within and between societies. We define IDS as caregiver speech or vocalisations during the interaction with the infant, and we define IDB as non-verbal behaviours that are produced with the infant during the interaction. This study aims to take a step towards a more

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generalised understanding of language development in children, moving beyond the urban and western societies in which our understanding of development is currently based, and the predicted results will aid in recognising different developmental pathways within multi-cultural communities.

KEYWORDS

culture, generalisability, infant-directed speech, non-verbal communication, small-scale societies, social communication

1 | INTRODUCTION

Infant-directed speech (IDS) refers to the change in speech and behaviour by adults when they are addressing infants. It is widely observed that adults tend to use a distinct form of speech when communicating with infants, regardless of their culture (Brosch & Bryant, 2015, 2018; Hilton et al., 2022; McClay et al., 2022). Compared to when adults are addressing other adults, adults modify their speech when addressing infants by slowing down their speech, articulating more carefully, using higher and more variable pitch and exaggerating their speech, along with other lexical and syntactic changes (Cristia, 2010; Dilley et al., 2019; Fernald & Simon, 1984; Snow, 1995; Soderstrom, 2007). Previous research shows that IDS supports language development in several ways (Golinkoff et al., 2015; Graf Estes & Hurley, 2013; Thiessen et al., 2005; Trainor & Desjardins, 2002). Whilst IDS supports the formation of strong social bonds and communicative skills (Hennessy & Zhao, 2023), our understanding of IDS across different cultures remains limited. In fact, the existing evidence from societies that differ from the typical sample population in interesting ways suggests that current theories of IDS and developmental processes may need revision (Cristia, 2023). Because the literature on language development is primarily based on evidence from urban, western contexts, there is strong motivation to explore the social context supporting communicative skills in societies that may be distinct in their child-rearing styles.

The reasons why adults use IDS are varied, with some proposing that it helps elicit infants' attention (Fernald & Simon, 1984; Werker & McLeod, 1989) and communicate affective intentions (Fernald, 1989, 1992). Others suggest that IDS aids children in learning aspects of language, such as vowel categories (Kuhl et al., 1997; Trainor & Desjardins, 2002) and grammar (Christophe et al., 2003; Morgan & Demuth, 1996). It is generally accepted that the process of slowing down, exaggerating and increasing the variability in the pitch may aid infants in their ability to learn words (Ma et al., 2011). According to Fernald (1992), the function of IDS changes over the course of development, initially serving to direct infants' attention and modulate arousal and affect, but later (by the end of the second year) serving more specific linguistic purposes. Another possibility is that the primary function of IDS is emotional regulation and expression, with language learning being its side effect (Benders, 2013; Corbeil et al., 2013; Kalashnikova et al., 2017; Trainor et al., 2000). This latter approach suggests that features of infant-directed communication may extend beyond what is observed in vocalisations. Since most of the research on this topic has been conducted in urban, western societies who place an emphasis on formal education, it is possible that some societies may vary in how infant-directed communication differs in the balance between linguistic and non-linguistic features (Brosch & Bryant, 2015, 2018; McClay et al., 2022).

There is a growing body of literature indicating that some cultures use significantly less IDS whilst interacting with their infants (Cristia, 2023; Cristia et al., 2023). For instance, Loukatou et al. (2022) found that in less-studied societies, such as in Lesotho in South Africa, infants are exposed to speech that is not primarily directed to them, and thus most of their language input comes from overhearing adult conversations. In a study on Tsimane forager-horticulturalist infants, Cristia et al. (2019) found that caregivers spent less than 1 min per daylight hour talking to

children younger than 4 years of age, yet, the overall frequency of speech including one-on-one interactions is not low amongst Tsmiane families. In other words, the average time spent talking to infants is infrequent when compared to the total speech in families. Casillas et al. (2019), similarly, studied IDS in a small-scale Tzeltal Mayan society examining children under the age of 3 years using daylong photo-linked audio recordings and reported an average of 3.63 min per hour for the time that children were directly spoken to. Shneidman and Goldin-Meadow (2012) also compared language input between 1-year-old Yucatec Mayan and United States infants. There, speech was considered directed if it was addressed to the infant regardless of whether they were alone or in a group that included other children. This study found that the total utterances heard by the US children are significantly higher than Mayan children. More recently, through a long-form recording of infants growing up in 11 villages in Malakula, Vanuatu the linguistic behaviour of 20-month infants was studied. In line with previous studies, results indicate the total child input from all speakers to be about 11.33 min per hour. This is interestingly even lower than what has been observed in other studies that had the most similar methods and populations – for example, Cristia et al. (2023). Taken together, this emerging work suggests that there are potentially many cultures where IDS is significantly less than what the literature currently suggests, and so there may be other important ways for adults to support language and social cognitive development than using speech to guide social interactions.

Greenfield et al. (2003) argued that there are various cultural pathways for universal human tasks. The acquisition of language skills is intricately influenced by the distinctive features of individualistic or collectivistic cultures. Theories of language development typically focus on parents' responsive behaviours as the major way of helping infants to learn the language (see Smith et al., 2018). In addition, literature on child development mostly examines urban and western societies where formal education and linguistic skills are prioritised for development (Cristia et al., 2019). One trait that is associated with children who had more years of formal education is having better linguistic 'performance' – that is, faster cognitive processing of words, higher vocabularies and more complex sentence structures (see Fernald et al., 2013; Hurtado et al., 2008). Nevertheless, there are other less well-studied societies who learn through ways other than formalised education, favouring social relationships and understanding as compared to factual-based knowledge and linguistic skills (Jonk, 2008). As mentioned previously, some research has examined IDS in these cultures, and it has been determined to be significantly less than in urban western societies (e.g., Cristia et al., 2023). However, these are limited in scope as they look only into one aspect of social input to children, neglecting other rich social inputs (e.g., non-verbal) that such children receive during social interactions with caregivers and others. In sum, even though language quantity may be 'less' in less well-studied societies, it can be of 'high quality' in other domains that have previously not been considered important or critical for language learning. For example, in these contexts, it may be the case that the non-verbal contexts surrounding language learning may be more important, and therefore scaffold the learning process.

This hypothesis must be understood in the context of rich evidence from post-industrial and large-scale societies, which indicate that infant-caregiver interactions impact language development. Gilkerson and Richards (2009), for instance, identified a relationship between the advanced language skills in children and the amount of speech they receive from their parents. Hart and Risley (1995) found that in 3 years or younger American children, the family's socioeconomic status can have a significant impact on the amount that children talk (up to a factor of three in quantity). The children from higher-level socioeconomic backgrounds also exhibited more inclination towards utilising a wider vocabulary, more complex grammatical structures, and greater use of declarative statements, questions and verb tenses referring to past and future events. Henning et al. (2005) showed that maternal speech is closely associated with positive vocalisation in 3-month infants. Zimmerman et al. (2009) not only found the effect of adults' word count in communication with their children significant in their language development but also showed the significance of two-sided conversations in that regard.

These differences between Western, Educated, Industrialized, Rich and Democratic (WEIRD) (Henrich et al., 2010) and non-WEIRD societies in infant-caregiver interactions suggest that more cross-cultural research in this area is important to understand the potentially culturally specific role of IDS in development, and to understand what is universal in how caregivers can aid cognitive, social and linguistic development. For example, some suggest

that early language learning must involve some quantity of overheard speech and is not exclusively child-directed (Ochs & Schieffelin, 1995). It has also been argued that speaking in a child-centred style is just one of many ways language learning proceeds, with different cultures having varying styles of speaking around children, but with language acquisition typically occurring around the same age worldwide (Casillas et al., 2019; Lieven, 1994). This is supported by naturalistic evidence (e.g., Barton & Tomasello, 1991) and behavioural experiments (e.g., Akhtar, 2005) that show how children are adept at observing and learning from the interactions around them (Rogoff, 2003). Having that said, the change noticed in the proportions of overheard to IDS in non-WEIRD societies does not necessarily suggest that directed speech with infants is negligible in such groups. Yet, there remains experimental evidence from less-studied societies indicating that when it comes to early language acquisition, talking directly to children is crucial, although in certain societies, much of the language input they receive is through unintentional overhearing. One example is the study by Shneidman and Goldin-Meadow (2012) in which although 1-year-old Yucatec Mayan children received a smaller proportion of directed speech compared to their large-family US counterparts, they experienced a substantial increase in directed input between 13 and 35 months, which is not the case for US children. The study also suggests that unlike overheard speech or direct speech from other children, direct speech from adults at around 14 months majorly predicts the prospective vocabulary of focal infants in Mayan communities.

It is known that besides verbal communication, parent-infant non-verbal interactions have impacts on the acquisition and development of language as well (Smith et al., 2018). Studies have demonstrated, for example, that caregivers modify both verbal and non-verbal behaviours, specifically their action (Meyer et al., 2023), gesture (Iverson et al., 1999; O'Neill et al., 2005), emotion (Wu et al., 2021; Wu et al., 2023) and touch (Lew-Williams et al., 2019; Stack & Muir, 1990) whilst communicating with their infants to facilitate their language learning. Gestural interactions between the caregiver and infant, in turn, can include pointing, showing, giving and instrumental functions like reaching and requesting (Tomasello, 1999). Carpenter et al. (1998) demonstrated the time duration of joint engagement between the infants and their mothers and the level of language use by mothers following their infants' focus of attention is closely linked to the infants' acquisition of gestural and linguistic communication skills. In addition, infants tend to follow where others are pointing and research shows a correlation between the production of pointing and the comprehension of language (Desrochers et al., 1995). A study on the families originating from Jyväskylä and the neighbouring areas from central Finland showed that joint attention's linguistic effects also evolve over time as at 14 months of age, intentional communication scores in parents and quantities of joint attentional behaviours could be correlated with the maternal interactional sensitivity, and this sensitivity could, in turn, identify language comprehension at 18 months (Laakso, 1999). Eye gaze is another known language development facilitator that interestingly shows its importance in less well-studied societies. A study that utilised eye tracking to assess face-to-face contacts in 5–7 months in rural Vanuatu suggests that infants, regardless of their culture, can universally follow gaze but only when it is cued by IDS and not after adult-directed speech – a.k.a., ADS (Hernik & Broesch, 2019). It was further found that consequent or simultaneous eye gaze and speaking to children or mutual eye gaze followed by directing the gaze to the object can improve children's linguistic development by enhancing the negative central component¹ (Çetinçelik et al., 2021; Richards et al., 2012).

Recently, Kosie and Lew-Williams (2023) introduced a generalised framework that aimed to give a more comprehensive understanding of infant-directed behaviours (IDB) under a newly proposed concept as 'infant-directed communication', or IDC. The definition of IDC, according to this work, is 'the suite of communication signals from caregivers to infants including speech, action, gesture, emotion, and touch'. They pointed out speech as a key component of infant-caregiver interactions, but they also noted that speech normally occurs along with other behaviours. To examine this new framework, a 10 min free play was observed between the caregivers and their infants for a group of forty-four 18- to 24-month-olds in Kosie and Lew-Williams (2023). Participants were chosen from English-speaking, Caucasian, middle-class and American households representing WEIRD societies, and the coding scheme used included the five proposed dimensions of IDC. Moreover, infants' gestures and vocalisations were coded for any possible relations with IDC. They found that the five dimensions of IDC were all predominantly employed by the caregivers when communicating with their infants. In addition, non-verbal communication cues supported the speech in a majority (above 60%) of cases. However, the use of IDC, was found to vary across families

and depend significantly on the behaviours and abilities of their infants as well as the infants' use of gestures and vocalisations.

Prevalent theories of language acquisition emphasise the infant experience as an active contributor to conversations (Shneidman & Goldin-Meadow, 2012). However, in several less well-studied communities, children are rarely engaged in direct conversation by their caregivers and there is the possibility that these children learn language from observing communicative exchanges or other ways (Lieven, 1994). Here, to gain a broader perspective on the prelinguistic situation of Tanna and Vancouver infants, we will examine 94 video recordings of free play sessions between mothers and their 20-month-old infants. The free play sessions consist of two conditions with toys and without toys to provide equal situations for the two groups in our sample. The with/without toys scenarios were designed because Tanna infants rarely use toys in their daily life whilst in Vancouver, toys are part of parent–infants' daily activities. We will code for the following four interactions between infant and caregiver including IDS, IDB, – that is, non-verbal behaviours that caregivers exhibit whilst interacting with infants, the simultaneous occurrence of IDS and IDB (which we call infant-directed communication), and 'solo' – that is, when infant and caregiver do not engage in a shared activity. The primary question we seek to answer here will be what the proportion of each dimension of infant-directed communications is in a less-studied culture like Tanna. We will also be interested in looking into the possibility of any differences in these dimensions between Tanna and Vancouver.

2 | RESEARCH QUESTIONS AND HYPOTHESES

Our aim is to identify and compare the proportion of time caregivers spend engaging in IDS and infant-directed non-verbal interactive behaviour (IDB), both within and between Tanna and Vancouver societies. We define IDS as any vocalisation produced by the caregiver during the caregiver–infant interactions. For example, any time the caregiver is vocalising in the interaction, this would be identified as IDS. On the other hand, we define IDB as any non-verbal interactive behaviour produced by the caregiver during the caregiver–infant interactions. For example, any time the caregiver is engaged with the infant (looking at them and playing with them) and not vocalising, this would be identified as IDB. We will also measure instances when caregivers produce both IDS and IDB simultaneously, referred to here and in the literature as IDC – infant-directed communication (see Kosie & Lew-Williams, 2023), as well as instances where the caregiver is with the infant but not vocalising or engaging in any way, referred to as 'solo' behaviour.

In line with previous research which found that caregivers in societies that are small-scale and rural (e.g., Tsimane and Tanna) produce significantly less IDS than what has been documented in the urban and primarily western literature (Cristia, 2023; Cristia et al., 2023), we expect less IDS produced by caregivers on Tanna compared to Vancouver (H1). Additionally, based on the literature describing early social interactions in the first 2 years of life across cultures – we expect to observe more IDB on Tanna compared to Vancouver (H2) (Cebioglu et al., 2022; Salomo & Liszkowski, 2013)². However, we have no reason to expect any societal-level differences in the proportion of time that caregivers produce speech and non-verbal communicative behaviours simultaneously, therefore we expect comparable amounts of combined IDS + IDB (referred to in previous literature as IDC) between societies (H3). Regarding our variable 'solo' where we coded the proportion of time caregivers spend not engaging or speaking with their infant, we expect more solo time in Tanna compared to Vancouver (H4) based on previous experimental reports in a similar context (see, e.g., results from Salomo and Liszkowski (2013) for differences in individual activities between Mayan, Chinese and Dutch children).

3 | IMPLICATIONS

The existing comprehension of children's language development is primarily grounded on WEIRD populations' theories. Language learning models, up to the present, have mostly revolved around the role of parent–infant

verbal communications as the major language development pathway and ignored other possible routes. This work seeks to demonstrate that there may be varied environmental factors that potentially affect language learning in different societies. In fact, verbal interaction is expected in such a context not to be the only way that people can communicate with each other, and non-verbal interactions may be more important, even sufficient to fulfil communicative needs. The results of the present research may be helpful for anyone who plans to work with small-scale and diverse communities in Canada or any other place where multiple cultures and different backgrounds coexist. Understanding the early social communication and development of children and the consequent effects on their later language acquisition can provide insights into the cultural variations within societies and enhance their education and well-being through better planning and implementation of policies.

4 | METHODS

For this research, we will examine a previously collected dataset of semi-structured video recordings of caregivers with their infants on Tanna Island, Vanuatu and Vancouver, Canada.

4.1 | Societies

4.1.1 | Tanna, Vanuatu

Tanna is located in the Tafea Province in the Republic of Vanuatu, South Pacific where we have a collaborative research relationship spanning over a decade with three communities. The cultural history of this region of Vanuatu involves the preservation of traditional social and cultural practices opposing westernisation. Villages on Tanna are composed of smaller hamlets totaling around 100 residents under the governance of a local chief and enclosed with a cultural meeting place. Families make a living through subsistence of farming and cultivating small cash crops. There is a strong emphasis on prioritising the transfer of cultural knowledge, the preservation of traditions and the development of survival skills. The attribute that makes Vanuatu an interesting community to study for our research is that it is the world's highest-concentrated linguistic landscape with 106 languages spoken (Lynch, 2001). The participants in this study are from the communities in Central Western Tanna speaking Lenakel and South-West Tanna languages.

4.1.2 | Vancouver, Canada

Metro Vancouver, with a population of 2.5 million is the third-largest urban area in Canada. The majority of the adult population have a high school education or higher and the median family income is 72, 662 (Statistics Canada, 2016). The structure of the family is nuclear and there are on average 2.5 people per household (Statistics Canada, 2016). This social ecology represents similarities to other western societies. The proportion of IDS is reported to be higher in western societies than in Tanna. Therefore, Vancouver is a benchmark to compare with Tanna.

4.2 | Procedure

In this study, caregivers engaged in a 5-min warm-up session in which the infant, caregiver and the experimenter played with wooden blocks and a doll. After participating in three different tests (see Cebioglu and

Broesch (2021) for a summary of the tests and results), all of the experimental stimuli were removed. Then, the caregiver and infant remained together for a 10-min free play session. The free play session consists of two conditions, each including 5 min of play with toys (i.e., blocks and baby-doll) and 5 min of play without toys. Recordings were captured from two distinct video angles. The overall procedure took 40 min, and the duration of free play was, on average, 8 min (ranging from 2 to 10 mins). Finally, caregivers completed a demographic and socialisation goals questionnaire (Cebioglu & Broesch, 2021). The total duration of video footage is approximately 16 h.

4.3 | Participants

The dataset consists of 94 mother-infant dyads from Tanna ($n = 65$) and Vancouver ($n = 29$). The data were collected between 2013 and 2018. The infants were on average 20.05 months of age ($SD = 1.86$, range = 18–24). The average age of infants was 20.07 months ($SD = 1.99$) in Tanna and 20 months ($SD = 1.57$) in Vancouver. There were 51 girls ($n = 39$ in Tanna, $n = 12$ in Vancouver) and 43 boys ($n = 26$ in Tanna, $n = 17$ in Vancouver). Because we used previously collected data in this research, we only requested and received approval from the research ethics board of Simon Fraser University. Participants in Vancouver were recruited from the greater Vancouver region of British Columbia, Canada. Participants were tested in their homes, laboratory (in Vancouver), daycare (in Vancouver) or a suitable outdoor space (in Tanna). All Tanna's mothers were born in Vanuatu. In Vancouver, 58% of mothers were Canadian born and English was their native language, whilst the remaining percentage consists of those who were not born in Canada or lived in families where English was spoken in addition to at least one other language. The level of formal education was significantly different between the two societies with an average of 18.84 years in Vancouver and 6.85 years in Tanna.

4.4 | Coding procedures

To determine the proportion of time the caregivers spent engaging in verbal IDS and non-verbal IDB in the videos, we will code each video recording one time. We will have three coders for the videos and will randomly assign the videos to each coder with 20% of all videos overlapping between the coders.

4.4.1 | Training and inter-rater reliability

To achieve inter-rater reliability (IRR), we will undergo rigorous training and practice coding on a random subset of 10% of the videos until 80% agreement is achieved for training purposes. After training, a new subset (20%) of videos will be randomly assigned to all three coders to code. These will be balanced by society so that each coder codes 10% from each society. Upon independent coding completion, IRR will be calculated, and coding will resume if IRR (Cohen's kappa) is 70% or higher. We will use Behavioural Observation Research Interactive Software (BORIS) which is a free, open-source software for all of our coding (Friard & Gamba, 2016).

4.4.2 | Variables

We mainly intend to identify the proportions of time that the caregivers engage with the infants using either verbal (IDS) or non-verbal (IDB) interactive behaviours, both IDS and IDB at the same time (which we refer to as infant-

directed communications or IDC), and no interactions ('solo'). To develop this framework, we watched several videos of both societies and developed a coding scheme described in the following. We will code the four mutually exclusive variables mentioned—IDS, IDB, IDC and 'solo', as well as non-observable situations. Non-observable, here, refers to any time that the infant or caregiver is out of view of the camera or the times when the procedure deviates in any way such as the presence of another adult. We will remove non-observable video duration from the total duration. We will then calculate the proportions of time of the total video duration. Our coding scheme is designed with the intention to be 'culture-free' and is based on objective observations of behaviour – that is, includes coding of vocalisations (sound) and interactions (movement). The only assumption that exists in such a framework is that the speech is directed to the baby and is not self-talk. To address this assumption, we will examine a subset of video narratives for speech and examine the translations from a previous study on this sample.

We characterise IDS as any vocal utterance produced by the caregiver whilst in the exclusive presence of the child. Following the work by Kosie and Lew-Williams (2023), speech here includes any communicative signal produced by the caregiver, for example, saying 'hmmm', laughing and so on. We define IDB as any interactive non-speech behaviour produced by the caregiver whilst in the exclusive presence of the child. Caregiver and child have body positions that are somehow oriented towards one another and there is movement within the dyadic space. The child may face out but there needs to be movement that is in view of the child. As Kosie and Lew-Williams (2023) suggest, IDB may include but not be limited to the following categories: (i) Infant-directed action when the caregiver interacts with an object to change the location or direction of the object, for example, when mom picks up the doll and moves it in front of the baby. (ii) Infant-directed gesture which is a movement of body or limbs with a communicative intent. Examples of this behaviour include indicating, pointing, representing, and dancing. (iii) Infant-directed emotion that describes when the caregiver produces facial expressions whilst interacting with the infant. Examples are smiling, frowning and acting surprised. (iv) Infant-directed touch which includes any intentional touching of the infant such as holding infant's hands, hugging and moving an object on the infant's leg. IDC is when both main aspects of communication, that is, IDS and IDB, are generated by the caregiver. Inspired by Kosie and Lew-Williams (2023), IDC is defined here as any suite of communication signals from caregivers towards the infant. An example is when during a caregiver–infant interaction, the caregiver begins singing and clapping hands towards the infant. We define 'solo' as any self-speech or self-engagement of the caregiver. An example is when an infant plays with toys without noticing the presence of the caregiver whilst the caregiver participates in playing by themselves using other toys and no interactions happen with the infant. Non-observable refers to any section of the video that we cannot code, or needs to be excluded from the codable video, including the cases where another person is present with the caregiver. This is because we assume that the adult solely speaks to or interacts with the child. In short, if someone else is present, we will remove the corresponding section from the coding.

5 | RESULTS

5.1 | Data analysis plan

We will carry out statistical tests in R Statistical Software (R Core Team, 2021), which will implement a multinomial logistic mixed-effects regression using the *nnet* package. The dependent variable will be the classification of infant-directed interactions as either IDS, IDB, IDC or 'solo' during each second of an infant's recorded free play session, whilst independent variables will be different demographic identifiers (e.g., caregiver age, child age, caregiver gender, child gender, society and caregiver years of formal schooling), the two different conditions of the study (with or without toys) and the interaction between condition and society (given that the presence of toys is more typical in such interactions within Canada, but not having toys is more typical in Vanuatu). The random-effects structure will include an intercept for dyad, and a random slope for the condition. Following standard analysis for mixed-effects models (Matuschek et al., 2017), we will first test a model with a maximal random-effects

structure, but if model convergence presents issues, we will then reduce the model by first de-correlating the slope and intercept, and then removing the slope. Our aggregate data will also be stripped of identifying information and made available on the Open Science Framework (OSF) website (osf.io).

Since we will use previously collected data in this study, we performed the power analysis via the *fabs* package (see *fabs* package for R [[github\biesanz\fabs](https://github.com/biesanz/fabs)]) and *ep-r* function. We obtained the inputs (i.e., effect size and degrees of freedom) for this function from Cristia's (2023) review which assessed the differences in the prevalences of IDS between a total of 72 samples from urban north American and rural areas. We did not find any prior study on the differences in IDB between urban and rural areas. The results of the power analysis performed showed that our research with $n = 94$ would have an expected power of 0.98 (for more details on the statistical power analysis method employed, please refer to Biesanz & Schragar, 2018).

6 | PROPOSED DISCUSSION

Our first hypothesis posits that the proportion of IDS is higher in Vancouver than in Tanna, aligning with previous literature (Cristia, 2023; Cristia et al., 2023). Confirming these results would replicate prior findings, but if we discover a higher proportion of IDS in Tanna or an equal distribution in both cultures, our study will contribute novel information to the literature. This divergence could be attributed to the distinct design of our study, that is, incorporating a semi-structured setting wherein mother-infant interactions are more prominent than in the natural observation study design.

Our second hypothesis anticipates a greater occurrence of IDB in Tanna compared to Vancouver. Meeting this expectation would be consistent with previous research, where a cross-cultural study on similar societies showed that Tanna mothers reference actions more frequently than Vancouver mothers, who tend to focus more on internal states (Cebioğlu et al., 2022). Such hypothetical results on more IDB in Tanna could, in turn, imply a potential link with language learning in small-scale societies although our variables here do not directly measure these influences. Rejection of this hypothesis, on the other hand, would indicate that IDB may not be cultural-dependent as some studies suggested (Lieven & Stoll, 2013).

The third hypothesis is exploratory, as there is no existing cross-cultural literature on infant-directed communications. Our results, in this part, aim to generalise the previously introduced behavioural category of caregiver–infant communication which only has been evaluated in urban western societies so far (Kosie & Lew-Williams, 2023).

Our fourth hypothesis is regarding the ‘solo’ category, where we expect more individual activities in Tanna, consistent with the evidence from other small-scale societies (Salomo & Liszkowski, 2013). The existing results, in that regard, are limited and our hypothetical findings would support and highlight the importance of infant self-exploration in small-scale cultures like Tanna.

We also plan to discuss the strengths and limitations of our research. One important aspect of our study is the utilisation of a diverse sample from a less-represented culture. Whilst most classic language development theories emphasise the speech aspect of communication, our study challenges this view by focusing on varied caregiver–infant communication pathways in this less-studied social context. Nevertheless, some limitations also exist that need to be addressed. Firstly, all our coders are from cultures other than Tanna, necessitating caution in interpreting the dataset. Additionally, our study captures infant–caregiver interactions in a semi-structured setting, and future research should consider incorporating natural observations. To conclude, we will contextualise our findings within the relevant results and discussions from the literature on child language learning with the aim to take a step towards decentering the western bias in developmental science.

AUTHOR CONTRIBUTIONS

Zahra Halavani: Conceptualization; data curation; formal analysis; methodology; project administration; writing – original draft; writing – review and editing. **H. Henny Yeung:** Conceptualization; funding acquisition; project administration;

writing – review and editing. **Senay Cebioğlu**: Methodology; resources. **Tanya Broesch**: Conceptualization; data curation; formal analysis; funding acquisition; methodology; project administration; supervision; writing – review and editing.

PEER REVIEW

The peer review history for this article is available at <https://www.webofscience.com/api/gateway/wos/peer-review/10.1002/icd.2498>.

DATA AVAILABILITY STATEMENT

Our aggregate data will also be stripped of identifying information and made available on the Open Science Framework (OSF) website (osf.io).

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ENDNOTES

¹ That denotes attentional arousal and attentional orientation towards significant stimuli.

² Refer to the comparison of dyadic interactions between Mayan, Chinese and Dutch societies.

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APPENDIX

CODING ETHOGRAM

General coding procedure

There will be training, followed by inter-rater reliability (IRR), and subsequently, independent coding of the videos. We will watch the video in real-time, and code for the four mutually exclusive variables produced by the caregiver and received by the child: infant-directed speech (IDS), infant-directed behaviours (IDB), infant-directed communication (IDC) (IDS+IDB) and ‘solo’, as well as non-observable as defined below. Mutually exclusive means that these codes cannot overlap. Coders will make decisions regarding the occurrence of any of the four variables at a given moment. In cases of ambiguity, discussions during training is essential, and resolutions will be documented in this ethogram.

Start/Stop: For us to identify a behaviour or speech, we generally use the one second rule, that is, if a behaviour is one second long, it counts as the behaviour or a change in behaviour. If it is less than one second, it is ignored.

Continuous coding: When we press button ‘a’ (e.g.), it is assumed that the behaviour is started, and button ‘b’ is for end of the same behaviour. Therefore, each of the four identified behaviours should have its specific start and stop buttons.

Training and IRR

Our coding team includes the first author and the two research assistants trained by the first author. To achieve inter-rater reliability, we will undergo rigorous training and practice coding on a random subset of 10% of the videos until 80% agreement is achieved for training purposes. After training, a new subset (20%) of videos will be randomly assigned to all three coders to code. These will be balanced by society so that each coder codes 10% from each society. Upon independent coding completion, IRR will be calculated and coding will resume if IRR (Cohen's kappa) is 70% or higher.

Operational definitions of variables to code

IDS: Any vocal utterance produced by the caregiver whilst in the exclusive presence of the child, **not limited to speech alone**. The child must be present, and we assume they can hear. In this variable, the child's behaviour is not

coded in any way other than present. Following Kosie and Lew-Williams (2023), speech includes any communicative signal produced by the caregiver, for example saying 'hmmm', laughing and so on.

IDB: Any interactive behaviour produced by the caregiver whilst in the exclusive presence of the child. Caregiver and child have body positions that are somehow oriented towards one another and there is movement within the dyadic space. Face out of the child is ok but there needs to be the movement that is in view of the child. The important point is that child does not need to be interacting, however, the eyes, or body or head of child recipient must be in the direction of the caregiver in this category. This includes but is not limited to playing with objects, playing with the child, touching (must be movement, not a resting touch) the child (note movement follows the one second rule), nodding, gesturing, eyebrow raising, shaking the head, expressing emotion towards the child – like a change in emotion, smile, frown and so on. Following Kosie and Lew-Williams (2023), IDB may include but not be limited to the following categories. Infant-directed action: When the caregiver is interacting with an object to change the location or direction of the object. For example, when mom picks up the doll and moves it in front of the baby. Infant-directed gesture: This is a movement of the body or limbs with a communicative intent. Examples of this behaviour include indicating, pointing, representing and dancing. Infant-directed emotion: This is when the caregiver produces facial expressions whilst interacting with the infant. For example, smiling, frowning and surprising. Infant-directed touch: This is any intentional touching of the infant. For example, holding the infant's hands, hugging and moving an object on baby's leg.

IDC (both): Both main aspects of communication, that is, IDS and IDB, which are produced by the caregiver. Inspired by Kosie and Lew-Williams (2023), IDC is any suite of communication signals from caregivers towards the infant. For example, when during an interaction between mom and baby, the caregiver begins singing and clapping hands towards the infant.

'Solo' (non-interaction, e.g., mom solo play): Any self-speech or -behaviour of the caregiver. It can also include the situation when the caregiver has none of the IDS, IDB, IDC and self-interaction. This situation happens when the infant is playing with toys without considering the presence of the mom and the caregiver is engaging in playing with some toys for themselves or not engaging in any interactions with the infant.

Non-observable (N/A): Any section of the video you cannot code, or needs to be excluded from the codable video, including if there is another person present as we assume that the adult is speaking or interacting with the child. Therefore, if someone else is present, this section is removed.