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SHORT REPORT

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Infant gaze following depends on communicative signals: An eye-tracking study of 5- to 7-month-olds in Vanuatu

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Abstract

Gaze is considered a crucial component of early communication between an infant and her caregiver. When communicatively addressed, infants respond aptly to others' gaze by following its direction. However, experience with face-to-face contact varies across cultures, begging the question whether infants' competencies in receiving others' communicative gaze signals are universal or culturally specific . We used eye-tracking to assess gaze-following responses of 5- to 7-month olds in Vanuatu, where face-to-face parent–infant interactions are less prevalent than in Western populations. We found that—just like Western 6-month-olds studied previously—5- to -7-month-olds living in Vanuatu followed gaze only, when communicatively addressed. That is, if presented gaze shifts were preceded by infant-directed speech, but not if they were preceded by adult-directed speech. These results are consistent with the notion that early infant gaze following is tied to infants' early emerging communicative competencies and rooted in universal mechanisms rather than being dependent on cultural specificities of early socialization.

KEYWORDS
communication, culture, eye-tracking, infant gaze following, non-WEIRD psychology, ostension, small-scale societies, Vanuatu

1 | INTRODUCTION

Gaze is a significant source of nonverbal communicative signals in human interactions. Infants and newborns aptly respond to others' gaze signals (Farroni, Massaccesi, Pividori, & Johnson, 2004; Senju & Csibra, 2008), raising the possibility of a universal mechanism, which allows human babies to receive gaze communication from their caretakers (Csibra, 2010). However, the evidence for young infants' developing competence in using others' gaze comes almost exclusively from Western and urban populations—that is, from a specific cultural context, which also emphasizes face-to-face and direct eye contact as a primary form of early social interactions between caregivers and infants. In many other societies around the globe, face-to-face interactions with babies are reported to be less frequent (Keller, Borke, Lamm, Lohaus, & Dzeaye Yovsi, 2011; Lancy, 2014; LeVine, 1994; Little, Carver, & Legare, 2016). However, sensitivity to gaze signals among infants growing up in such social environments has not been studied. This raises the question whether infants' abilities to rely on gaze may be specific to cultural context in which they are most often studied, or—they are common across diverse contexts, regardless of the cultural norms surrounding gaze in parenting practices. To address this question we sought to examine infants' sensitivity to communicative gaze signals in a small-scale, rural and nonindustrial society, where face-to-face interactions between caregivers and infants are less frequent than in Western populations. We studied infants living in Vanuatu using the same experimental method that had been employed previously to study Western infants in the laboratories (Senju & Csibra, 2008).

One extensively studied infant response to gaze is gaze following, that is, active shifting of own gaze to the object gazed-at by another person (Brooks & Meltzoff, 2005; Moore, Angelopoulos, & Bennett, 1997). Eye-tracking studies found that infants as young as 5-to-6 months of age follow the gaze of a person on a computer screen (Gredebäck, Theuring, Hauf, & Kenward, 2008; Senju & Csibra, 2008; Szufnarowska, Rohlfing, Fawcett, & Gredebäck, 2014). The mechanisms and origins of infant gaze following are debated. Some researchers consider it an automatic response and an outcome of general attentional and learning processes (de Bordes, Cox, Hasselman, & Cillessen, 2013; Deak, Krasno, Triesch, Lewis, & Sepeta, 2014; Szufnarowska et al., 2014; Triesch, Teuscher, Deák, & Carlson, 2006). Others interpret it within a broader pattern of empirical findings, and argue that it reveals infants' preparedness to receive communication from others (Csibra, 2010; Csibra & Gergely, 2011).

What evidence speaks to the latter view? First, long before babies follow others' gaze overtly, with their own gaze, their attention does it covertly. According to one report even newborns detect an object on the screen faster, if it shows up in a location toward which someone previously gazed (Farroni et al., 2004). This suggests that at least some mechanisms supporting gaze following may be independent of experience. Second, both overt and covert following of gaze in young infants is expressed best in situations where gaze shifts are accompanied by a clear signal that someone is communicating to the baby (Farroni et al., 2004; Senju & Csibra, 2008; see also: Daum, Ulber, & Gredebäck, 2013; Deligianni, Senju, Gergely, & Csibra, 2011; but see: Gredebäck, Astor, & Fawcett, 2018). One such ostensive signal (Csibra, 2010)—also detectable by infants from birth—is infant-directed speech (Cooper & Aslin, 1990). For instance, in one influential eye-tracking experiment (Senju & Csibra, 2008) 6-month-old infants followed gaze shifts of an adult on the screen *only* if these were preceded by infant-directed speech, and not when they were preceded by matched adult-directed speech.

Regardless of the theoretical views concerning their mechanisms and functions, the current knowledge of early infant skills in dealing with gaze behaviors of others suffers from a major limitation. It is based on the evidence coming predominantly from a single cultural environment, namely: infants living in urban or Western populations. Such evidence is, however, readily assumed to reveal universal features of infant development. Meanwhile, there is growing concern in the social sciences whether psychological phenomena reported in easily accessible Western samples generalize to the human population (Henrich, Heine, & Norenzayan, 2010; Kline, Shamsudheen, & Broesch, 2018; Nielsen, Haun, Kärtner, & Legare, 2017).

The Western sampling bias in infant studies may be seen as particularly troubling for the hypothesis that early gaze following is driven by universal mechanisms supporting reception of communicative signals from others, because of considerable variation in how much exposure to such signals infants actually receive across different parenting contexts (Lancy, 2016; LeVine, 1994; Ratner & Pye, 2017). Historically, according to a widespread notion in developmental psychology, caregivers tend to engage in dyadic (i.e., involving infant and caregiver) and triadic (i.e., involving infant, caregiver, and an external object) face-to-face interactions with babies at a close distance, allowing infants to have ample visual access to adult's communicative signals, including gaze behaviors (Tomasello, 1999; Trevarthen, 1998). However, there is a growing body of literature documenting cultural variation in parents' propensity to engage in face-to-face contact with infants (Keller et al., 2011; LeVine, 1994; Little et al., 2016; for a recent review see: Lancy, 2014, 2016).

Research Highlights

- We used portable eye-tracking to assess infant gaze following in rural Vanuatu, where face-to-face parent–infant interactions are less prevalent than in Western urban populations.
- Like Western 6-month-olds studied before, Ni-Vanuatu 5- to 7-month olds followed gaze shifts preceded by infant-directed speech, but not those preceded by adult-directed speech.
- Results are consistent with the notion that gaze following is tied to infants' early emerging communicative competencies and rooted in mechanisms potentially universal across human groups.

The cross-cultural differences are often discussed in terms of two distinct parenting styles. Some argue that Western cultures promote a so-called *distal* parenting style, which relies on face-to-face contact and visual modality of the interactions. However, the so-called *proximal* parenting style, which relies more on physical modality of contact between caregivers and babies is typical of small-scale non-Western societies (Kärtner, Keller, & Yovsi, 2010; Keller et al., 2009, 2011; Konner, 2005). Recently Little et al. (2016) measured prevalence of visual and physical engagement between caregivers and infants during free-play triadic interactions in United States and in a small-scale Melanesian society of Tanna island, Vanuatu. Ni-Vanuatu caregivers were less likely than those in US to engage infants face-to-face, when introducing a novel object, and (at least in one of the two reported studies) they were more likely to engage infants through physical contact. Little et al. (2016) argue that adults' tendency to use overt, visually accessible communicative signals as a primary form of communication with infants may be a product of Western culturally transmitted interactional patterns, rather than a universal aspect of parent–infant interactions.

These findings may speak against universal mechanisms in parental *production* of infant-directed gaze communication, but they do not speak directly against the universal mechanisms behind infants' *reception* of such behaviors. Infants raised in proximal-parenting contexts pay less overt attention to caregivers' faces—potentially as a consequence of lower frequency of face-to-face contact (Kärtner et al., 2010). However, their competence in receiving communicative gaze signals is in fact unknown.

The main aim of our study was to fill this gap. We used an eye-tracking paradigm (Gredebäck et al., 2008, 2018; Senju & Csibra, 2008; Szufnarowska et al., 2014) to assess gaze-following responses of 5- to 7-months-old infants in the same rural Melanesian small-scale society of Tanna island, in the same general region where Little et al. (2016) found face-to-face contact in triadic interactions to be less prevalent than in Western population. Gaze-following assessment is well suited to detect potential impact of the non-Western parenting style on infants' sensitivity to communicative gaze, since—on some accounts—infants acquire gaze-following responses through basic learning processes (Deak et al., 2014; Moore et al., 1997; Triesch et al., 2006). By using eye tracking for the first time to study gaze following in a rural non-Western population of babies, we were adding to a body of closely comparable data from various group of Western infants (Gredebäck et al., 2008, 2018; Senju & Csibra, 2008; Senju et al., 2015; Szufnarowska et al., 2014).

Secondly, our study aimed at testing, not only whether Ni-Vanuatu infants follow gaze, but also whether their responses were driven by communicative competencies. Following the design of the aforementioned study by Senju and Csibra (2008), we assessed responses to gaze shifts presented in the contexts of infant-directed speech (IDS) and adult-directed speech (ADS). Previous studies with infants around 6 months of age either found higher rates of gaze following in communicative than in non-communicative contexts (Senju & Csibra, 2008; Szufnarowska et al., 2014), or found no difference (Gredebäck et al., 2018; Szufnarowska et al., 2014), but never the opposite pattern. Based on these findings, we expected Ni-Vanuatu infants to show higher rates of gaze following in communicative (involving IDS) than in noncommunicative contexts (involving ADS).

As part of the second author's ongoing research project investigating parenting and infant development, mainland Tanna island was selected for its geographic isolation and minimal influence of Western society and formal education. Tannese communities rely on subsistence living (small-scale agriculture and marine foraging) with most households producing their own food and few selling to the local village market. Early child experience and development in Tanna are distinct from the experiences of children in typically studied urban, Western settings. There is no television or newspaper and community members rarely travel off the island. Access to formal education is limited and in some Tannese communities it is actively rejected as part of their spiritual practices. Consequently, the influence of Western ideals and parenting practices is minimal. Social ecology of the infant is also notably distinct. Infants are born into a community of multiple caregivers. Older children, aunts, uncles, fathers, grandparents are all available daily to assist with the demands of raising a child, thus providing a rich social environment for the infant. Infants are valued and most individuals engage in joyful interactions when they see an infant. Adults use IDS when taking to infants. For instance, when fathers speak to babies, they modify their vocal pitch by using higher and more variable fundamental-frequency, than when speaking to adults (Broesch & Bryant, 2017).

2 | METHODS

2.1 | Research plan

Field research requires working within constraints, which rarely affect laboratory research. In our case, experimenter's and research assistants' time, access to participants, and access to electricity were limited. In designing the study we aimed at a solution, which would ensure that we can collect full and balanced sample in less than 3 weeks without the need to rely on analyzing and reviewing data in the field. Consequently, we made the following decisions prior to the field visit. We assumed only minimal inclusion criteria both for trials and participants (see Sections 2.1 and 2.4 below). These did not require relying on any other data than the eye-tracking data (as e.g., good-quality video recording may not always be available) and would not result in rejecting participants with imperfect data (which we anticipated to be more frequent than in a typical laboratory study). We chose within-subjects block design with counter-balanced block-order, to ensure that data collection for both conditions would be completed simultaneously and that the distribution of suboptimal eye-tracking data will be uniform across the two conditions. Instead of adopting the typical ways of ensuring good signal-to-noise ratio in the data (namely, through exclusions and replacement of participants), we decided to boost it by doubling the number of trials per condition per participant (six trials in Senju & Csibra, 2008; 12 trials in our study) and more than doubling the sample size per condition ($N = 10$ in Senju and Csibra's study; planned $N = 24$ in our study). Given the low population of the specific region, we planned to recruit a slightly wider age-range of participants (5-to-7-month-olds) than those tested by Senju & Csibra (6-month-olds).

2.2 | Participants

Twenty-two infants (10 females; age: 155–253 days, mean: 200 days) constituted the final sample. Based on earlier study using within-subject block design (Szufnarowska et al., 2014) and with counter-balancing in mind, we aimed at collecting data from 24 infants, but managed to test only 23 before the end of the research visit. One male infant was tested but excluded for not providing any valid trials in the ADS condition. All participants included in the final sample provided at least one valid trial per condition.

All data were collected in June 2016. Participating families were recruited in villages east of Lenakel town and surrounding Lounikawek community. Each village contains fewer than 100 people typically living in smaller family units. The primary language spoken in all participating families was Lenakel (the language spoken in the north and western parts of Tanna island). Families were recruited by word of mouth with the help of a local assistant who was a speaker of Lenakel proficient in English. After receiving information about the procedure and purpose of the study, the caregivers gave verbal consent to participate. Each family received 300 Vatu (approximately 3.5 CAD) as a compensation for their time. A donation was made to Lounikawek village for hosting and facilitating the research project. The study was approved by the Office of Research Ethics, Simon Fraser University, and by the Vanuatu Kaljoral Senta in Port Villa.

2.3 | Apparatus and setup

Infants' gaze was recorded using a Tobii (Stockholm, Sweden) X2-60 eye-tracker mounted below a GeChick 2501C mobile monitor (15.6″ diagonal) that received HDMI video signal (resolution: 1280x720 pixels, refresh rate: 60 Hz) from a Toshiba Portege Z30-B-11C laptop with Windows 7 operating system. Tobii Studio 3.2.1.190 software was used for stimuli presentation and data collection.

Infants were tested in 18 different locations in the houses and local kitchen homes belonging to the participating families. Typically these were small dwellings constructed out of local plant materials (bamboo and palm leaves). The center of the presentation screen was at the eye level of an infant sitting 60 cm away either on parent's laps or on the floor/ground in front of the caregiver. A beige curtain suspended behind the presentation screen concealed the rest of the equipment and the experimenter, who monitored the infant behavior either through a small viewing hole in the curtain or through a video camera mounted above the screen. A local research assistant helped position the parent and the baby in front of the monitor until we achieved successful calibration. After that, the research assistant either left the room or remained out of view of the infant. Caregivers were instructed not to talk to or interact with the infants in anyway. They were also instructed to keep their eyes closed throughout the study.

2.4 | Stimuli

We created video stimuli based on those used by Senju and Csibra (2008, Experiment 2, see also: Gredebäck et al., 2018, 2008; Senju & Csibra, 2008; Szufnarowska et al., 2014; Téglás, Gergely, Kupán, Miklósi, & Topál, 2012). Each video showed a female actress native to the region where we conducted the study on Tanna island. Each video started with her seated centrally behind a table and facing down (2 s). A colorful attention-getting animation (animation phase: 2 s) appeared overlaid on the actress' head. The actress turned her head toward one of the objects standing next to her on the table, one on each side (head-turn phase: 1 s). The picture of the actress gazing at the object continued as a still frame (gazing phase: 5 s) (Figure 1).

Each infant watched trials in two conditions presented in two separate blocks with a different local female actress featured in each condition. The stimuli for the two conditions differed only in audio accompanying the animation phase. At its onset a female voice uttered "Rewuto" ("Hello" in Lenakel language) using either infant-directed speech (IDS condition) or adult-directed speech (ADS condition). The two utterances came from the same female speaker and were matched in intensity. Consistently with characteristics of IDS in Lenakel as well as in other languages (Broesch & Bryant, 2015, 2017), the IDS utterance had higher average pitch, higher pitch range, and longer duration than the ADS utterance (Figure 2).

All stimuli were generated from just four video recordings of the two actresses gazing in the two directions, with the attention-getting animations, pairs of objects, and the audio track edited with Adobe Premier software. The acoustic properties of the two speech samples (Figure 2) were assessed using Praat 5.3.13 software.

In addition to the speech sample presented at the onset of the animation phase, the onset of each trial was accompanied by the same computer-generated attention-getting sound of a bell.

2.5 | Procedure

A standard 5-point calibration was administered prior to each trial-series and repeated until data for at least four calibration points were obtained. After calibration was achieved, each infant viewed two blocks of trials separated by a break (mean duration = 14 min 19 s, SD = 3 min 11 s). Each block lasted until two series of six trials elapsed or until infant showed lack of attention through for example, crying or extensive back-arching (Figure 3).

Each of the two blocks showed trials from a different condition (IDS or ADS) and a different actress. The identities of the two actresses and the order of conditions (IDS in block 1 and ADS in block 2 or *vice versa*) were counterbalanced across babies. The actress' gaze direction (left vs. right) was counterbalanced in the following order: (block 1, series 1) ABBABA, (block 1, series 2) BAABAB, (block2, series 1) BAABAB, (block 2, series 2) ABBABA, starting with leftward gaze for half of the babies and with rightward gaze for the other half. Each trial in a series showed a different pair of objects that

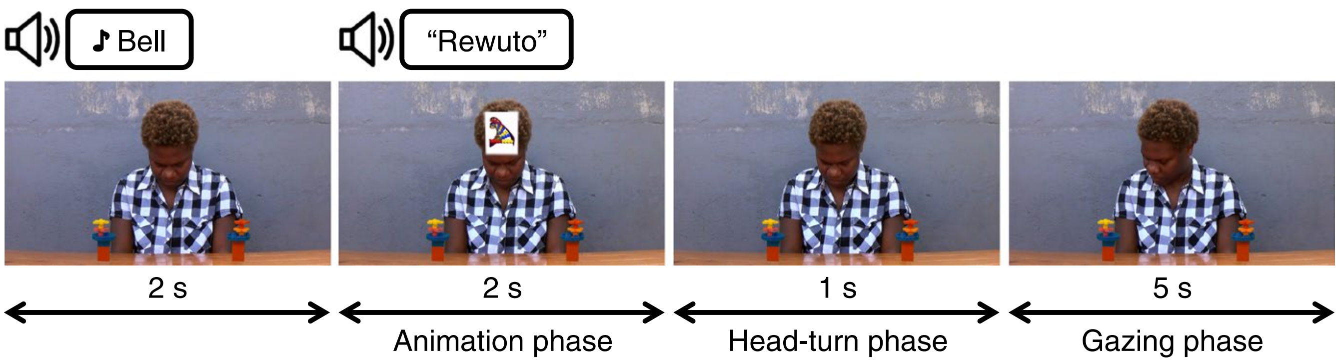

FIGURE 1 The structure of a single trial.

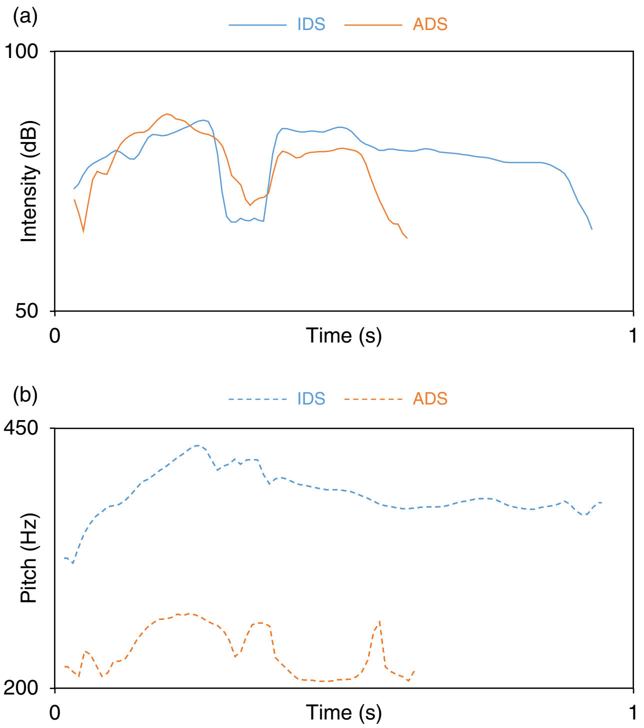

FIGURE 2 Intensity (a) and pitch (b) of the two speech samples used in the IDS and ADS conditions. The two samples had identical mean intensity and similar intensity profiles. Consistently with IDS characteristics in other languages, the two Lenakel utterances used in the experiment differed in pitch (mean_{IDS} = 387 Hz, mean_{ADS} = 235 Hz), pitch range (max_{IDS}-min_{IDS} = 114 Hz, max_{ADS}-min_{ADS} = 65 Hz) and duration, resulting mostly from the elongation of the last vowel in the IDS utterance (IDS: 0.96 s, ADS: 0.64 s)

were made of plastic building blocks and matched in size and overall appearance. Each trial-series had the same order of the six object-pairs. For half of the babies, all trials showed mirrored versions of the stimuli. Each trial was preceded by an attention-getter (a shaking black-and-white checkerboard accompanied by a bell sound) presented at the center of the screen until the infant looked toward it.

2.6 | Data analysis

For each stimulus three rectangular areas of interest (AOIs) were defined. The target-AOI and the distractor-AOIs were static and had identical dimensions. Each stretched from the bottom of the screen up to height of the taller of the two objects plus one visual degree, and their width was calculated as the width of the wider of the two objects plus two visual degrees (in order to allow for approximately 1-degree margin around each object). The head-AOI was dynamic. In its initial position and in its final position the head-AOI was defined as a rectangle around the actress' head with each side set one visual degree away from the head's outermost points. Its exact size and position during the head-turn phase was defined using the Tobii Studio dynamic AOIs functionality.

Following prior studies and reports of discrepancies between different measures of gaze following in young infants (Gredebäck et al., 2018), we decided to employ more than one measure. For each infant we calculated three separate difference scores according to the formula DS = $(X_{Target} - X_{Distractor})/(X_{Target} + X_{Distractor})$, where X is either (a) Gaze duration: duration of gaze recorded within the object's AOI during the gazing phase; or (b) Gaze frequency: number of visits to the object's AOI during the gazing phase; or (c) First gaze:

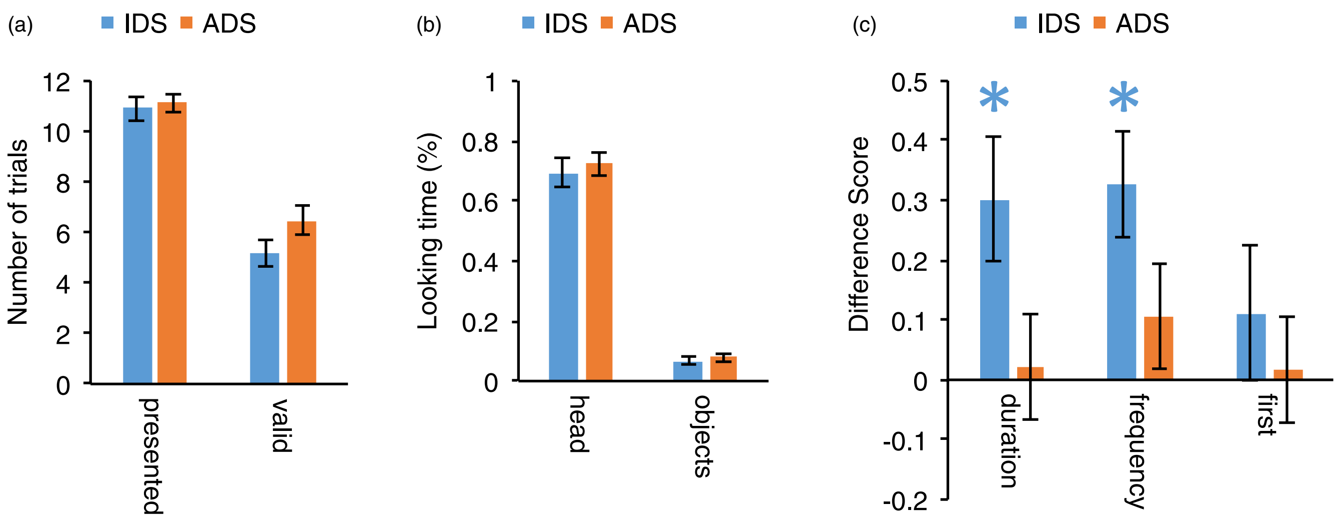

FIGURE 3 (a) Mean number of trials that the infants sat through (presented trials, max 12) and mean number of trials included in the analyses (valid trials) across the IDS and ADS conditions. (b) Mean percentage of time the infant gaze was recorded in the head AOI during the 1-s-long head-turn phase, and the percentage of time the infant gaze was recorded in either the target object AOI or the distractor object AOI during the 5-s-long gazing-phase, across the IDS and ADS conditions. (c) Mean difference scores of infant gaze-following across the IDS and ADS conditions calculated for duration of gaze, the frequency of gazing and the first gaze to target AOI vs. distractor AOI. Positive scores indicate preferential gazing towards the target object. Asterisks indicate average difference score above the chance level of 0 by 2-tailed t-tests, p < .05. Error bars in all graphs show standard error of the mean

number of trials with the object's AOI fixated first in the gazing-phase (for similar measures see: Gredebäck et al., 2008; Senju et al., 2015; Senju & Csibra, 2008; Szufnarowska et al., 2014; Téglás et al., 2012).

Eye-tracking data were exported from Tobii Studio as raw data. The output was a series of gaze positions in screen coordinates assessed at the frequency of 60 Hz (i.e., every 16.67 ms), as well as three series of binary values reporting whether the current gaze position fell within each of the three AOIs or not. A trial was deemed valid if the eye-tracker reported gaze (min = 16.67 ms) falling within the head-AOI during the head-turn phase as well as within the distractor- or the target-AOI, or both during the gazing phase. Note, that this liberal trial-inclusion criterion was chosen to avoid costly loss of data obtained in the field. It allowed us to exclude trials with zero evidence of looking at the critical part of the stimuli (namely: the actress' head-turn). But it did not distinguish between nonrobust fragmentary record of looking at an AOI and correctly recorded but very short visits to the AOI. Only data from valid trials were used for further analysis (Figure 3).

3 | RESULTS

Unless stated otherwise all reported *t* tests are 2-tailed.

Fifty-three percent of the presented trials were deemed valid. It is less than in some laboratory studies (cf. 70% in Gredebäck et al., 2018), where trial-inclusion criteria are more stringent, but babies are less likely to be distracted by uncontrolled factors and data quality is overall better. Our liberal trial-inclusion criterion allowed for individual valid trials with only 16.67 ms of recorded looking at the head-AOI during the head-turn, which in fact might have not been enough to detect direction of the head-turn. However, there were only five (2%) such trials (two in IDS and three in ADS condition) among all 256 trials deemed valid. Median length of looking at the head-AOI during head-turn in valid trials was 858 ms (first quartile: 367 ms, third quartile: 1,000 ms), suggesting that overall the key directional signal of dynamic gaze shift was attended to long enough to be processed. For detailed distributions of gaze across the three AOIs see supplementary online materials.

There were no significant differences between the two conditions in the number of trials that infants on average sat through, IDS: 10.9, ADS: 11.1, $t(21) = 0.36$, $p = 0.725$, the number of valid trials contributed, IDS: 5.2, ADS: 6.5, $t(21) = 1.84$, $p = 0.081$., the percentage of the 1-s-long head-turn phase spent looking at the head, IDS: 69%, ADS: 72%, $t(21) = 0.77$, $p = 0.448$, nor in the percentage of the the 5-s-long gazing-phase spent looking at either of the two objects, IDS: 7%, ADS: 8%, $t(21) = 0.77$, $p = 0.452$ (Figure 3). Thus, we found no evidence to suggest that the stimuli involving IDS were more engaging or elicited more overt attention from infants than those involving ADS.

3.1 | Gaze duration

Infants spent longer time looking at the target object than the distractor object in the IDS condition, $t(21) = 2.92$, $p = 0.008$, $d = 0.62$, but not in the ADS condition, $t(21) = 0.20$, $p = 0.842$, $d = 0.04$.

3.2 | Gaze frequency

Similarly, during the gazing phase only in the IDS condition—and not in the ADS condition—infants looked more often toward the target object, IDS: $t(21) = 3.72$, $p = 0.001$, $d = 0.79$, *ADS*: $t(21) = 1.28$, $p = 0.215$, $d = 0.27$.

3.3 | First gaze

Difference score for first object fixated was not different from the chance level of 0 in neither IDS, $t(21) = 0.97$, $p = 0.341$, $d = 0.21$, nor ADS condition, $t(21) = 0.19$, $p = 0.854$, $d = 0.04$ (Figure 3).

A series of 2x2 ANOVAs found no significant interaction between condition (IDS vs. ADS) and neither actress identity nor order of conditions for none of the three gaze-following measures, highest $F(1,20) = 2.21$, $p = 0.153$.

Earlier studies comparing 6-month-olds gaze following in ostensive and nonostensive contexts (Senju & Csibra, 2008; Szufnarowska et al., 2014) suggested a clear directional hypothesis that infants should be more likely to follow gaze preceded by IDS than that preceded by ADS. Indeed, when we tested this hypothesis using 1-tailed *t* tests, we found that in our sample the different scores on gaze frequency, $t(21) = 1.79$, $p = 0.044$, $d = 0.34$ as well as on gaze duration, $t(21) = 1.99$, $p = 0.030$, $d = 0.39$, were higher in IDS than in ADS condition. This is consistent with the previous literature.

4 | DISCUSSION

We conclude that 5- to 7-month-old Melanesian infants being raised in a rural nonindustrial small-scale society, where they receive less frequent exposure to face-to-face triadic interactions with their caregivers, are nevertheless competent receivers of others' gaze communication, just like Western infants tested in earlier studies (Gredebäck et al., 2008; Senju & Csibra, 2008; Szufnarowska et al., 2014).

Similarities in the patterns of performance of Melanesian and Western babies are striking. First, Ni-Vanuatu infants followed the gaze of a person on the computer screen and did so at the age comparable to the youngest Western infants tested using similar procedures (Gredebäck et al., 2008, 2018; Senju & Csibra, 2008; Szufnarowska et al., 2014).

Second, just like British babies of similar age (Senju & Csibra, 2008) Ni-Vanuatu infants followed only gaze shifts preceded by infant-directed speech and responded at chance-level to gaze shifts preceded by adult-directed speech. This pattern further supports the claim that gaze following in young human infants reflects their early emerging communicative competencies. Notably, it cannot be explained away by any differences in visual saliency (de Bordes et al., 2013; Szufnarowska et al., 2014; cf. Csibra, Hernik, Shamsudheen, Tatone, & Senju, 2014), because stimuli for IDS and ADS conditions were visually identical and differed only in the accompanying audio. Moreover, across four separate measures we found no statistical evidence to suggest that IDS might have rendered our visual stimuli more attentionally engaging for infants than ADS.

Even though Ni-Vanuatu 5- to 7-month-olds in our study spent more time looking at the gazed-at target rather than the distractor (in IDS condition), they did not tend to saccade to the target *first*. A similar dissociation between these two measures of gaze following has been observed in Swedish 5-month-olds (Gredebäck et al., 2008), but not in 6-month-olds. Notably, while Senju and Csibra (2008) tested exclusively 6-month-olds, 36% of babies in the current Vanuatu sample were below the age of 6 months.

Cultural variation in caregivers' provision of distal face-to-face communication is often raised as a key argument against the notion of universal mechanisms behind parent–infant communication and early social learning (Lancy, 2014, 2016; Little et al., 2016). Nevertheless, the results of our study suggest that following of gaze in communicative contexts may be available to human infants from various cultural groups regardless of the frequency of exposure to communicative gaze signals from caregivers (cf. Senju et al., 2015). However, more research with infants raised in the context of proximal non-Western parenting style is needed in order to validate this conclusion.

Admittedly, caution is also needed when drawing general conclusions about the role of learning and innate factors in supporting the gaze-following responses of 5- to 7-month-olds. At least some infant experiences remain similar across cultural contexts (Broesch, Rochat, Olah, Broesch, & Henrich, 2016) and minimal exposure to communicative gaze may be one of them. Proximal parenting style implies relatively lower frequency of face-to-face contact, but does not preclude infant exposure to communicative gaze signals altogether (Kärtner et al., 2010; Little et al., 2016). Infants raised in such contexts may be expected to deal competently with others' communicative gaze—like the Ni-Vanuatu infants in our current study—regardless of whether such competencies are determined primarily by innate mechanisms or whether they are also driven by some necessary learning process.

While eye-tracking has been one of the most valued methods of studying early infant competencies in the laboratory for over a decade, so far it has rarely been used in the field to study non-Western infants (Forssman et al., 2017). Long-standing debates regarding cultural variation are often fueled by methodological discrepancies in how cognition and behavior are studied in Western and non-Western populations. Our study sets an example of how eye-tracking can be successfully used to assess culturally diverse samples of human infants.

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CONFLICT OF INTEREST

Authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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