# Child-directed speech in Ku Waru and Nungon (Papua New Guinea)

Hannah S. Sarvasy
Western Sydney University, Australia

Alan Rumsey
Josua Dahmen
Australian National University, Australia

John Onga
Kailge Community, Papua New Guinea

Stephanie Yam
University of Cologne, Germany

**Abstract:** It is still unknown whether parents in all societies make special speech adjustments when speaking to infants and small children. Researchers in a range of disciplines continue to cite the Kaluli community of Papua New Guinea (PNG) as evidence that not all societies make such adjustments in child-directed speech (CDS), but until recently there have been few modern, quantitative analyses of prosodic, phonological or morphosyntactic features of CDS for any language of PNG. Now, however, a solid body of research on CDS in PNG communities attests to widespread adjustments in CDS to toddlers and preschoolers, especially in the two languages on which we conduct firsthand research: Ku Waru and Nungon. Here, we present the state-of-the-art in current understanding of special features of CDS in Ku Waru and Nungon, in the domains of prosody, phonology, lexicon, and morphosyntax. Nungon CDS has higher mean pitch and greater pitch range than adult-directed speech (ADS), while Ku Waru results are less conclusive in this direction. CDS in both languages features optional modification of consonants that makes them sound similar to early child productions, while Nungon CDS vowels are not hyper-articulated relative to ADS vowels. Both languages are described by native speakers as utilizing a medium-sized set of special baby-talk lexical items, and these have variable distribution relative to ADS lexical counterparts in corpora. CDS in Nungon, but not as clearly in Ku Waru, shows evidence of morphosyntactic "fine-tuning" to child production abilities. Nungon CDS features an unusual morphosyntactic alteration that arguably makes sentences longer and more syntactically complex but simplifies words morphologically. Overall, the possible modifications available for CDS in both languages constitute less a coherent "register" that speakers may slip into or out of, but more a menu of optional features, some apparently binary and some measured in terms of degree, which may be applied in conjunction with each other or separately, and which adults often apply variably within a single recording session.

**Keywords:** child-directed speech; Papuan languages; Nungon; Ku Waru.

**Corresponding author:** Hannah S. Sarvasy, MARCS Institute for Brain, Behaviour and Development, Western Sydney University, Penrith NSW 2751, Australia. Email: h.sarvasy@westernsydney.edu.au

**ORCID IDs:** Hannah Sarvasy: https://orcid.org/0000-0002-9551-480X; Alan Rumsey: https://orcid.org/0000-0002-9710-4695; Josua Dahmen: https://orcid.org/0000-0002-1015-2353

**Introduction**

In most of the world's communities for which the linguistic features of child–caregiver interactions have been studied, child-directed speech (CDS) is reported to display special acoustic, lexical, prosodic, and/or morphosyntactic features that differ from those of adult-directed speech (ADS) (Soderstrom, 2007; Weinstein & Baldwin, 2024, *inter alia*). Perhaps the most famous reported exception is the Kaluli-speaking community (Bosavi[1] language family) of Papua New Guinea (PNG) which continues to be frequently cited as evidence against the universality of special CDS features (e.g., Duranti, 2009; Johnson et al., 2023; Rosenberg et al., 2004; Rowe, 2008; Soderstrom, 2007; *inter alia*). Indeed, until recently there were few modern, quantitative analyses of prosodic, phonological or morphosyntactic features of CDS for any language of PNG, including Kaluli. But now, a growing body of research on CDS in communities of PNG attests to widespread use of at least some special CDS features. In this section, we use the term "CDS" to refer to both the general notion of speech directed to children (of any age), and to refer in some cases specifically to speech directed to children older than 1;0. Indeed, the youngest children in almost all studies of CDS in PNG have been older than 1;0 (Hellwig et al., forthcoming).

Features of CDS have been examined to varying degrees for the nine languages of PNG in which child language acquisition has been studied (for more information on what is known about child language acquisition in Papuan languages of PNG, see Hellwig et al., forthcoming). The best-known accounts of CDS in a PNG language come from Schieffelin's pioneering research on Kaluli (Schieffelin, 1985, 1990), but these lack details on some facets of CDS, with no measurements of pitch or vowel acoustics, for instance. Goldman (1986, 1987) describes aspects of the Huli (Engan) baby-talk lexicon while reporting, without details, the presence of prosodic and pragmatic adjustments in Huli CDS that align with cross-linguistic norms. San Roque reports possible consonant substitution, prompting routines, and a prevalence of "where" questions in Duna (Bogaia) CDS (Rumsey et al., 2013; San Roque, 2008, 2016). As part of a broader study of language shift from Tayap (isolate) to the Papua New Guinean lingua franca Tok Pisin (descended from a variety of Pacific Pidgin English), Kulick (1980, 1992; Kulick & Terrell, 2019) reports on some aspects of mixed Tayap/Tok Pisin CDS. Boer et al.'s (2022) study of child production of Tok Pisin consonants in children's speech lacks reference to CDS.

Recent quantitative research into linguistic features of CDS in PNG has focused on four languages: Ku Waru (Chimbu-Wahgi), Nungon (Finisterre), Qaqet (Baining), and Yélî Dnye (isolate). Previous work on Ku Waru CDS investigated phonetics/phonology (Rumsey, 2017) and morphosyntax (Rumsey et al., 2020); in this paper, we present

---

[1] Throughout this paper, the family to which a language belongs is given in parentheses the first time the language is mentioned.

new studies of prosody and the baby-talk lexicon in Ku Waru CDS. Previous work on Nungon CDS focused on phonetics and prosody (Sarvasy et al., 2019, 2022), morphosyntax (Sarvasy, 2019, 2020, 2021, 2022, 2023b), and pragmatics (Sarvasy, 2022, 2023c). While a baby-talk CDS lexicon for Nungon was mentioned in the Nungon reference grammar (Sarvasy, 2017) and in several previous studies focusing on other topics, the distributions of Nungon baby-talk lexical items were never examined: this will be done here. Frye's monograph (2022) on Qaqet (Baining) CDS is the only book on linguistic characteristics of CDS in a language of PNG; Frye investigates mean length of utterance, disfluencies, mean pitch and pitch range, speaking rate, attention-directing, responses to child errors, and baby-talk lexicon. Marisa Casillas is the only researcher to date who has used day-long recordings with a PNG speech community, that of Yélî Dnye (Bergelson et al., 2023; Bunce et al., 2024; Casillas et al., 2021); she has used these to assess CDS quantity, rather than its linguistic features (her studies are also the principal ones in PNG that involved children younger than 1;0 alongside older children).

Passing mention of lexical and discourse aspects of CDS occurs in reference grammars of additional PNG languages, such as Mali (Baining; Stebbins, 2011, pp. 28–29) and Manambu (Ndu; Aikhenvald, 2008, pp. 44, 138). Discussion of facets of how adults interact with small children in PNG societies is also scattered throughout the language socialization and anthropological linguistics literature (San Roque & Schieffelin, forthcoming).

In this paper, we present an overview of special CDS adjustments in multiple linguistic domains in Ku Waru and Nungon. We survey our published work on CDS phonetics and phonology and morphosyntax, and present new data and analyses on baby-talk lexicons and aspects of Ku Waru prosody and morphosyntax. Overall, the picture is of a complex constellation of adjustments in CDS of both languages, with structural similarities and divergences, and wide variation in application within and across individuals.

In the next section, we provide background information on the two languages and our recording methods. Each of the following four sections presents a comparative overview of known features of an area of CDS (Prosody, Phonology, Lexicon, and Morphosyntax) in both languages. We then summarize and discuss the evidence, with further comparison to Papuan languages Duna, Huli, Kaluli, Mali, Manambu, and Qaqet, and close with a brief conclusion.

## Language Background and Methods

### Ku Waru

Ku Waru is a regional speech variety within a large dialect continuum in PNG's Western Highlands Province (for details about the grammar of Ku Waru, see Merlan & Rumsey, 1991, 322–343; Rumsey et al., 2020, 3–7). It has about 15,000 speakers and is the first language of everyone born in the village of Kailge, where Alan Rumsey's fieldwork has been carried out in collaboration with Francesca Merlan and John Onga, who is himself a native Ku Waru speaker. Nearly everyone at Kailge under the age of 65 also speaks Tok Pisin (a largely English-lexified pidgin/creole, which is PNG's main lingua franca, see Introduction). They primarily use Tok Pisin when travelling to other language regions, rather than in Kailge. Most children in Kailge these days learn Tok Pisin as a second language and alternate between it and Ku Waru to some extent even at Kailge (for details, see Rumsey, 2014).

The Ku Waru data that we draw on here are taken mainly from a corpus that consists of transcripts of interaction between five target children and their caregivers, audio and video recorded between 2013 and 2016 by John Onga and another Ku Waru-speaking local collaborator, Andrew Noma, using Olympus LS14 digital audio recorders and Canon HFM52 digital video recorders (see Rumsey et al., 2024). The children ranged in age between 1;4 and 4;9 at the time of recording. The selection of focus children was based on interviews with a large number of parents, and the need to find children with birth dates spaced 6–7 months apart so as maximize the overall age range within the initial 2-year period when most of the recordings were made. The recordings were made monthly, for 60–65 minutes.

The article also draws on audio recordings made by Onga and Noma during 2004–2007 (on Uher cassette recorders with Audio-Technica ATR25 microphones) involving two focus children (one of them John Onga's son Jesi). Those recordings were made at longer intervals than the ones in the 2013 and 2016 study—generally of about 3 months. For both corpora, in line with the caregivers' preferences, almost all of the recordings were made in their houses, during the daytime, talking around the hearth or while engaging in indoor work activities.

After completing the recording sessions, Onga and Noma transcribed their respective recordings by hand and translated them into English. Their transcripts were later typed by Appen Language Services into a plain-text format. They were then processed by corpus managers Tom Honeyman and Charlotte van Tongeren in OpenRefine to fix regular scribe and typist spelling errors and inconsistencies. All of the transcripts in the 2013–2016 corpus were entered into ELAN (Max Planck Institute for Psycholinguistics, 2024), and time-aligned with the associated media files. The ELAN files with the transcripts, and media files, are freely available to interested researchers in the

PARADISEC Catalog (https://catalog.paradisec.org.au/), in collection AR3.

**Nungon**

Nungon is the umbrella term for the six southern village-lects of an oval-shaped, thirteen-village, dialect continuum in and around the Uruwa River valley in the Saruwaged Mountains, Morobe Province, PNG (see the Nungon reference grammar for background on the area and grammar of the Nungon dialects: Sarvasy, 2017). The Uruwa River valley dialects differ greatly in phonology and lexicon (with 60–88% cognacy rates; Wegmann, 1994); the northern dialects also differ from the southern dialects in the morphological formation of the remote future tense (Wegmann, 1994). Each Nungon village-lect has no more than about 400 speakers in the region and the diaspora; in total, there are about 1,000 speakers of Nungon dialects. The Nungon-speaking area is not accessible by road, and Tok Pisin is less present there than in the Ku Waru-speaking area.

The Nungon corpus, recorded in just the Towet village dialect, includes three longitudinal studies, capturing data from nine children aged 1;1–5;10; it totals about 182 hours of digitally transcribed child–caregiver interactions (Sarvasy, 2023a). Study 1 (2015–2017) involved five children, aged 1;13 to 3;10 at the study's outset, audio- and video-recorded, using Zoom H5n recorders and a Canon digital camera with video capability for 1 hour per month over 2 years (17 months for the youngest child). Study 2 (2019) involved three additional children, aged 2;4–2;8 at the outset, each recorded for 4 hours within 1 week per month, for 5 months. Study 3 (2023) involved one additional child, aged 2;1 at the outset, recorded for four half-hour sessions each month, over 3 months.

All recordings were digitally transcribed in the village, using solar-powered laptops, by Towet Nungon speakers Lyn Ögate, Stanly Girip, James Jio, Nathalyne Ögate, Tabitha James, Yöngwenwen Hessy, and Böiwa Ögate. Transcriptions used Mid-CHAT format (MacWhinney, 2000) and were completed using a word-processor and the software CLAN (MacWhinney, 2000).

## Prosody

Perhaps one of the most immediately salient characteristics of CDS in many languages is its prosodic modifications relative to ADS: cross-linguistically, these typically involve higher overall pitch, greater pitch range, distinctive prosodic contours, slower speech, shorter utterances, longer pauses, and a more reliable positioning of pauses at phrase boundaries, compared to ADS (Cruttenden, 1994; Fernald, 1989; Katz et al., 1996; Soderstrom, 2007; Stern et al., 1983; Wang et al., 2015).

We focus here on one of the most widely studied and perceptually salient features of CDS, cross-linguistically: higher mean pitch and greater pitch range. Perceptually higher pitch in CDS was reported incidentally for the PNG language Kaluli in Schieffelin's groundbreaking and influential work; for instance, when a mother and her daughter (aged 2;6) engage in teasing word play together, they both are said to maintain "high pitch" (Schieffelin, 1990, pp. 109–110). Schieffelin also notes that mothers hold pre-verbal infants to face themselves or others and speak "for them," using a high-pitched, nasalized register similar to the one used to address dogs (1990, p. 71–72; see also Schieffelin, 1979, pp. 106–108).[2] The relationship in pitch between IDS/CDS and pet-directed speech has also been noted for English-speaking communities (Gergely et al., 2017; Jeannin et al., 2017; Xu et al., 2013).

Fernald et al.'s (1989) acoustic analyses of mother's speech to their children in six language varieties (American English, British English, German, French, Italian, and Japanese) revealed a higher fundamental frequency and wider pitch range than in speech directed to other adults by the same speakers. Others corroborated these results for some of the languages included in that study, such as American English (Garnica 1977), British English (Shute & Wheldall, 1989), German (Fernald & Simon, 1984), and Japanese (Amano et al., 2006), and for other languages, like Mandarin Chinese (Grieser & Kuhl 1988; Liu et al., 2009), Cantonese (Wang et al., 2021), Dutch (Benders et al., 2021), and Australian English and Thai (Kitamura et al., 2001), among others. Among these, however, pitch range in CDS has been shown to be constrained to a degree in tonal languages (Mandarin, Cantonese, Thai) or pitch-accented languages (Japanese). For instance, Kitamura et al. (2001) suggest that Thai mothers "may restrict pitch excursions in order not to disrupt tonal information" (p. 386).

---

[2] There is also a very small amount of recent data, but without language-specific analyses on pitch, in infant-directed speech (IDS) in Enga (Engan), the Papuan language of PNG with the most speakers. As part of a cross-cultural experiment that aimed to assess the universality of various prosodic features of infant-directed speech and song (Hilton et al., 2022), anthropologist Pauline Wiessner recorded six female speakers of Enga each producing one very brief (3–16 seconds long) spoken snatch, and one very brief sung snatch (8–13 seconds long), in response to the prompt that they should simulate calming a "fussy" infant (usually, in the presence of an actual infant). Five of the six speakers also recorded similarly brief adult-directed spoken and sung snatches. However, this very small amount of data (13–27 seconds of IDS per speaker) in very noisy settings and without Enga transcriptions is unfortunately insufficient to draw conclusions about prosodic and phonological features of Enga IDS. Further, even if there were more data and of better quality, we would be sceptical about drawing conclusions about differences between IDS and ADS based on this study, due to the mismatch in affect between the highly emotionally "marked" IDS elicited (to calm an agitated infant) and the emotionally neutral ADS (normal conversation and song—not, for instance, to calm an agitated adult). Wiessner also notes that some of the "songs" sung to the infants were actually magic charms, hinting at a fascinating facet of Enga speech to children that is yet to be fully described (Pauline Wiessner, p.c., 2025).

K'iche' Mayan-speaking adults famously were shown to not make significant pitch modifications in CDS compared to ADS, even sometimes using a lower pitch register when addressing children (Bernstein Ratner & Pye, 1984). Bernstein Ratner and Pye (1984) point out that in K'iche', high pitch serves as a signal of deference to addressees of high status. In contrast, young children "come last in the Mayan age-grading system" (Bernstein Ratner & Pye, 1984, p. 521) and do not belong to the category of interlocutors with whom high-pitched voice is used.

Here, we focus on mean pitch and pitch range in Ku Waru and Nungon CDS.

**CDS Prosody: Ku Waru**

In order to check whether the general cross-linguistic tendency for higher mean pitch and greater pitch range also manifests in Ku Waru CDS, we conducted a small-scale acoustic study of the differences in mean pitch and pitch range between Ku Waru CDS and ADS using the existing Ku Waru child language corpus and interviews with parents who featured in that corpus.

*Data Collection*

The CDS data come from the Ku Waru child language corpus, while the ADS data (due to a lack of suitable recordings of ordinary adult conversations in Ku Waru) are from interview sessions that had been recorded for another purpose: Ku Waru speaker Onga asked parents questions while acting as an interpreter in the presence of an English-speaking Australian researcher (Lauren Reed). From these data sources, we selected three women who featured in both CDS and ADS corpora. The children whom these women were addressing in the CDS portion were aged 2;4 (a boy), 2;10 (a girl) and 3;3 (a girl) at the time of recording in July 2013. We note that the data sample used for this prosodic analysis was comparatively small and we did not conduct any prosodic analyses of speech by male participants. Further, our ADS data for these speakers was not truly conversational, since it was from interviews with a foreign researcher and non-Ku Waru speaker present, to whom the women might have in effect been directing their speech.

*Speech Sampling*

We sampled 50 utterances of both ADS and CDS for each of the women. Utterances were defined as segments of a speaker's continuous speech that are separated by more than 300 ms of non-speech by the same speaker (cf. Woolard et al., 2023; Kitamura et al., 2001). To broaden the range of contexts for data sampling, one set of 25 consecutive utterances were extracted from the beginning of each recording, and a second set of 25 consecutive utterances were taken from halfway into the recording (cf. Kitamura et al., 2001), recording length permitting. Utterances consisting of only

one word or a standalone non-lexical vocalization, and any other types of interference that might affect the fundamental frequency (overlapping talk, extra-linguistic noise and clicks, laughter, whispering and creaky voice) were excluded from the speech sampling. All utterances were extracted from Ftable using Praat (Boersma & Weenink, 2025), resulting in a total of 300 sound files (3 caregivers × 2 contexts × 50 utterances).

## Pitch Measurement and Analysis

We used Praat's automatic measurement tool to measure the mean $F_0$ (fundamental frequency), minimum $F_0$ and maximum $F_0$ (see also Kitamura et al., 2001; Frye, 2022) for each of the 300 utterances sampled. To minimize pitch-tracing errors, the pitch trace of each sound file was visually and aurally inspected in the Praat sound editor. An expanded pitch range of 100–600 Hz was set to account for both Praat's recommended pitch range of 100–500 Hz for analyzing adult female voices and the higher pitch range that has been found in other studies of women's CDS, which can reach up to 600 Hz (see Fernald & Simon, 1984). All other pitch parameters were left at Praat's default settings. To facilitate data interpretation and more accurately reflect the logarithmic character of human pitch perception, all fundamental frequency values were subsequently converted to a chromatic scale with twelve semitones (the same scale that is used for conventional music notation). The mean pitch was calculated with a reference value of 100 Hz, using the formula: semitones $= 12 \times \log_2(\max_{F0} \div 100)$. The pitch range was determined by subtracting the minimum pitch from the maximum pitch, using the formula: semitones $= 12 \times \log_2(\max_{F0} \div \min_{F0})$. The results were analyzed in RStudio (Posit team, 2024).

## Results

**Mean Pitch in Ku Waru CDS.** Figure 1 provides a visual summary of the distribution of mean pitch data across the three women. The greatest difference in mean pitch is found in speech addressed to the youngest child, aged 2;4, by the woman Naldi[3]. The linear regression model showed the CDS of this speaker to have a significant pitch difference compared to the corresponding ADS dataset (estimate = 2.33; standard error = 0.49; $p < 0.00001$). For the two other speakers, the median pitch of the analyzed CDS speech was slightly higher (Annie) or lower (Saina) than the corresponding ADS, but these differences were not statistically significant. However, it is worth noting that for all three speakers the highest-pitched utterances all occurred in the CDS datasets.

---

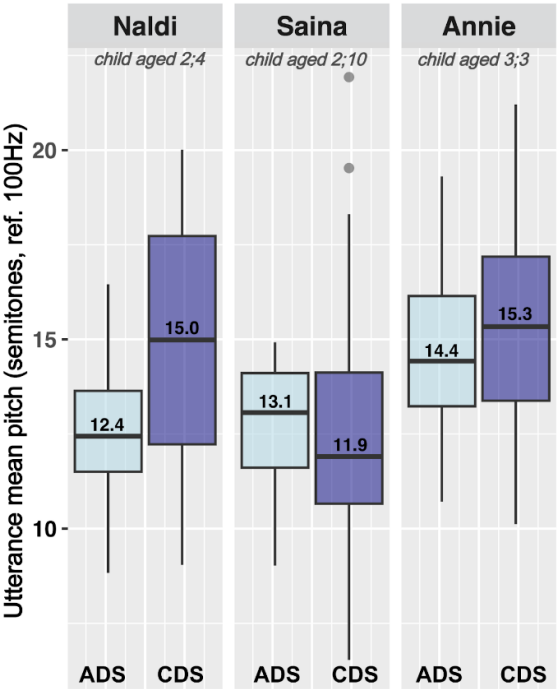[3] Ku Waru children and parents are referred to by first names here.

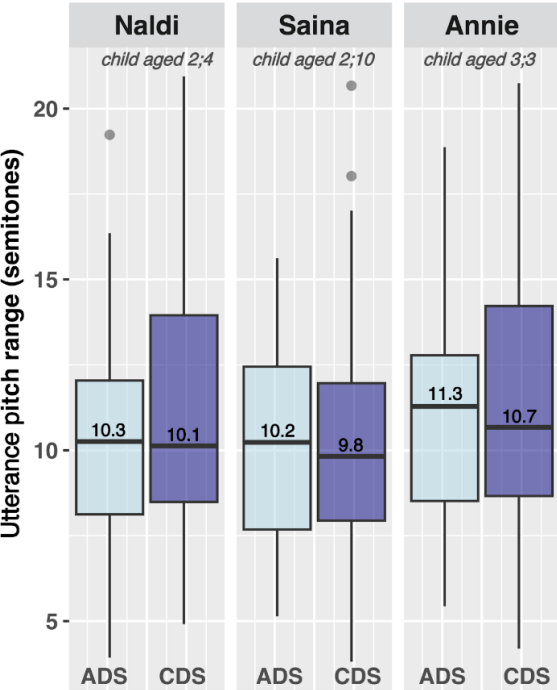**Figure 1.** *Utterance mean pitch in Ku Waru ADS and CDS.*



**Figure 2.** *Utterance pitch range for Ku Waru ADS and CDS.*

**Pitch Range in Ku Waru CDS.** To examine potential differences in pitch range between CDS and ADS in Ku Waru, we extracted and compared the pitch range of the CDS and ADS datasets, shown in Figure 2. For all three speakers, the ADS median utterance pitch range was slightly greater for ADS than for CDS—a difference of 0.2 semitones (Naldi), 0.4 semitones (Saina) and 0.6 semitones (Annie), respectively. However, for all three speakers, a linear regression model showed that these differences in pitch range were not significant (estimate = 0.52; standard error = 0.40; $p$ = 0.195). While the median pitch range was slightly greater in ADS for all three speakers, it is worth pointing out that for all three speakers, the utterances with the greatest pitch ranges all occurred in CDS.

### CDS Prosody: Nungon

For CDS in Nungon, Sarvasy et al. (2022) examined mean pitch and pitch range in vowel tokens across three types of speech: a) CDS to 2-year-olds (2;2–2;9) and 3-year-olds (3;0–3;10), b) conversational ADS in native Nungon speaker pairs, and c) monologue narratives with an adult, female, non-native Nungon speaker as primary interlocutor. The results showed that pitch in these vowel tokens differed between CDS (to both 2- and 3-year-olds) and conversational ADS, such that both men and women used higher mean pitch and an increased pitch range in CDS than in ADS. Women's and men's use of pitch differed only in the monologual recordings with the non-native Nungon speaker as interlocutor; that was where women showed the greatest mean pitch, even higher than in CDS, while men's highest mean pitch was in CDS, followed by the monologues, then by conversational ADS. Women's pitch range in the monologues was similar to the range in their CDS, and these were both higher than the range in conversational ADS; men's pitch range was greatest in CDS, while their ranges in conversational ADS and the monologues were similar. This suggests that, in terms of pitch, Nungon-speaking men treat CDS in a different way than either conversational ADS or more performative monologue recording sessions, while for women, the monologue recording sessions were akin to CDS and even elicited a higher mean pitch than CDS (see Sarvasy et al., 2022, for a more detailed discussion).

### Comparative CDS Prosody Summary

Our knowledge of mean pitch and pitch range in Ku Waru and Nungon CDS stems from two different methodological approaches. The new Ku Waru study we present here follows Frye (2022) in using the utterance as the unit for pitch analyses, while Sarvasy et al. (2022) used individual vowels as the unit of analysis. The ADS data used as a counterpart to CDS for Ku Waru here stem from not free conversations, but interviews with a foreign, non-Ku Waru speaker and Ku Waru-speaking interpreter;

they are thus imperfect counterparts to the Ku Waru conversational CDS. The conversational ADS data used by Sarvasy et al. (2022) are dyadic conversations in Nungon; Sarvasy et al. (2022) also, however, examined a second type of ADS: monologues recorded with a non-native Nungon speaker as primary interlocutor.

Our results also differ in that Sarvasy et al. (2022) found Nungon corroboration for the cross-linguistic tendency for CDS to feature both higher mean pitch and greater pitch range than conversational ADS, while the present analyses of Ku Waru CDS and ADS show significantly higher mean pitch in CDS for only one of three speakers, and no significant difference in pitch range between CDS and ADS for any of the speakers. The study on Nungon by Sarvasy et al. (2022) suggests that non-conversational ADS, especially with a non-native speaker present, may exhibit higher pitch than conversational ADS, and (for Nungon-speaking women, but not men) greater pitch range. Thus, it would be ideal to investigate mean pitch and pitch range in Ku Waru CDS using truly conversational ADS samples in the future.

## Phonology

Along with prosody, phonetic and phonological adjustments in CDS can be highly salient and are well-attested cross-linguistically. Widely attested modifications include many that make CDS sound similar to early child productions: consonant substitutions, consonant cluster reductions, long-distance consonant assimilation (or "consonant harmony"), and an abundance of CVCV-structure words (Cruttenden, 1994). Some voice-onset time (VOT) modifications in CDS have been shown to reduce the acoustic contrast between two phonemes, as in Swedish (Sundberg & Lacerda, 1999), perhaps again, approximating child productions. Another type of attested modifications does not necessarily make CDS sound child-like: instead, they have been hypothesized to have a didactic purpose and serve to scaffold language acquisition. Among these are voice-onset time (VOT) modifications that serve to accentuate phonemic differences in Hakka and English CDS (Cheng, 2014, Cristia, 2010, Moslin, 1979), and vowel hyper-articulation (Sarvasy et al., 2022).

The reduction in CDS of phonemic contrasts between consonants is not universal, but it is well-attested, cross-linguistically. Recent research has shown reduced acoustic contrast in CDS for the four-way voicing distinction in Nepali stops in CDS to 10–18-month-old children (Benders et al., 2019), and for sibilants in Danish CDS to 19–20-month-old children (Bohn, 2013). Further systematic modification of consonants in CDS relative to ADS is attested for languages in Australia: Arandic (Turpin et al., 2014) and Warlpiri (Laughren, 1984). In fact, the CDS register for those languages has been analyzed as involving reduced phonological contrasts and co-occurrences, and a smaller phonological inventory, than ADS. Turpin et al. (2014, p. 51) report that Arandic adults describe the CDS register as mimicking the way children speak. Indeed, Turpin and colleagues distinguish two phases of Arandic CDS, "early" and "late," each

with distinct phonological patterns; the early phase has the most neutralization of phonological contrasts, and its phoneme inventory can be represented as a set of nine segments—much reduced from the full 27 of Arandic ADS (Turpin et al., 2014, pp. 56–57). Some contrasts, such as between lamino-palatal and lamino-dental sounds, are neutralized in both phases of the Arandic CDS register.

For vowels, multiple studies have shown that the triangle in acoustic space formed by the three cardinal vowels /i/, /u/ and /a/ is larger in CDS than in ADS; this has been shown to be the case for, among others, American, Australian and British English (Burnham et al., 2002; Kuhl et al., 1997; Uther et al., 2007; but see Green et al., 2010), Mandarin (Liu et al., 2003), Spanish (García-Sierra et al., 2021), Swedish (Kuhl et al., 1997; but see Van de Weijer, 2001), and Japanese (Andruski et al., 1999; but see Martin et al., 2015; Miyazawa et al., 2017). There is some debate as to whether this should be considered "hyper-articulation," with the presumed aim of being understood and/or teaching correct speech sounds, or whether it stems from some other factors (Cristia, 2013; Cristia & Seidl, 2014). Indeed, the opposite—smaller vowel triangles in CDS, compared to ADS, or "hypo-articulation"—has been found for CDS in some other languages, such as Cantonese (Rattanasone et al., 2013), Dutch (Benders, 2013), German (Audibert & Falk, 2018), and Norwegian (Englund & Behne, 2006).

Here, we will focus on contrast reduction among consonants in Ku Waru CDS (making CDS sound more child-like) and show that Nungon CDS has an absence of vowel hyper-articulation (so lacks this presumably didactic element). We summarize our previous work in this area, which happened to differ in foci between Ku Waru (consonants) and Nungon (vowels).

**CDS Phonology: Ku Waru**

Our discussion of Ku Waru CDS phonology focuses on key consonants that have markedly different realizations in CDS than in ADS, namely the palatal consonants /ny/ and /ly/ in relation to apico-alveolar counterparts, the lateral consonants, and the apico-alveolar rhotic tap/trill /r/. The Ku Waru phonemic consonant inventory (ADS) is shown in Table 1. Characters shown without brackets are the ones used in the practical orthography for Ku Waru in this article. Accompanying some of the characters, in square brackets, are phonetic representations of the main allophones of the corresponding phonemes, with the most frequently occurring ones on the left.

In Ku Waru CDS, we see a general pattern by which sounds with various places of articulation are replaced by counterparts with an alveolar place of articulation, especially: palatals and velars, as well as the post-alveolar retroflex flap.

**Table 1.** *Ku Waru phonemic consonant inventory*

**Stops, glides and rhotic consonants**

|  | Labial | Alveolar | Palatal | Velar |
|---|---|---|---|---|
| Plain stop | p | t |  | k |
| Fricative |  | s |  |  |
| Prenasalized stop | b [mb], [mp] | d [nd], [nt] | j [ɲd͡ʒ] | g [ŋg] |
| Nasal | m | n | ny [ɲ] | ng [ŋ] |
| Continuant | w |  | y |  |
| Rhotic |  | r [ɾ], [r] |  |  |

**Lateral consonants**

|  | Post-alveolar retroflex flap | Alveolar continuant | Palatal continuant | Prestopped velar |
|---|---|---|---|---|
| Lateral | rlt [ɭ̆] | l | ly [ʎ], [ʎ̥] | gl [ᶢʟ], [ᵏʟ̥] |

*Nasals*

Until the age of about 3;0, Ku Waru-speaking children do not produce distinct forms for the palatal and alveolar nasals. Instead, they pronounce the palatal nasals as alveolar ones. Adults sometimes do likewise when talking to young children. Examples of this are shown in Table 2.

**Table 2.** *Examples of replacement of Ku Waru palatal nasal consonants by alveolars in the speech of young children's speech and in some CDS by adults*

| Phonemic form | Adult pronunciation | Children's form and occasional CDS form | Meaning |
|---|---|---|---|
| nyim | [ɲɪm] | [nɪm] | he/she said |
| manya | [maɲʌ] | [manʌ] | down |

*Laterals*

Just as with nasals, until the age of about 3;0, Ku Waru-speaking children do not produce distinct forms for the palatal and alveolar laterals, instead pronouncing the palatal nasals as alveolar ones. And as with nasals, adults sometimes do likewise when talking to young children. Examples are shown are in Table 3.

Of the four Ku Waru lateral consonants, the typologically unusual and phonetically complex velar lateral /gl/ is the most frequently occurring lateral consonant (Rumsey,

2017). The alveolar /l/ appears to have come into the phonemic inventory of adult Ku Waru only since the arrival into the region of the pidgin-cum-creole Tok Pisin, after the 1930s. This is evident from the fact that in Ku Waru ADS this sound only occurs in loan words from Tok Pisin. A minimal quadruplet exists in which the four lateral consonants contrast in word-medial position (*korlta* [koɭʌ] 'chicken' / *kolya* [koʎʌ] 'place' / *kogla* [koᶢʟʌ] 'cry' / *kola* [kolʌ] 'cola drink'), and other near-minimal contrasting forms exist.

**Table 3.** *Examples of replacement of Ku Waru palatal lateral consonants by alveolars in the speech of young children's speech and in some CDS by adults*

| Phonemic form | Adult pronunciation | Children's form and occasional CDS form | Meaning |
|---|---|---|---|
| lyim | [ʎɪm] | [lɪm] | he/she took |
| ilyi | [ɪʎi] | [ɪli] | this |
| paly | [paʎ̥] | [pal] | all |

Although alveolar /l/ does not occur in the adult Ku Waru lexicon in non-loan words, children use it in place of /gl/ and /lk/, and so do some adults in their CDS, as seen in Table 4.

**Table 4.** *Examples of replacement of Ku Waru pre-stopped velar lateral consonant by alveolar lateral in the speech of young children and in some CDS*

| Phonemic form | Adult pronunciation | Children's form and occasional CDS form | Meaning |
|---|---|---|---|
| ogla | [oᶢʟʌ] | [olʌ] | up |
| manya mogla | [maɲʌ moᶢʟʌ] | [manʌ molʌ] | sit down! |
| mogl | [moᵏʟ̥] | [mol] | no |

Most children do not produce adult-like versions of the [ᶢʟ]/[ᵏʟ̥] sound until they are 5–6 years old. In the meantime, as alternative pronunciations of it they use not only [l] as shown above, but also [k], [g] and [t], and later [ɣ] and [x]. Interestingly, adults and older children when speaking to children in our corpus never use [k], [g], [ɣ], or [x] as imitative baby-talk realizations of [ᶢʟ], only [t] and, far more often, [l].

*Rhotic Tap/Trill*

Up until the age of 2;6–3;0, Ku Waru-speaking children and some adults in their CDS use alveolar [l] in place of /r/ (replacement of rhotics by laterals, stops and glides is widely attested in child speech, cross-linguistically; Tomić & Mildner, 2015). Examples are in Table 5.

**Table 5.** *Examples of replacement of Ku Waru rhotic [r] with alveolar lateral [l] in the speech of young children and in some CDS by adults*

| Phonemic form | Adult pronunciation | Children's form and occasional CDS form | Meaning |
|---|---|---|---|
| rais | [rais] | [lais] ~ [lait] ~ [las] | rice |
| kera | [kerʌ] | [kelʌ] | bird |
| kar | [kar] | [kal] | motor vehicle |

Alternatively, intervocalic /r/ is sometimes pronounced as [t] in the speech of Ku Waru children and in some CDS. An example is [utu] for *uru* 'sleep'.

*Alveolar Consonants in Place of Velars*

As is widely attested in child-language studies around the world (McAllister Byun, 2012), especially before about 2;6, Ku Waru children sometimes use alveolar consonants in place of velar ones, and so do some adults in their CDS. Examples are in Table 6.

**Table 6.** *Examples of replacement of Ku Waru velar consonants with alveolars in the speech of young children and in some CDS*

| Phonemic form | Adult pronunciation | Children's form and occasional CDS form | Meaning |
|---|---|---|---|
| ga | [ŋga] | [da] ~ [nda] | sweet potato |
| kim | [kim] | [tim] | a girl's name |
| le | [ᵍʟe] | [te] | excrement |

In this section we have presented examples of six consonant mutations that sometimes occur in Ku Waru CDS: ɲ > n, ʎ/ʎ̥ > l, ᵍʟ/ᵏʟ̥ > l, r > l and r > t, and velars > alveolars. It is striking that all of these mutations involve replacement of sounds with other places of articulation by alveolar sounds. In the Lexicon section, we will compare that

set of mutations with the ones that are observed within a set of what 11 Ku Waru parents identify as baby-talk lexical items (*kang kel-nga ung-ma* 'words of or for small children').

**CDS Phonology: Nungon**

We will briefly summarize generalizations about consonants in Nungon CDS, then sum up what we know about Nungon CDS vowel phonetics.

### Nungon CDS Consonants

In Nungon CDS, consonant replacement is attested, and at least one baby-talk lexical item involves a non-phonemic sound (cf. Manambu extra-phonemic bilabial trill in one baby-talk term; Aikhenvald, 2008, p. 44).

In the Kotet Nungon dialect, word- and syllable-final /k/ are realized as glottal stops, and there is no rhotic, such that the counterpart to /r/ in this dialect is /l/ or /d/. The Nungon child–caregiver conversation data all come from the Towet village dialect, which lacks a glottal stop and lateral /l/, except in inter-dialect loans, like the flowering tree name *longgö longgö*. Speakers of Towet Nungon sometimes say that the Kotet dialect, with /l/ instead of /r/ and with the glottal stop for /k/ sounds "childish," and in fact, CDS and CS (child speech) in Towet Nungon optionally exhibit both of these features (Sarvasy, 2019). Towet adults sometimes replace word- and syllable-final /k/ with glottal stops, and /r/ with /l/ or the palatal glide /y/, when speaking to small children. This is widely attested in the Towet Nungon child–caregiver corpus, but its use has not yet been investigated systematically to find, for example, correlations between these features in the children's speech and their occurrence in CDS.

In the Lexicon section, we will see that the Nungon baby-talk lexicon includes at least one word with a non-phonemic sound: baby-talk [ɣɪ] 'pitpit', 'wild sugar cane' (counterpart to adult *dee*) begins with a voiced velar fricative, which never occurs word-initially in adult Nungon, where it is solely an intervocalic allophone of velar stops (Sarvasy, 2017).

### Nungon CDS Vowels

Towet Nungon has six phonemic vowels (two front, three back, and one low-mid) and contrastive vowel length. For instance, *yo-nga* [jɔ.ŋa] means 'speaking,' but *yoo-nga* [jɔː.ŋa] means 'taking them.' The acoustics of the six phonemic vowels in Towet Nungon adult speech were investigated in Sarvasy (2017) and then with a more detailed, quantitative treatment in Sarvasy et al. (2020).

Sarvasy et al. (2022) investigated whether Towet Nungon vowels in CDS are hyper-articulated relative to those in adult–adult paired conversations, and adult monologues produced with a non-native (researcher) primary interlocutor. Vowel tokens were extracted from three datasets: child–caregiver conversations (10 speakers, five men and five women: 1,580 vowel tokens), adult dyadic conversations (eight speakers, four men and four women: 718 vowel tokens), and adult monologue narratives (eight speakers, five women and three men: 1,507 vowel tokens). Four speakers (two men and two women) featured in all three datasets, while seven (three women and four men) featured in both child–caregiver and adult dyadic conversations, and five (two women and three men) featured in both the child–caregiver and adult monologue narratives.
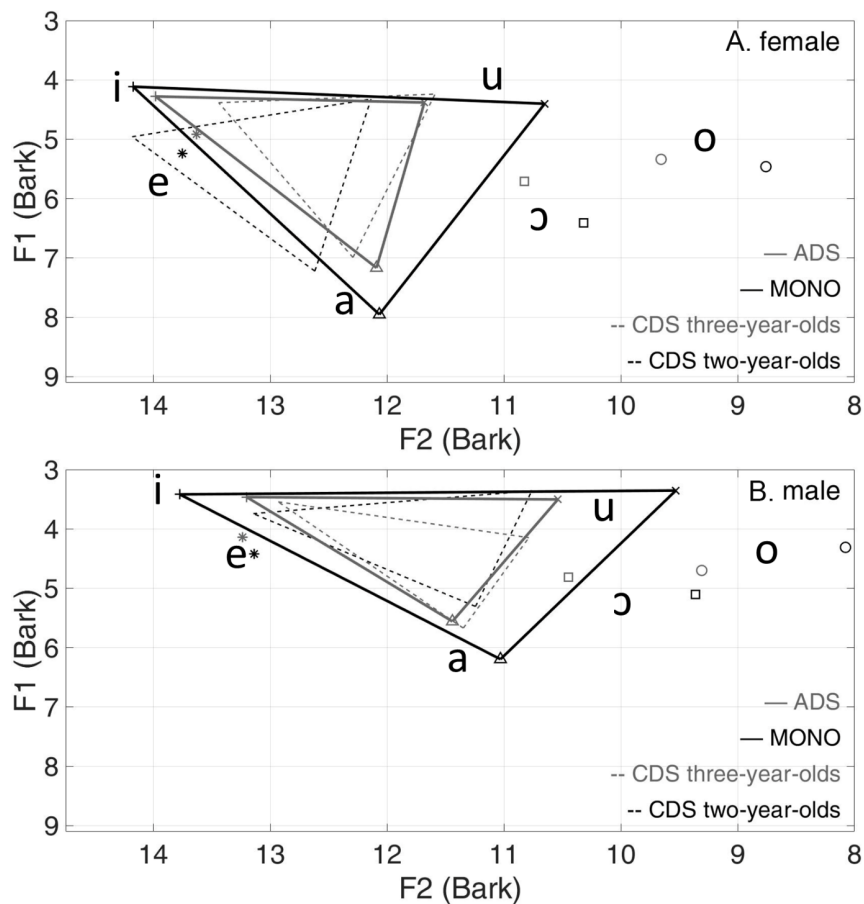


**Figure 3.** *Vowel triangles for Nungon CDS to 2-year-olds and 3-year-olds, conversational ADS, and monologues with a non-native speaker interlocutor (Sarvasy et al., 2022, p. 12).*

We assessed vowel hyper-articulation using the "vowel triangle" technique, by which the area of the triangle formed by connecting the vowels /i/, /u/ and /a/ in an F1/F2

acoustic space graph is calculated (following García-Sierra et al., 2021). These triangles are shown in Figure 3.

There was no significant difference in vowel triangle size between CDS (to either 2-year-olds or 3-year-olds) and the adult–adult paired conversations (which we took to exemplify conversational ADS), but the vowel triangles in the monologues with a foreign, non-native Nungon speaker as primarily interlocutor/recorder were significantly larger than those of both CDS and conversational ADS (Sarvasy et al., 2022). Thus, Towet Nungon CDS to children aged two and three does not feature vowel hyper-articulation relative to conversational ADS.

We found that only one feature, vowel duration, differed in CDS directed to 2-year-olds versus CDS directed to 3-year-olds. That is, both men and women produced vowels of longer duration when speaking to 2-year-olds than they did when speaking to 3-year-olds and other local adults. The vowel durations in the ADS monologues were similar to those in the CDS to the 3-year-olds.

**CDS Phonology Comparative Summary**

We have seen that in both Ku Waru and Nungon, there is some alteration of consonants in CDS that makes them closer to the productions of small children. In Ku Waru, this even entails substituting a non-native Ku Waru phoneme, the alveolar [l] (found in adult speech only in Tok Pisin loan words), for all three other Ku Waru lateral phonemes (retroflex, palatal and pre-stopped velar). The Ku Waru consonant replacements we discussed generally involve use of alveolar sounds instead of sounds with other places of articulation: palatals to alveolars, velars to alveolars, the rhotic to alveolar lateral or stop, and the reduction of contrasts among laterals such that the alveolar lateral is used in place of the others. In contrast, in Nungon CDS of Towet village, while the alveolar lateral is one of the common replacements for the rhotic, the replacement of velar oral or nasal stops by alveolar ones is unattested in Nungon CDS. Towet Nungon CDS further exhibits a consonant replacement unattested in Ku Waru CDS: the replacement of word-final /k/ with glottal stops. This shows clearly that, while there are cross-linguistic patterns, the specifics of consonant replacement in CDS are necessarily language-specific.

We also saw that in Nungon CDS, vowels are not hyper-articulated relative to conversational ADS. Instead, monologues directed at a non-native Nungon speaking interlocutor did feature vowel hyper-articulation. A Ku Waru vowel acoustics study remains a desideratum for future research.

**Lexicon**

A central aspect of children's early language development is the acquisition of the core lexicon of their language. CDS figures in that process in various ways (Clark, 1993)—for example, through particular CDS distributions of vocabulary that differ from those in ADS. Here, our treatment will be limited to "nursery" or "baby-talk" lexical items that are used mainly or entirely in children's speech and in adults' CDS.

One of the most striking features of CDS in many languages is the presence of special "nursery" or "baby-talk" words used only when speaking to children and by children themselves, most of which have different ADS counterparts. An example in English is baby-talk *tummy* for ADS *stomach.* Baby-talk lexical items can be found in languages as typologically and geographically diverse as Romāni (Réger & Gleason, 1991), Inuktitut (Crago & Allen, 1997) and Japanese (Mazuka et al., 2008), among many others. Ferguson (1964, 1977) and then Haynes and Cooper (1986) surveyed reports on selected languages from around the world and found that most had special baby-talk lexicons. But Ferguson's sample included no Pacific languages, and Haynes and Cooper's (1986) included only one of them (the Oceanic language Palauan)—a severe under-representation, given that about a quarter of the world's languages are spoken in the region.

Languages of Oceania still remain greatly underrepresented in child language studies, but it was from one of them—Kaluli—that the first strong challenge to the universality of baby-talk lexicons emerged. One of Schieffelin's findings was that "Kaluli use no baby-talk lexicon, for they said (when I asked about it) that to do so would result in a child sounding babyish, which was clearly undesirable and counterproductive" (Ochs & Schieffelin, 1984, p. 293). That finding has been widely cited as a counterexample to the presumed universality of baby-talk lexicons. However, a less-cited point is that an extensive set of baby-talk lexical items was described for a neighboring language, Huli (Goldman, 1986, 1991).

Before we turn to our own new data on baby-talk lexical items in Ku Waru and Nungon CDS, we note that our methodology expands on that of Ferguson (1977) and Haynes and Cooper (1986), which primarily used word lists, without noting variation or frequency in actual CDS. We present word lists along with frequencies in corpora, following Crago and Allen (1997) on Inuktitut, Réger and Gleason (1991) on Romāni, and Ota et al. (2018; see also Ota & Skarabela, 2016, 2018) on English.

**CDS Lexicon: Ku Waru**

Unlike Schieffelin's (1990) report for Kaluli, Rumsey and Onga have found that every Ku Waru speaking adult or older child whom they have asked about the matter says

that there are distinct words that are used by and to small children and has readily provided examples of what they consider to be such words. Further, again unlike the Kaluli, Ku Waru people say it is good for parents to use those words to small children sometimes, "to help them understand and learn to talk". In order to investigate these local understandings of CDS systematically, Onga interviewed 11 Ku Waru-speaking parents about them. Speaking to the parents in Ku Waru, he asked them the equivalent of the following questions:

1. Do small children have their own ways of talking that are different from adults'?
2. If they do, what do you call their way of talking?
3. What words of that kind can you think of?
4. Do adults and older children sometimes use those same words when talking to small children?
5. If they do, why?
6. Is it good or bad for them to do that?
7. Why?

All 11 interviewees answered yes to question 1. The most frequent answer to question 2 was *kangabola kel-ma-nga ung-ma,* which can be translated either as 'small children's words' or 'words for small children' (hereafter "baby-talk" or "BT"). When asked for examples of such words, as in question 3, all interviewees readily provided them, in sets containing from 11 to 17 items, with a median of 13. All of the words that were included in any of those sets are shown in the leftmost column of Table 7, along with what was said to be the equivalent Ku Waru adult word in column 2, and our English gloss of it in column 3. Column 4 shows the number of lists on which each of the words was included. That number can be taken as a rough measure of the extent to which the form in question figures in Ku Waru people's shared understandings or stereotypes about how small children talk, and how others talk to them.

Whereas columns 1–4 provide information about what Ku Waru adult caregivers take to be typical of baby-talk, columns 5–8 provide information about the extent to which the actual adult CDS in the Ku Waru child–caregiver interaction corpus includes those words (for this purpose, individuals over the age of ten were treated as adults). For interpreting the figures in columns 6 and 7, it is important to take account of the fact that the children represented in the corpus did not talk as much as the adults. Rather, out of a total of 1,365,614 word tokens in the corpus, 469,820, or about 34.4%, were spoken by children, while 895,798, or about 65.6%, were spoken by adults. In order to take account of that difference, a weighting of 1.907 was assigned to the numbers in column 7 to compute the weighted ratio of baby-talk word tokens spoken by adults vs. children in column 8.

**Table 7.** *Forms identified by Ku Waru parents as "small children's words" and their frequency of use by children and their adult interlocutors in our corpus*

| Baby-talk form | Adult word in Ku Waru | English gloss | No. of parental BT word lists that contain the BT word | Tokens of BT word in the corpus | Tokens of BT word by adults in CDS | Tokens of BT word by children | Weighted ratio of incidence of BT word in CDS vs. children's speech (in %) |
|---|---|---|---|---|---|---|---|
| *da* | *ga* | sweet potato | 6 | 4 | 3 | 1 | 61–39 |
| *pipi* | *kera* | bird | 6 | 230 | 142 | 88 | 46–54 |
| *dit/det* | *kar* | car/truck | 5 | 112 | 63 | 49 | 40–60 |
| *lais/lait/las* | *rais* | rice | 5 | 43 | 3 | 40 | 4–96 |
| *tali/talip* | *kalyip* | peanut | 5 | 0 | 0 | 0 | NA |
| *neta* | *neka* | red pandanus | 4 | 0 | 0 | 0 | NA |
| *balut/palut* | *balus* | plane | 3 | 7 | 0 | 7 | 0–100 |
| *tenapa* | *kenapa* | corn | 3 | 0 | 0 | 0 | NA |
| *tim/timu* | *kim/kimu* | green vegetable | 3 | 3 | 2 | 1 | 51–49 |
| *yayi* | *kuru* | evil spirit / devil | 3 | 1028 | 668 | 360 | 49–51 |
| *gu* | *lku* | house | 2 | 382 | 2 | 380 | 0–100 |
| *kal* | *kar* | car/truck | 2 | 94 | 12 | 82 | 7–93 |
| *kela* | *kera* | bird | 2 | 83 | 9 | 74 | 6–94 |
| *lawa* | *plawa* | flour/flower | 2 | 5 | 1 | 4 | 12–88 |
| *nela* | *neka* | red pandanus | 2 | 0 | 0 | 0 | NA |
| *pawa* | *flawa* | flour/flower | 2 | 42 | 3 | 39 | 4–96 |
| *tait* | *rais* | rice | 2 | 0 | 0 | 0 | NA |
| *te* | *gle* | excreta | 2 | 5 | 2 | 3 | 26–74 |
| *toti* | *sosis* | sausage | 2 | 0 | 0 | 0 | NA |
| *tu* | *ku* | money/stone | 2 | 0 | 0 | 0 | NA |
| *tun* | *kung* | pig | 2 | 4 | 0 | 4 | 0–100 |
| *ulu* | *uru* | sleep | 2 | 1 | 0 | 1 | 0–100 |
| *utu* | *uru* | sleep | 2 | 113 | 82 | 31 | 58–42 |
| *bil* | *bi* | pen/pencil | 1 | 4 | 4 | 0 | 100–0 |
| *deti* | *tata/lapa* | father | 1 | 144 | 69 | 75 | 40–60 |
| *lu* | *lku* | house | 1 | 19 | 5 | 14 | 16–84 |

| Baby-talk form | Adult word in Ku Waru | English gloss | No. of parental BT word lists that contain the BT word | Tokens of BT word in the corpus | Tokens of BT word by adults in CDS | Tokens of BT word by children | Weighted ratio of incidence of BT word in CDS vs. children's speech (in %) |
|---|---|---|---|---|---|---|---|
| *miyau* | *lopa pus* | cat | 1 | 32 | 20 | 13 | 45–55 |
| *mun mun* | *kalyimbi* | moon | 1 | 0 | 0 | 0 | NA |
| *nana* | --- | small/cute/baby thing | 1 | 2514 | 1671 | 843 | 51–49 |
| *nunu* | *keri to- no-* | kiss | 1 | 34 | 29 | 5 | 75–25 |
| *pepe* | *pekpek* | excreta | 1 | 49 | 32 | 17 | 50–50 |
| *pola* | *pora* | finish | 1 | 14 | 5 | 9 | 23–77 |
| *tera* | *kera* | bird | 1 | 0 | 0 | 0 | NA |
| *wala* | *wara* | water | 1 | 117 | 78 | 39 | 51–49 |

The following points are evident from the data in Table 7:

1. There were considerable differences among the 11 parents as to which words they cited in the interviews as typical baby-talk ones. Nonetheless, a clear majority of the words cited by any of the parents (24/34) were cited by at least one other parent.
2. There is a disparity between the frequency with which the interviewees cite given words as typical baby-talk and how often those words actually occur in the corpus, either within adults' speech or the children's. The most extreme examples of this are: *da* for *ga* 'sweet potato,' which was cited by six of the 11 parents but only occurs four times in the corpus; *tali* or *talip* for *kalyip*, 'peanut,' cited by five parents, which never occurs in the corpus; and *neta* for *neka* 'red pandanus,' cited by five of the parents, which also never occurs in the corpus. This disparity is probably related to the fact that the substitution of alveolar stops for velar stops occurs mainly in CDS to children under about 2;6, whereas a large majority of our samples are from interactions with older children.
3. Conversely, several of the most frequently occurring words in Table 7 are among those cited by a small minority of the interviewees. Examples are the following, each of which was offered as baby-talk by only one of the 11 parents: *pepe* for *pekpek*, 'excreta' (Tok Pisin), with 49 instances; *wala* for *wara* 'water' (Tok Pisin), with 117 instances, *deti* (Tok Pisin) for *tata* or *glapa* 'father', with 144 instances; and *nana* 'small/cute/baby thing', with a whopping 2514 instances. For *pepe, wala,* and *deti*, it is possible that most interviewees declined to list these because they are based on

Tok Pisin words (*pekpek, wara* and *dedi*). Consistent with the parents' characterization of the words listed in the table (as used both by small children and by adults when speaking to them), among the 25 words with any attested instances in the corpus, all but three (*balut* 'plane,' *tun* 'pig,' and *ulu* 'sleep') are used by both children and their adult interlocutors.

4. There are wide disparities in the weighted ratios of uses of putative baby-talk words by children *vs.* their use by the adult interlocutors. This variation occurs in both directions, with some of those words being used far more often by the children and some by the adults. For the words that occur only a few times in the corpus, this variation is not significant. So, limiting the count to the putative baby-talk words that occur ten or more times in the corpus, we can see the adult-to-child usage ratio ranges from 75–25 for *nunu* 'kiss' (n=34) to .03/99.7 (rounded to 0/100 in the table) for *gu* 'house' (n=382).

5. In the Phonology section, we discussed six consonant mutations that have been observed in Ku Waru CDS: ɲ > n, ʎ/ʎ̥ > l, ᵍ͡L/ᵏ͡L̥ > l, r > l, r > t, and velar stops > alveolar stops. Only four of those six mutations are present among the items provided by the interviewees: ʎ/ʎ̥ > l (*tali* 'peanut'), r > l (*kal* 'car,' *kela* 'bird,' *ulu* 'sleep,' *wala* 'water'), r > t (*tait* 'rice,' *utu* 'sleep') , and velar stops > alveolar stops (*da* 'sweet potato,' *tali* 'peanut,' *neta* 'red pandanus,' *tenapa* 'corn,' *tim* 'green vegetable,' *te* 'excreta,' *tera* 'bird,' *tu* 'money/stone,' *tun* 'pig').

6. Although we are discussing Ku Waru CDS phonology and lexicon in separate sections in this paper, some of the items in Table 7 suggest that the distinction between the two is better seen as a cline rather than a categorical difference. As shown in the Phonology section, parents are aware of the systematic differences between children's pronunciation of a wide range of Ku Waru consonants and that of adults and sometimes match their pronunciation of those consonants to that of children.

The data above exhibit a disparity between what a community may acknowledge as appropriate words to use with children and actual practice. In the Ku Waru case, there is extreme variability in the extent to which adults identify and use baby-talk forms. We also note the absence of ɲ > n or ᵍ͡L/ᵏ͡L̥ > l mutations among the words cited by the interviewees. But there are also many differences that Ku Waru parents *are* aware of, and these play a part, both in how they speak to children, and in the lexical items they point to as stereotypic instances of it, or CDS shibboleths.

**CDS Lexicon: Nungon**

In her first nine months of immersion fieldwork on Nungon grammar, Sarvasy (2017) found that adults agreed widely that there were baby-talk lexical items in Nungon. As reported further in Sarvasy (2019), these have varying word classes, origins, and semantics. A partial list is in Table 8.

**Table 8.** *A selection of Nungon baby-talk lexical items with adult counterparts*

| Baby-talk form | Adult word (Towet Nungon) | English gloss | Origin of baby-talk form |
|---|---|---|---|
| *bui* | *hup* | chicken | the call by which Nungon speakers summon chickens |
| *buu* | *yup* (Nungon), *barus* (Tok Pisin) | airplane | onomatopoeia |
| *dada* | *dat* | (older) sibling | phonological modification |
| *dudu* | *murong* | genitals | unknown |
| *ede* | *dogu* | ghost, spirit | unknown |
| *mama* | *mak* | mother | phonological modification |
| *nana* | *tanak* | food | modification |
| [ɣɪ] | *dee* | pitpit | unknown |
| *nauk* | *yamuk* | water | phonological modification |
| *nou=ma* | *unom=ma* | bogeyman | phonological modification |
| *nunu* | *i-no-ng yo-* | kiss | unknown |
| *papa* | *nan* | father | Tok Pisin? |
| *tutu* | *mum* | breast(milk) | Tok Pisin? |
| *adö* | *amök* | sit | phonological modification |
| *aing* | *yii-* | bite | onomatopoeia? |
| *dai* | *duo-* | sleep | Tok Pisin? |
| *ding!* | *di-* | burn/danger | Co-opting of existing (ADS) form |
| *hoit* | *honggit-* | grab | phonological modification |
| *pait* | *emo-* | fight | Tok Pisin |
| *purik* | *iwan-* | turn | unknown |
| *toik* | *towi-* | fix | phonological modification |

Of the Nungon baby-talk forms in Table 8, some, like those for 'water,' 'food,' 'airplane,' etc. are used as nouns. Others, like 'bogeyman' and 'genitals,' can be used somewhat like adjectives, indicating that something is related or suggestive of a bogeyman, or that someone is revealing their genitals. These functions are not also found with the adult counterparts; for instance, the adult *murong* is strictly a noun, referring to the genitals, and someone who is dressed immodestly can be called *murong-ni* 'genitals-ADJ,' not *murong* without an adjectivizer. Still others have verbs as their non-baby-talk counterparts, like those for 'turn,' 'grab,' 'sleep,' and 'bite'—but

the baby-talk forms do not inflect directly, like their non-baby-talk counterparts. Children use these as stand-alone utterances, but in CDS, these are most often used in a complex predicate construction with an auxiliary verb *to-* 'do,' as in example (1):

(1)      Aing    to-wangka-k.
            bite.BT  do-NFUT.SG-3SG
            'It will bite.' [Lit.: 'It will do biting.']

The adult way of expressing 'it will bite' requires the speaker to indicate, through an obligatory prefix on 'bite,' the person and number of the bitten argument, as in (2):

(2)      Ge-i-wangka-k.
            2SG.O-bite-NFUT.SG-3SG
            'It will bite you.'

At least two baby-talk forms do not have direct adult counterparts. When something is dangerous to touch, adults tell children *ding!* This looks like the form of the verb *di-* 'burn' that occurs in multi-verb predicates, *di-ng.* But in CDS, *ding!* is used for both very hot things and for things that could be otherwise harmful—such as stinging tree leaves (here, this appears similar to Huli; Goldman, 1986, p. 200 [1.6, 1.8]). Such a warning is not used with adults. Also, the widely used baby-talk *dada* 'sibling' is used for both same- and different-sex siblings, but in non-baby-talk, the terms *naat* 'different-sex sibling,' *oruk* 'brother of male,' and *daa* 'sister of female' are used. There is a rare non-baby-talk form *dat* 'sibling,' attested in one song, but this is not used in everyday parlance.

Children learning Nungon vary in their own use of baby-talk verbs (Sarvasy, 2023b; this remains to be investigated for baby-talk nouns). The child TO produced 1–4 tokens of baby-talk verbs in each 1-hour recording session from age 2;3 through 2;7 (she was recorded for 1 hour per month), while the child AB produced only two baby-talk verb tokens in this period with a similar recording schedule of 1 hour per month, and only in one of his five recording sessions at these ages. The child MK produced only one baby-talk verb token across all 15 1-hour recording sessions she participated in from age 2;4 through 2;7, and the child MF produced no baby-talk verb tokens in any of her six recording sessions at 2;4 and 2;5 (Sarvasy, 2023b).

This variation possibly relates to variation in use of baby-talk forms in Nungon CDS, illustrated in Table 9 (verbs) and Table 10 (nouns).

**Table 9.** *Baby-talk verb and adult counterpart token counts (adult form token counts in parentheses) in Nungon CDS*

| Child, age (# of sessions) | Parent | *aing* 'bite' (adult *yii-*) | *toik* 'arrange' (adult *towi-*) | *purik* 'turn' (adult *iwan-*) | *hoit* 'grab' (adult *honggit-*) | *adö* 'sit' (adult *amök*) | *pait* 'fight' (adult *emo-*) | *dai* 'sleep' (adult *duo-*) | *ding* 'burn' (adult *di-*) |
|---|---|---|---|---|---|---|---|---|---|
| TO, 2;4 | mother | 1 (2) | 0 (1) | 2 (0) | 2 (3) | 0 (0) | 0 (0) | 1 (0) | 0 (0) |
| TO, 2;4 | father | 1 (1) | 0 (2) | 0 (1) | 1 (15) | 0 (2) | 0 (0) | 3 (0) | 0 (0) |
| TO, 2;5 | mother | 2 (0) | 0 (0) | 0 (0) | 4 (1) | 3 (2) | 0 (0) | 1 (0) | 0 (0) |
| TO, 2;6 | mother | 0 (0) | 0 (0) | 1 (0) | 3 (1) | 0 (2) | 0 (0) | 0 (0) | 0 (0) |
| TO, 2;7 | mother | 2 (0) | 0 (2) | 3 (1) | 4 (3) | 1 (4) | 1 (0) | 0 (0) | 0 (0) |
| AB 2;4–2;7 (4 sess.) | father, mother | 0 (3) | 0 (14) | 0 (1) | 0 (13) | 0 (10) | 0 (1) | 1 (7) | 0 (1) |
| MK 2;4–2;7 (15 sess.) | father, mother | 0 (39) | 0 (30) | 0 (22) | 3 (144) | 0 (27) | 0 (0) | 0 (25) | 0 (5) |
| MF 2;4–2;5 (6 sess.) | father | 0 (23) | 0 (24) | 0 (5) | 0 (47) | 0 (26) | 0 (0) | 2 (24) | 0 (1) |

Table 9 shows the distributions of the eight baby-talk verbs from Table 8 in Nungon CDS to four children aged 2;4–2;7 (just 2;4–2;5 for MF); note that two of the verbs do not occur in CDS in this sample at all. The child TO's parents produce a range of baby-talk verb types, and multiple tokens, in each recording session at 2;4, 2;5, 2;6, and 2;7 (in the table, there is just one 1-hour session at each age; the mother's and father's tokens are separated for the session at 2;4, but this was a single session in which both parents featured). This contrasts greatly with AB's, MK's, and MF's parents when those children were of the same age; for these children, multiple sessions are represented within a single row in the table, since there are so few tokens of baby-talk verbs in these parents' CDS. (MF and MK are from a 2019 study with dense recording protocols, so these children were generally recorded for four 1-hour sessions during 1 week each month; at 2;6, MK was recorded for only three 1-hour sessions, and MF was recorded for only two sessions at age 2;5.)

While TO's parents produce at least one token of all forms except *toik* and *ding* in these sessions, the parents of AB, MK and MF are attested as producing tokens of only two different forms during this period: *hoit* and *dai*. Yet this is clearly not an artefact of the conversational content: parents of all three children produced the adult counterparts to all baby-talk verbs with generally robust token numbers except *pait* 'fight' in the speech of the parents of MK and MF

Similarly, TO's parents produced more baby-talk noun tokens than the other three children's parents in the same period, as seen in Table 10. Here, the nouns *nauk* 'water,' *buu* 'airplane,' *nana* 'food,' and *dada* 'sibling' are counted in CDS per session (for TO) and across multiple sessions in the study period (AB, MF, and MK). TO's parents

produce these multiple times per session, and in general, with higher frequency than the baby-talk verbs in Table 9.

**Table 10.** *Baby-talk noun and adult counterpart token counts (adult form token counts in parentheses) in Nungon CDS*

| Child, age (# of sessions) | Parent | *nauk* 'water' (adult *yamuk*) | *buu* 'airplane' (adult *balus*) | *nana* 'food' (adult *tanak*) | *dada* 'sibling' (adult: *naat, daa, oruk*) |
|---|---|---|---|---|---|
| TO, 2;4 | mother | 3 (6) | 3 (6) | 10 (8) | 12 (0) |
| TO, 2;4 | father | 0 (2) | 1 (5) | 2 (0) | 6 (0) |
| TO, 2;5 | mother | 2 (2) | 6 (12) | 9 (0) | 12 (0) |
| TO, 2;6 | mother | 0 (4) | 2 (0) | 2 (0) | 1 (1) |
| TO, 2;7 | mother | 10 (0) | 12 (17) | 0 (2) | 7 (4) |
| AB, 2;4–2;7 (4 sessions) | father, mother | 0 (36) | 1 (5) | 0 (1) | 10 (20) |
| MK, 2;4–2;7 (15 sessions) | father, mother | 0 (136) | 0 (108) | 1 (84) | 3 (7) |
| MF, 2;4–2;5 (6 sessions) | father | 0 (21) | 0 (11) | 0 (20) | 16 (3) |

In Table 10, baby-talk noun tokens are consistently present in CDS to TO between 2;4 and 2;7. In contrast, the other parents produce only one baby-talk token of *buu* 'airplane' and one of *nana* 'food' in the study period, with 0 tokens of *nauk*, but they all produce more tokens of the endearing kin term *dada* 'sibling' than of these other nouns. This is clearly not because they never speak of water, airplanes, or food, as indicated through the token numbers for the adult counterparts to these nouns (Table 10). It appears that the kin baby-talk term *dada* either features more heavily and widely in use in CDS than the three inanimate nouns in Table 10, and/or its use persists in CDS even when parents have stopped using baby-talk terms for inanimate objects and substances. The prevalent use of baby-talk *dada* 'sibling' is likely related to the affective implications of its use to refer to a relationship between children (reminiscent of Schieffelin's discussion of the importance of a particular sibling relationship for Kaluli children; Schieffelin, 1990).

Finally, Tables 9 and 10 show that even parents who use baby-talk verbs and nouns relatively frequently, like TO's parents, do not use these in CDS to the exclusion of adult counterparts: TO's parents generally use a combination of baby-talk terms and the adult counterparts in a single session.

**Lexicon Comparative Summary**

The new data we presented in this section show that Ku Waru CDS and Nungon CDS involve the use of special baby-talk lexical items that are recognized as such by speakers, but that distribution of these items in child–caregiver interaction corpora is

mixed. We further showed that: a) for Ku Waru, at least, there is high variability in the baby-talk terms listed by individual parents, and b) for Nungon, at least, variation in degree of use of particular baby-talk verbs and nouns is not an artefact of conversation topic.

## Morphosyntax

Cross-linguistically, utterances in CDS are expected to feature fewer errors and to be shorter and simpler than in ADS, although fine-tuning of complexity and length to children's abilities is also attested (Snow, 1995; Soderstrom, 2007). Only rarely is CDS reported to involve caregiver production of morphological forms that would be unacceptable in ADS. For instance, an Inuktitut CDS sample involved a relatively small percentage of verbs (10%) and nouns (20%) that bore no affixes; in Inuktitut ADS, all verbs and nouns always bear affixes (Crago & Allen, 1997). Here, we first focus on evidence for and against morphosyntactic fine-tuning in Ku Waru and Nungon CDS, and then on morphological and syntactic structures that would be unacceptable in ADS but are used in CDS in these languages.

### Fine-Tuning: Clause Chaining and Multi-Verb Predicates in CDS

In the first areas of morphosyntax considered here, clause chaining and multi-verb predicates, we consider whether there is evidence for fine-tuning of morphosyntactic complexity in Ku Waru and Nungon CDS to children as they develop.

Papuan languages like Ku Waru and Nungon are known for a special sentence type that is not present in the grammars of Western European languages: clause chains (Sarvasy, 2024, forthcoming; Sarvasy & Aikhenvald, 2024a, 2024b). In a clause chain, one or more clauses with verbal predicates that are under-specified for, usually, tense and often other grammatical categories, combine with a single clause, usually the last, of which the verbal predicate bears full specification for all the grammatical categories marked on the verbs of independent clauses in the language. A Ku Waru clause chain is provided in (3).

(3)  olyo   med          maket-ma-nga   **pu-p**      kalyip    baim  **te-p**
     1PL    down.there    market-PL-GEN   go-NF.1      peanut    buy   do-NF.1

     **no-b**         pilawa         **lyi-p**     **no-b**        **pu-mulu**
     eat-NF.1       flour.balls   get-NF.1   eat-NF.1     go-FUT.1PL

     'We'll go down to the markets and buy peanuts and eat them and get some flour balls and eat them and then we'll go.' [Lit.: 'As for us, going down to the markets, buying peanuts, eating (them), getting flour balls, eating (them), we will go (away again).'] (Rumsey et al., 2020, p. 4)

Example (3) is a clause chain sentence containing six clauses (in this clause chain, three of the clauses, *no-b, no-b,* and *pu-mulu,* comprise just a verbal predicate, with no explicit arguments). All of the clauses except the last one have a verbal predicate that lacks tense and subject number marking and bears only the first-person "non-final" verb suffix *-p/-b.* Only the last clause, *pu-mulu* 'we will go,' could function as an independent clause; *pu-mulu* bears inflection for future tense and for plural number as well as first person; these categories are understood to apply to the entire preceding clause chain.

In both Ku Waru and Nungon, clause chains contain a further fascinating feature: "switch-reference marking" (Haiman & Munro, 1983). With switch-reference marking, the non-final (also called "medial") verbal predicates in clause chains must be marked in a binary fashion according to whether the subject of the upcoming clause will be co-referential with the subject of the present clause, or not. This is illustrated in (4a) and (4b), two short Nungon clause chains addressed to TO, 2;7:

(4a) o       babiya-ya        ngo     **to-nga**              babiya    bög-in
     CONJ book-2SG.POSS    PROX    SG.O.take-MV.SS    book        house-LOC

     **ong-i-roc-ma**    ngo.
     go-IRR-2SG-RF     PROX

     'And taking this book of yours, you will go to school, here.'
     (Mother to TO, 2;7, activity: teasing)

(4b) ogo                      nungon  **na-una**      **aa-ha-rok**?
     SAME.LEVEL.NEAR what        eat-DS.3SG   see-PRES.SG-2SG
     'Over there, it having eaten what, do you see it?'
     (Mother to TO, 2;7, activity: looking at a picturebook)

Both (4a) and (4b) are minimal clause chains of just two clauses: the non-final clause with verbal predicate that lacks tense marking, and the final clause with verbal predicate bearing full specification for tense and subject information. But the verbal predicate of the non-final clause in (4a), *to-nga,* is marked for "same-subject," since its (unstated) subject, 2SG, is shared by the following, final clause. In contrast, the verbal predicate of the non-final clause in (4b), *na-una,* is marked for "different-subject," since its (unstated) subject (a crocodile pictured in a book) differs from the subject of the following clause, 2SG.

We are beginning to know more about how clause chaining features in CDS in languages that have this sentence type (Sarvasy & Choi, 2020a, 2020b), and data from Ku Waru and Nungon have played a central role in this recent expansion in knowledge, along with Japanese (Clancy, 2020, 2024), Korean (Choi, 2020, forthcoming; Sarvasy & Choi, 2024), and Turkish (Aksu-Koç & Ögel-Balaban, 2020, 2024). Clause chains are

robustly present in CDS, like discourse more generally, in clause chaining languages; in Korean and Nungon CDS, for instance, the non-final clause types used in clause chains are consistently more frequent than other non-independent clause types, like relative or complement clauses (Sarvasy & Choi, 2024).

Clause chains contain multiple verbs, and these are predicates of different clauses within the chains, hence clause chains are complex, multi-clause sentences. Another type of complex morphosyntactic structure involving multiple verbs that is common in languages of PNG involves a single clause with a complex predicate. This is the multi-verb predicate, which encompasses both the more narrowly defined "serial verb construction," which cannot contain any markers of dependence on the verbs in it (Aikhenvald, 2018) and, more broadly, any predicate type that contains more than one verb (Sarvasy, 2021a). The acquisition of multi-verb predicates is under-studied (Sarvasy, 2021b), and highly language-specific, but there is some evidence from Nungon that children's expansion of use of multi-verb predicates corresponds to an expansion in use of clause chains (Sarvasy, 2021). In the remainder of this section, we consider whether CDS in Ku Waru and Nungon shows evidence of age-related fine-tuning in terms of morphosyntactic complexity.

### *Clause Chaining in Ku Waru CDS*

Rumsey et al. (2020) is a detailed study of early clause chains in Ku Waru children's speech from age 1;8 to 4;11. In a corpus of 32,760 reviewed utterances from those samples, we found that two-clause chains first appear in the data from the four target children between the ages of 1;9 and 2;10. Philip produces his first two-clause chains at 2;07, and Jacklyn at 2;10. Across the samples including all four target children, three-clause chains first appear between 2;11 and 3;3; four-clause ones at 3;10 (from Philip, the only child in sample older than 3;08); and five-clause chains at 4;07 (from Philip). For the two children for whom we have data beyond the age of 3:00, Jacklyn and Philip, there is a turning point at around that age (2;10 for Jacklyn and 3;0 for Philip), after which there at are least some child-produced clause chains in every session; clause chains occur in 23% of Jacklyn's verb-bearing utterances by 3;3 and in 19% of Philip's by 3;6.

To investigate the extent of fine-tuning of clause chains in Ku Waru caregivers' CDS with reference to that corpus, we counted clause chains in both child and adult speech and tabulated the incidence of clause chains of various lengths in the speech of caregivers to Philip at six ages between 2;5 and 4;9 and to Jacklyn at five ages between 2;8 and 3;4, and compared it to those of the children at the same sessions.

**Table 11.** *Incidence and length of clause chains in samples from two Ku Waru speaking children and their caregivers*

| Child | Age | Number of clause chains produced by child | Average length of clause chains produced by child | Longest clause chain produced by child | Number of clause chains addressed to child by caregivers | Average length of clause chains addressed to child by caregivers | Caregivers' longest clause chain |
|---|---|---|---|---|---|---|---|
| Philip | 2;05 | 0 | NA | NA | 117 | 2.28 | 4 |
| | 2;11 | 0 | NA | NA | 98 | 2.27 | 4 |
| | 3;05 | 19 | 2.00 | 2 | 85 | 2.31 | 5 |
| | 3;10 | 49 | 2.20 | 4 | 96 | 2.36 | 5 |
| | 4;03 | 55 | 2.07 | 3 | 131 | 2.39 | 6 |
| | 4;09 | 96 | 2.17 | 4 | 133 | 2.33 | 6 |
| Jacklyn | 2;08 | 0 | NA | NA | 41 | 2.07 | 3 |
| | 2;11 | 21 | 2.10 | 3 | 64 | 2.16 | 4 |
| | 3;01 | 22 | 2.09 | 3 | 47 | 2.23 | 6 |
| | 3;02 | 18 | 2.00 | 2 | 32 | 2.19 | 4 |
| | 3;04 | 8 | 2.13 | 3 | 22 | 2.09 | 3 |

With respect to the numbers of clause chains per session, Table 11 shows little evidence for fine-tuning by the caregivers of either child. Philip's caregivers use large numbers of them in the 2;05 and 2;11 sessions, where Philip uses none. In the 3;05 and 3;10 sessions the caregivers use slightly fewer clause chains than they did at 2;11, while Philip's usage climbs markedly, from 19 to 49. Between 4;03 and 4;09 it increases by another 57%, while the caregivers' increases by only 1.2%. The average and maximum *lengths* of clause chains used by Philip's caregivers show a smoother rise across the sample period than do clause chain counts. In that respect, they resemble the rise in Philip's numbers of chains, but not the average and maximum lengths of his clause chains, which show more erratic developmental trajectories.

It is harder to find evidence of fine-tuning as related to clause chaining in CDS by Jacklyn's caregivers, probably because of the much smaller period for which data are available. Table 11 shows that Jacklyn's caregivers produce fewer clause chains per session than Philip's; we attribute this to two factors. First, the interactional style used by the caregivers in these sessions tends to involve firing simple, non-clause chain, questions at the child, and second, use of Tok Pisin (a non-clause chaining language) by both caregivers and the child is much higher in Jacklyn's sessions in general than in Philip's sessions (Rumsey, 2014); use of the non-clause chaining Tok Pisin could

"prime" discourse participants to use fewer or shorter clause chains in their Ku Waru utterances.

Based on the same samples that are drawn on in the above discussion of frequency and length of clause chains, Rumsey et al. (2020, pp. 20–26) found little age-based structural simplification of clause chains in CDS in three other respects:
1) in the *kinds* of clauses used by the adults vs. children;
2) in the complexity of event structure within the clause chains;
3) in the incidence of a certain optional morphological simplification of medial verbs.

Note, however, that all of these findings pertain to interactions with children of 2;5 and above. Further work would be required in order to determine the extent to which they are valid for interactions with younger children.

### Clause Chaining in Nungon CDS

Like Ku Waru, Nungon features clause chaining, but with two main differences: formal and distributional. First, Nungon medial verbs are formally simpler than Ku Waru medial verbs, in that they do not indicate temporal simultaneity or sequentiality. Second, in terms of switch-reference marking, Nungon discourse involves roughly equal proportions of same-subject (4a) and different-subject (4b) medial verbs, while Ku Waru discourse shows a strong preference for only same-subject medial verbs (as in example (3); Rumsey et al., 2020; Sarvasy, 2020). This distributional difference bears out in the proportions of same- and different-subject-marked medial verbs in Ku Waru and Nungon CDS, and is reflected in a major difference in the development of different-subject marking among children learning Ku Waru and Nungon: Ku Waru-speaking children experience a major delay before producing clause chains with different subjects, while Nungon-speaking children do not (Sarvasy, 2020; Sarvasy & Choi, 2020b, 2024).

For Nungon, the question of whether parents fine-tune their clause chaining to their children's development was investigated in a somewhat different way from Ku Waru (see previous section), in that clause chain length in Nungon CDS was not directly investigated. Sarvasy (2020) simply quantified the proportion of a speaker's total verbs per recording session that were medial (non-final) verbs. This was assessed for three children, Abraham, Niumen, and TO, and three of their parents: Niumen's mother, and TO's father and mother. A higher proportion of medial verbs suggests longer and/or more frequent clause chains. Results are shown in Figure 4.
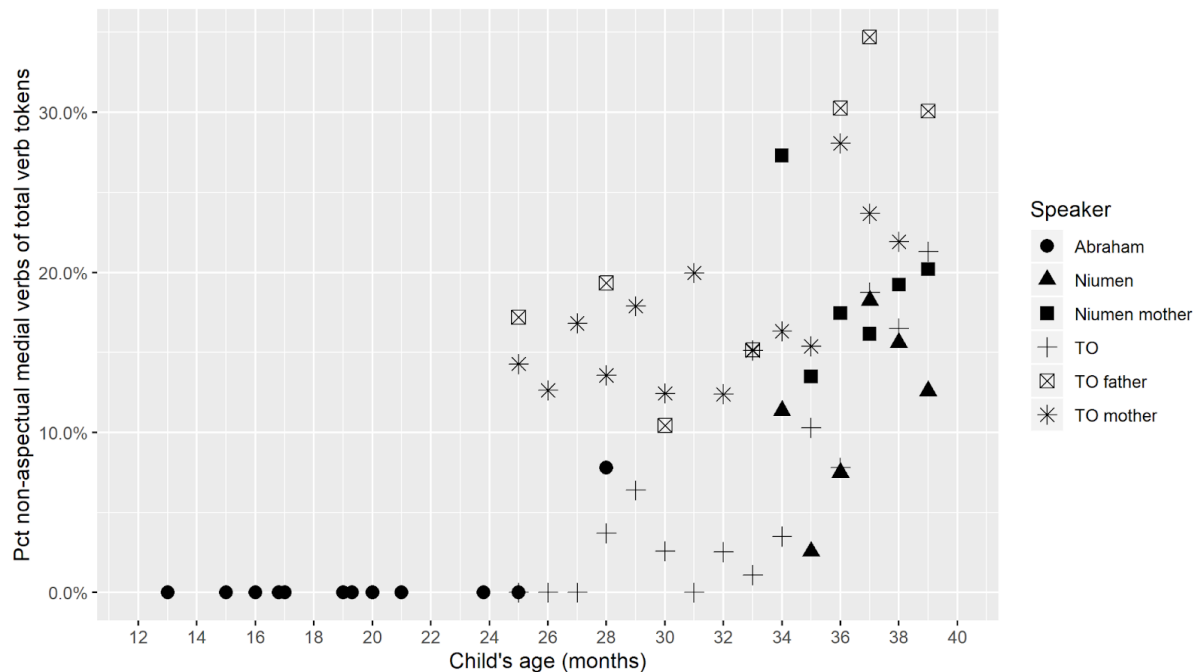
**Figure 4.** *Percentage of total verb tokens per session that were medial verbs, per speaker, Nungon sessions (Sarvasy, 2020, p. 9).*

Figure 4 shows that from the earliest developmental stages for which we have Nungon CDS data—2;01 for TO's parents and 2;10 for Niumen's mother—medial verbs are present in the parents' CDS.

Both parents of TO show an increase in proportional use of medial verbs (relative to total verbs) from when TO is 36 months old (3;00), which is around the age (starting at 35 months) when TO herself begins to show a steeper increasing trend in medial verb proportions; this could be related to fine-tuning of parental speech. Similarly, Niumen's mother's proportional medial verb use shows an overall increasing trend from 2;11 through 3;3. (Niumen's session at 2;10 may be considered an outlier, as the first session of the longitudinal study for him and his mother, involving less speech overall from Niumen's mother than the other sessions, and involving the presence of additional interviewers, including Sarvasy, unlike other sessions.) Niumen's mother shows her highest proportion of medial verbs in the final session at 3;3. Although Niumen's medial verb proportions do not climb as steadily upward as TO's, his three highest medial verb proportions occur in the last three sessions of the study period.

In sum, Nungon parental proportional use of medial verbs appears to broadly keep pace with children's use, in a kind of fine-tuning. For TO, there is an extended period between 2;1 and 3;00 during which the proportional use of medial verbs by both TO

and her parents stays relatively low and stable. We have no data on Niumen or his mother's productions before 2;10, but overall, both his and his mother's proportional medial verb use show generally increasing trends from 2;11 on. Parents thus appear to be tailoring their speech, in terms of the use of medial verbs, at least, to the perceived communicative abilities of their children. As seen in Sarvasy (2020), these two children show increases in clause chain numbers and number of clauses per chain by around 3;1, so it makes sense that their medial verb proportions increase around this age (since clause chains contain minimally one medial verb).

### Multi-Verb Predicates in Nungon CDS

Nungon features multi-verb predicates (or multi-verb constructions, MVCs): serial verb-like constructions in which multiple verb roots, sometimes bearing dependent suffixes, combine in a single predicate. These differ from clause chains, in which medial verbs serve as predicates of separate clauses. (In Ku Waru, there is no morphological difference between medial verbs and the verbs used in MVCs; Rumsey et al., 2020; in Nungon, there is a clear morphological difference.)

Sarvasy (2021) examined MVCs in the speech of Niumen (called NN there) and TO, and their parents. There, the overall frequency of MVCs was assessed through the ratio of MVCs to total utterances. Results are in Figure 5.
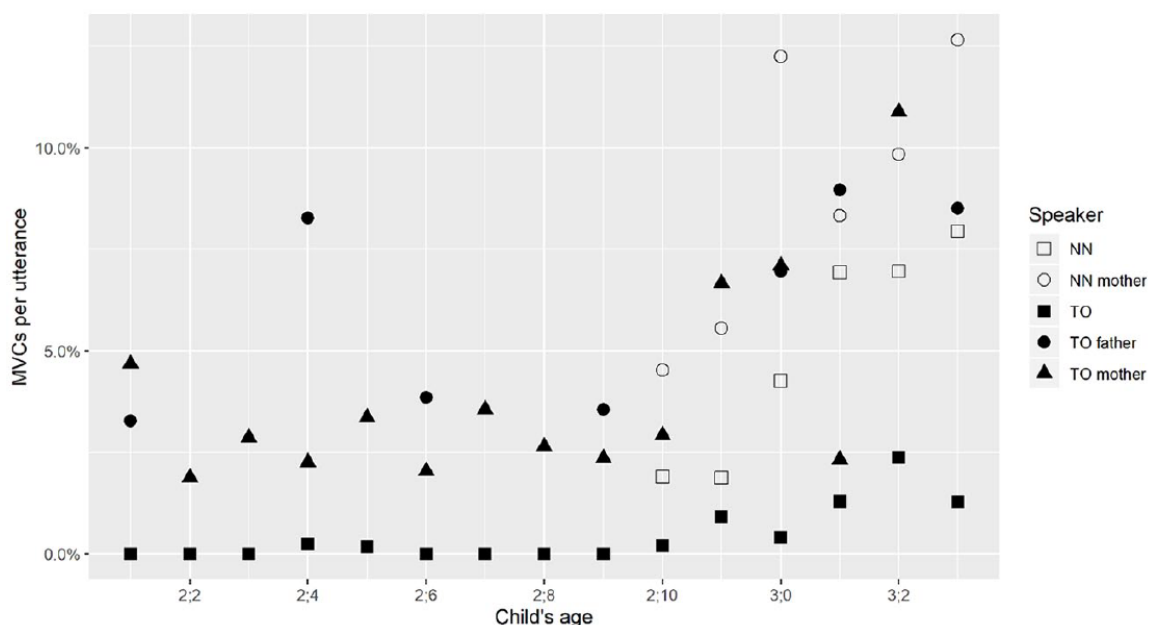


**Figure 5.** *Multi-verb predicates per utterance, by speaker (Sarvasy, 2021, p. 494).*

Sarvasy (2021) interpreted Figure 5 to suggest a maintenance in parental MVC proportions while the children produce relatively few MVCs themselves (through about age 2;10), then a jump in adult use of MVCs around age 2;11 and continuing increasing trend thereafter. If true, this would fit with the finding above (interpretation of Figure 4, medial verb proportions results) that parents' clause chaining stays at a relatively steady level until about age three, when children's clause chain production accelerates; then there is a jump in parental clause chain production as well, and ongoing increasing trend.

**Special Alterations to CDS**

Although baby-talk lexicons are widespread, it is thought to be relatively rare for CDS to contain morphosyntactic structures that are unacceptable in ADS. But this is evident in two areas of Ku Waru and Nungon CDS: a special baby-talk form of the ergative case suffix in Ku Waru CDS, and a special morphosyntactic expansion of simplex sentences in Nungon CDS.

***The Ku Waru CDS Ergative Marker Form***

As in many of the world's languages (Dixon, 1979), Ku Waru grammar treats the subjects of transitive verbs differently from those of intransitive verbs. Transitive verb subjects receive an ergative case suffix *-ni/-n*, under certain circumstances (for the relevant conditioning factors, see Rumsey, 2010). This marking is seen in (5):

(5)     Abak-n                    marasin    tu-ru-m
        man's.name-ERG    fertilizer    hit/do-RP-3SG
        'Abak pumped the fertilizer.'

In a study based on two of the same longitudinal runs as for the clause chain study discussed above, Rumsey (in Rumsey et al., 2013) found that ergative marking was first attested from one of the children, Jesi, at 1;10 and at 2;4 for the other, Enita, but that there were very few instances of it until 2;5 for Jesi and 2;9 for Enita. Despite the children's sparse production of ergative marking early on, their caregivers invariably include ergative marking where appropriate from the earliest speech samples for the children (1;9 for Jesi and 1;8 for Enita), at about the same rate as in their ADS.

However, among the ergative-marked tokens in Ku Waru child speech and CDS are some that use a distinct baby-talk form of the ergative marker: *-na/-ne*. An example from CDS is (6), spoken by John Onga to his son Jesi at the age of 3;11.

(6)     Alan-nga    redi-na         ung            nyi-kim
        Alan-GEN    radio-ERG    words/talk    say-PPR-3SG
        'Alan's radio is talking.'

If this were produced in ADS, the ergative marker on *redi* 'radio' would take the form *-n.* In our samples, Jesi and Enita use both the *-na/-ne* variant and the *-ni/-n* one, with a preponderance of the latter, from the earliest stage at which they used any ergative marking.[4] Their caregivers also use mainly the *-ni/-n* variant in their CDS, with occasional instances of *-na/-ne,* as in (6).

### *Nungon CDS Morphosyntactic Expansions*

Nungon speakers have been shown to use a special morphosyntactic expansion construction in CDS to small children by which any lexical verb (e.g., 'die') can be used in nominalized form with the verb *to-* 'do' as auxiliary (e.g., 'do dying'), in a way that is never done by adults in ADS. This "nominalization plus do auxiliary" construction was discussed initially for just TO's parents in Sarvasy (2019) and then established as a community-wide practice in Sarvasy (2023b). It is illustrated in (7):

(7)     Father: Obö-k        to-wangka-k;       na-mo-k            to-i.
                break-NMZ   do-NFUT.SG-3SG   1SG.O-give-NMZ   do-IMP.2SG
                'It will do breaking; do giving it to me.' (AB 1;5; Sarvasy, 2023b)

In (7), the verbs *obö-* 'break' and *na-mo-* 'give me' are nominalized through the addition of an uninflecting *-k* to the verb root; they form a complex predicate with the verb *to-* 'do,' which carries the tense, mood, and subject person/number inflections for the whole predicate. In standard Nungon ADS, this would never be expressed in this way; rather, the two lexical verbs would inflect directly, as:

(8)     Obö-wangka-k;          na-mo-hi.
            break-NFUT.SG-3SG   1SG.O-give-IMP.2SG
            'It will break; give it to me.'

The special CDS nominalization with 'do' auxiliary construction appears to be heavily present in the CDS of some parents to children in their second year of life, and is largely phased out in CDS by about 3;3. For instance, one parent uses this more than normal inflected verbs when his child is 1;5, but by the time that child is 2;3, the father uses almost all normal inflected verbs (Sarvasy, 2023b).

Some children may seize on the nominalized verb forms used in this construction and then use them as an optional "default" verb form; this was the case for TO (described in Sarvasy, 2019), but not for three other children studied in the same age range (Sarvasy, 2023b).

---

[4] For the precise figures see Rumsey et al. (2013, p. 157).

Nungon verbs have dozens of inflectional forms, depending on tense (there are five grammatical tenses), mood, modality, and subject person/number (including singular, dual, and plural number values). Beyond this, verbs belong to seven different classes, based on the forms of the inflectional suffixes used with them. Class membership is lexically determined: it cannot be predicted on the basis of phonological characteristics of the verb roots. This makes for much morphological complexity for the child to master.

When a verb is nominalized, this simplifies things in two ways: first, some verb classes share a nominalizing suffix, such that there are fewer nominalizing suffixes than verb classes (and consonant-final verb roots do not receive any suffix to function as nominalized). Second, nominalized verbs do not inflect for tense, mood, modality, or subject person/number; they bear an unchanging nominalizing suffix. The Nungon CDS nominalization plus 'do' auxiliary thus could be argued to scaffold child learning by presenting children with just one verb's set of inflections to learn (the verb *to-* 'do') first, while other verbs are packaged as simple nominalizations. But all parents observed thus far use this construction alongside directly inflected verbs; the questions of how and when they choose to use the nominalization plus 'do' auxiliary construction, and at what point their speech illustrates the full range of inflectional possibilities for all verb classes, remain open for further study.

**Morphosyntax Comparative Summary**

We found some evidence of fine-tuning of morphosyntactic complexity in Ku Waru and Nungon CDS. For instance, in Ku Waru, there is a slight increase in overall clause chain length in CDS to older children, and the proportion of all clauses that are chained is greater in ADS than in CDS in general, suggesting that at some point adults begin to address older children using more clause chains. In Nungon, adults begin to use more chained clauses and more multi-verb predicates in speech to children from about the age of 3;0, which is also when Nungon-speaking children begin to use longer and more complex clause chains, and more multi-verb predicates.

Both languages have a morphosyntactic CDS feature that is unacceptable in ADS. In Ku Waru CDS, there is a special baby-talk form of the ergative suffix, while in Nungon CDS, parents optionally expand simplex predicates into more morphosyntactically complex auxiliary constructions.

## Discussion

We organize our discussion here according to the four areas of language presented above.

**Prosody**

Our prosodic analysis of CDS in Ku Waru and Nungon compared the mean pitch and the pitch range with the ADS equivalents in both languages. The Nungon data involved children aged 2;2–3;10, while the children in the Ku Waru dataset were aged 2;4–3;3 at the time of recording. In the Nungon dataset, and for one speaker of Ku Waru (addressing a child aged 2;4), the mean pitch of CDS was found to be significantly higher than that of ADS. These results are in line with the widely reported cross-linguistic tendency for higher pitch in CDS, reported without measurements for Huli CDS (Goldman, 1986) and attested but without statistical significance for Qaqet CDS (Frye, 2022). While two Ku Waru speakers showed no significant mean pitch difference between ADS and CDS in the analyzed dataset, their highest-pitched utterances all occurred in CDS, not ADS. For Kaluli, Schieffelin (1990, pp. 102–106, 108–110) remarks on the use of higher pitch and "exaggerated intonation and descent in melody" in playful interaction between an older sibling and a younger one, and in "teasing" between a mother and child, but does not explicitly link this to the child-directed nature of the interactions.

We found a slight difference between Ku Waru and Nungon pitch range in CDS *vs.* ADS. In Nungon, CDS pitch range was significantly greater than that of ADS across sexes—a result that aligns with general CDS expectations (Soderstrom, 2007) and also mirrors the findings reported for Qaqet (Frye, 2022). Ku Waru, on the other hand, showed no significant difference in pitch range between ADS and CDS in the dataset. As with mean pitch, however, the Ku Waru sampled utterances with the greatest pitch ranges were all CDS, not ADS.

**Phonology**

In both Ku Waru and Nungon, adults optionally modify consonants in CDS. In both languages, these modifications result in productions that resemble early child productions. It seems clear that the adult modifications mimic child productions, rather than the other way around. For Ku Waru, for instance, children consistently have difficulty producing palatal nasals and laterals and the velar lateral phoneme until about age 2;6 or older (much older for the velar lateral), and so CDS optionally involves the replacement of these sounds with their alveolar equivalents, as occurs in children's speech. Children learning Ku Waru also produce an alveolar /l/ or /t/ instead of /r/ and sometimes replace velar stops with alveolar ones, as adults occasionally do in Ku Waru CDS. In Nungon CDS, there are fewer documented consonant alterations than in Ku Waru: the prominent ones discussed in this paper are the replacement of /r/ with /l/ or the glide /y/, and the replacement of word-final /k/ with a glottal stop. It is noteworthy that CDS in both Ku Waru and Nungon involve the production of consonant segments that are not part of the adult phoneme inventory yet are associated with early child speech production. These are the alveolar /l/ in Ku Waru (except in

words derived from Tok Pisin); and the /l/, glottal stop, and (word-initial) voiced velar fricative in the Towet dialect of Nungon.

We can draw a distinction between the phenomenon of optional systematic consonant alteration, and that of extra-phonemic sounds that obligatorily occur in just a particular baby-talk lexical item. The first type covers all the alterations described for Ku Waru CDS (and CS), and the general replacement of /r/ and word-final /k/ in Towet Nungon CDS. Such generalized replacements are also reported for CDS in the Papuan language Duna (Duna-Bogaia; San Roque & Schieffelin, forthcoming). In contrast, just the Towet Nungon baby-talk word for 'pitpit' begins with a voiced velar fricative, which is not a true phoneme of adult Nungon. This is not a widespread feature of Nungon CDS: it is confined to this baby-talk lexical item. Similarly, just one baby-talk lexical item in the East Sepik language Manambu begins with a sound that is extra-phonemic for adults: a bilabial trill (Aikhenvald, 2008, p. 44).

We have not yet studied the acoustics of vowels in Ku Waru ADS or CDS. The Nungon CDS vowel triangle has an equivalent size to that of Nungon ADS in adult dyadic conversation, so there is no evidence of vowel hyper-articulation in Nungon CDS. But vowel durations are overall longer in Nungon CDS to 2-year-olds than 3-year-olds, as is found in CDS in many other languages (Soderstrom, 2007).

**Lexicon**

Ku Waru and Nungon speakers have acknowledged widely used sets of "baby-talk" lexical items, like speakers of the Papuan languages Huli (Goldman, 1986), Mali (Baining; Stebbins, 2011, pp. 28–29), and Manambu (Aikhenvald, 2008, pp. 44, 138). Ku Waru and Nungon baby-talk terms include some with transparent origins, arising through: (a) modification of adult forms (as in only a small minority of Huli baby-talk forms; Goldman 1986, pp. 199–200), (b) onomatopoeia, or (c) borrowing from Tok Pisin (which, as in Manambu, is seen as an "easy" language for children; Aikhenvald, 2008, pp. 615, 617, possibly boding ill for local language maintenance). Multiple forms in both Ku Waru and Nungon also exhibit "full lexical replacement" (like most Huli baby-talk words; Goldman, 1986, p. 199), showing no relation to the counterpart adult form, or having no single-word adult counterpart. We have no ready explanation for why the two languages, possibly related only in the deep past, share a baby-talk term for 'kiss': *nunu.*

We presented new data on baby-talk lexical items for both Ku Waru and Nungon that go beyond general word lists to examine corpus distributions and individual variation. For Ku Waru, the 11 adults consulted by John Onga agreed that Ku Waru speakers use baby-talk lexical items, but when asked to list these, their lists diverged to a large degree. Further, the most commonly cited baby-talk words were not necessarily the ones used most commonly in CDS in the Ku Waru child–caregiver speech corpus.

For Nungon, child–caregiver pairings differed in the frequencies of baby-talk lexical items for the age range 2;4–2;7. For both baby-talk nouns and verbs, we used comparative counts of adult and baby-talk lexical counterparts to show that such differences were not an artefact of conversation topic. Further, caregivers who did use baby-talk terms tended to use both the baby-talk terms and their adult counterparts in CDS in the same sessions.

Our findings on the existence, local awareness of, and widespread use of baby-talk lexical items in Ku Waru and Nungon CDS diverge from what has been reported for Kaluli (Schieffelin, 1990) and Qaqet (where adults interviewed in Tok Pisin provided just three examples of Qaqet baby-talk lexical items, despite the more robust use of baby-talk lexical items in closely-related Mali; Frye, 2022, pp. 149–150; Stebbins, 2011, pp. 28–29). But the evidence given against baby-talk lexicons for Kaluli seems to stem mainly from adult responses to questioning, while for Qaqet, Frye relies on the occurrence of baby-talk forms in retellings of the silent "Pear Story" video (Chafe, 1980), rather than in naturalistic corpus data. Cross-linguistically, Pear Story retellings are not known for containing baby-talk terms or being emblematic of CDS styles, so it is possible that the failure to produce baby-talk terms here is an artefact of the study design.

**Morphosyntax**

Our discussion of Ku Waru and Nungon morphosyntax focused on two areas: fine-tuning of morphosyntactic complexity to children's developmental stages, and non-ADS-like structures. The aspect of morphosyntax that we discussed for both languages was clause chaining—a type of complex sentence with one or more non-embedded dependent clauses that is widespread in Papuan languages. Ku Waru and Nungon CDS show similarities and differences in clause chaining. In both, clause chains are present in CDS from the earliest sampled children's ages, and in the children's speech between 2;0 and 3;0, albeit in much lower proportions. In both Ku Waru and Nungon there is a turning point at around 3;0, after which the children's clause chains become more frequent. But ADS differs across the two studies in that in Nungon the children's turning point coincides with an increase in the proportion of clause chains in the parents' ADS, which has the effect of keeping it higher than the children's, whereas in Ku Waru CDS the proportion of clause chains is already high by 2;5 and does not show a noticeable increase thereafter. Nungon multi-verb constructions (MVCs) in child speech and CDS show a similar pattern, with increases in both from about 2;11.

The apparent Nungon fine-tuning in number of clause chains in CDS versus the lesser degree of it in Ku Waru CDS is consistent with another aspect of our findings concerning Ku Waru CDS after 2;5: its low degree of child-age-based structural simplification of CDS with respect to clause type, event structure, and morphology.

The last two areas of morphosyntax that we examined show a further contrast between Ku Waru and Nungon CDS, in the extent to which CDS utterances comprise acceptable ADS-like utterances. Ku Waru adults consistently use well-formed, adult-like utterances with regard to ergative marking: there is no indication that they sometimes omit ergative marking, even in CDS to children who do not yet use ergative marking reliably. But they do sometimes use a distinct baby-talk form of the ergative marker in the same environments where they use the adult form in their ADS. Nungon adults do something that is cross-linguistically unusual (or at least poorly attested): (a) they optionally produce longer and more syntactically complex utterances in CDS than in the ADS counterparts, bucking expectations that CDS utilize shorter and syntactically simpler sentences than ADS (Soderstrom, 2007), and (b) further, these expanded CDS utterances, while not strictly "ungrammatical," are nonsensical and unattested in ADS. Here, Nungon CDS appears to sacrifice brevity and syntactic simplicity for the sake of morphological simplicity.

## Conclusion

We have shown that speech directed to toddlers and preschool-aged children in Ku Waru and Nungon can have special qualities, different from those of conversational ADS, in multiple linguistic domains. It is important to remember that the features we describe have variable distributions within and across speakers at any given time point. Overall, the possible modifications available for CDS in both languages constitute less a coherent "register" that speakers may slip into or out of, but more a menu of optional features, some apparently binary and some measured in terms of degree, which may be applied in conjunction with each other or separately, and which adults often apply variably within a single recording session. Our data thus confirm earlier researchers' doubts about the notion of "register" (see references in Weinstein & Baldwin, 2024) while confirming the use of adjustments in CDS for two Papuan languages.

## References

Aikhenvald, A. Y. (2008). *The Manambu language of East Sepik, Papua New Guinea*. Oxford University Press. https://doi.org/10.1093/oso/9780199539819.001.0001

Amano, S., Nakatani, T., & Kondo, T. (2006). Fundamental frequency of infants' and parents' utterances in longitudinal recordings. *The Journal of the Acoustical Society of America, 119*(3), 1636–1647. https://doi.org/10.1121/1.2161443

Audibert, N., & Falk, S. (2018). Vowel space and f0 characteristics of infant-directed singing and speech. In *Proceedings of the 19th International Conference on Speech Prosody* (pp. 153–157). https://doi.org/10.21437/SpeechProsody.2018-31

Baran, J. A., Laufer, M. Z., & Daniloff, R. (1977). Phonological contrastivity in conversation: A comparative study of voice onset time. *Journal of Phonetics, 5*(4), 339–350. https://doi.org/10.1016/S0095-4470(19)31204-5

Benders, T., Pokharel, S., & Demuth, K. (2019). Hypo-articulation of the four-way voicing contrast in Nepali infant-directed speech. *Language Learning and Development, 15*(3), 232–254. https://doi.org/10.1080/15475441.2019.1577139

Benders, T., StGeorge, J., & Fletcher, R. (2021). Infant-directed speech by Dutch fathers: Increased pitch variability within and across utterances. *Language Learning and Development, 17*(3), 292–325. https://doi.org/10.1080/15475441.2021.1876698

Bernstein Ratner, N., & Pye, C. (1984). Higher pitch in BT is not universal: Acoustic evidence from Quiche Mayan. *Journal of Child Language, 11*(3), 515–522. https://doi.org/10.1017/S0305000900005924

Bergelson, E., Soderstrom, M., Schwarz, I.-C., Rowland, C. F., Ramírez-Esparza, N., R. Hamrick, L., Marklund, E., Kalashnikova, M., Guez, A., Casillas, M., Benetti, L., Alphen, P. V., & Cristia, A. (2023). Everyday language input and production in 1,001 children from six continents. *Proceedings of the National Academy of Sciences, 120*(52), Article e2300671120. https://doi.org/10.1073/pnas.2300671120

Boer, J., Claessen, M., & Williams, C. (2022). Acquisition of Tok Pisin phonology in the multilingual highlands of Papua New Guinea. *International Journal of Speech-Language Pathology, 24*(3), 283–293. https://doi.org/10.1080/17549507.2022.2080271

Boersma, P. & Weenink, D. (2025). *Praat* (Version 6.4.27) [Computer software]. http://www.praat.org/

Bohn, O. S. (2013). Acoustic characteristics of Danish infant directed speech. In *Proceedings of Meetings on Acoustics ICA2013, 19*(1), Article 060055. https://doi.org/10.1121/1.4798488

Buchan, H. (2012). *Phonetic variation in Gurindji Kriol and northern Australian English: A longitudinal study of fricatives in maternal speech* [Doctoral dissertation]. University of Wollongong. http://ro.uow.edu.au/theses/3789

Burnham, D., Kitamura, C., & Vollmer-Conna, U. (2002). What's new, pussycat? On

talking to babies and animals. *Science, 296*(5572), 1435–1435. https://doi.org/10.1126/science.1069587

Casillas, M., Brown, P., & Levinson, S. C. (2021). Early language experience in a Papuan community. *Journal of Child Language, 48*(4), 792–814. https://doi.org/10.1017/S0305000920000549

Chafe, W. L. (Ed.). (1980). *The pear stories: Cognitive, cultural, and linguistic aspects of narrative production*. Praeger.

Cheng, M.-C. (2014). Exploration of the phonetic difference in stops between Hakka infant-directed speech and adult-directed speech. *Concentric: Studies in Linguistics 40*(1), 1–35. https://doi.org/10.6241/concentric.ling.40.1.01

Choi, S. (2020). Development of clause chaining in Korean. *Frontiers in Psychology, 11*, 256. https://doi.org/10.3389/fpsyg.2020.00256

Clancy, P. M. (2020). To link or not to link: Clause chaining in Japanese narratives. *Frontiers in Psychology, 10*, Article 3008. https://doi.org/10.3389/fpsyg.2019.03008

Clancy, P. M. (2024). Clause chains and intonation units in Japanese narratives. In H. S. Sarvasy & A. Y. Aikhenvald (Eds.), *Clause chaining in the languages of the world* (pp. 702–736). Oxford University Press. https://doi.org/10.1093/oso/9780198870319.003.0026

Clark, E. (1993). *The lexicon in acquisition*. Cambridge University Press. https://doi.org/10.1017/CBO9780511554377

Clark, E. (2016). *First language acquisition*. Cambridge University Press. https://doi.org/10.1017/CBO9781316534175

Crago, M. B., & Allen, S. E. M. (199). Linguistic and cultural aspects of simplicity and complexity in Inuktitut (Eskimo) child-directed speech. In E. Hughes, M. Hughes & A. Greenhill (Eds.), *Proceedings of the 21st Annual Boston University Conference on Language Development* (pp. 91–102). Cascadilla Press.

Cristia, A. (2010). Phonetic enhancement of sibilants in infant-directed speech. *The Journal of the Acoustical Society of America, 128*(1), 424–434. https://doi.org/10.1121/1.3436529

Cristia, A. (2013). Input to language: The phonetics and perception of infant-directed speech. *Language and Linguistics Compass, 7*(3), 157–170.

https://doi.org/10.1111/lnc3.12015

Cristia, A., & Seidl, A. (2014). The hyper-articulation hypothesis of infant-directed speech. *Journal of Child Language, 41*(4), 913–934. https://doi.org/10.1017/S0305000912000669

Cruttenden, A. (1994). Phonetic and prosodic aspects of baby talk. In B. J. Richards & C. Gallaway (Eds.), *Input and interaction in language acquisition* (pp. 135–152). Cambridge University Press. https://doi.org/10.1017/CBO9780511620690.008

Dilley, L. C., Millett, A. L., McAuley, J. D., & Bergeson, T. R. (2014). Phonetic variation in consonants in infant-directed and adult-directed speech: The case of regressive place assimilation in word-final alveolar stops. *Journal of Child Language, 41*(1), 155–175. https://doi.org/10.1017/S0305000912000670

Dixon, R. M. W. (1979). Ergativity. *Language 55*(1), 59–138. https://doi.org/10.2307/412519

Duranti, A. (2009). Linguistic anthropology: History, ideas, and issues. In A. Duranti (Ed.), *Linguistic anthropology: A reader* (2nd ed., pp. 1–59). Wiley-Blackwell.

Englund, K., & Behne, D. (2006). Changes in infant directed speech in the first six months. *Infant and Child Development, 15*(2), 139–160. https://doi.org/10.1002/icd.445

Fais, L., Kajikawa, S., Amano, S., & Werker, J. F. (2010). Now you hear it, now you don't: Vowel devoicing in Japanese infant-directed speech. *Journal of Child Language, 37*(2), 319–340. https://doi.org/10.1017/S0305000909009556

Ferguson, C. A. (1964). Baby talk in six languages. *American Anthropologist, 66*, 103–114. https://doi.org/10.1525/aa.1964.66.suppl_3.02a00060

Ferguson, C. A. (1977). Baby talk as a simplified register. In C. E. Snow & C. A. Ferguson (Eds.), *Talking to children: Language input and acquisition* (pp. 209–235). Cambridge University Press.

Fernald, A. (1989). Intonation and communicative intent in mothers' speech to infants: Is the melody the message? *Child Development*, 60(6), 1497–1510. https://doi.org/10.1111/j.1467-8624.1989.tb04020.x

Fernald, A., & Simon, T. (1984). Expanded intonation contours in mothers' speech to newborns. *Developmental Psychology*, 20(1), 104–113. https://doi.org/10.1037/0012-1649.20.1.104

Foley, W. A. (1986). *The Papuan languages of New Guinea*. Cambridge University Press. https://doi.org/10.1017/S002222670001166X

Frye, H. (2022). *Child-directed speech in Qaqet: A language of east New Britain, Papua New Guinea*. ANU Press. https://doi.org/10.22459/CDSQ.2022

García-Sierra, A., Ramírez-Esparza, N., Wig, N., & Robertson, D. (2021). Language learning as a function of infant directed speech (IDS) in Spanish: Testing neural commitment using the positive-MMR. *Brain and Language, 212*, Article 104890. https://doi.org/10.1016/j.bandl.2020.104890

Garnica, O. K. (1977). Some prosodic and paralinguistic features of speech to young children. In C. E. Snow & C. A. Ferguson (Eds.), *Talking to children* (pp. 63–88). Cambridge University Press.

Gergely, A., Faragó, T., Galambos, Á., & Topál, J. (2017). Differential effects of speech situations on mothers' and fathers' infant-directed and dog-directed speech: An acoustic analysis. *Scientific Reports, 7*(1), Article 13739. https://doi.org/10.1038/s41598-017-13883-2

Goldman, L. R. (1986). Anatomical terms in Huli names and games. *Mankind, 16*(3), 190–208. https://doi.org/10.1111/j.1835-9310.1986.tb00734.x

Goldman, L. R. (1987). Ethnographic interpretations of parent-child discourse in Huli. *Journal of Child Language, 14*(3), 447–466. https://doi.org/10.1017/S0305000900010230

Goldman, L. R. (1991). Language acquisition - Bambi B. Schieffelin, The give and take of everyday life: Language socialization of Kaluli children. Cambridge University Press, 1990. Pp. viii+ 278 [Review]. *Language in Society, 20*(4), 663–668. https://doi.org/10.1017/S0047404500016821

Green, J. R., Nip, I. S., Wilson, E. M., Mefferd, A. S., & Yunusova, Y. (2010). Lip movement exaggerations during infant-directed speech. *Journal of Speech, Language, and Hearing Research, 53*(6), 1529–1542. https://doi.org/10.1044/1092-4388(2010/09-0005)

Grieser, D. L., & Kuhl, P. K. (1988). Maternal speech to infants in a tonal language: Support for universal prosodic features in motherese. *Developmental Psychology, 24*(1), 14–20. https://doi.org/10.1037/0012-1649.24.1.14

Haynes, L. & Cooper, R. (1986). A note on Ferguson's proposed baby-talk universals.

In J. Fishman (Ed.), *The Fergusonian impact: In honor of Charles A. Ferguson on the occasion of his 65th birthday. Volume 1: From phonology to society* (pp. 127–134). De Gruyter Mouton. https://doi.org/10.1515/9783110873641-011

Hellwig, B., Sarvasy, H. S., & Casillas, M. (forthcoming). Language acquisition. In N. Evans & S. Fedden (Eds.), *Oxford guide to the Papuan languages*. Oxford University Press.

Jeannin, S., Gilbert, C., Amy, M., & Leboucher, G. (2017). Pet-directed speech draws adult dogs' attention more efficiently than adult-directed speech. *Scientific Reports, 7*(1), Article 4980. https://doi.org/10.1038/s41598-017-04671-z

Johnson, A., Elliot, M., & Allen, S. E. (2023). Morphological simplification in Inuktitut child-directed speech. In *Proceedings of the 25th Workshop on Structure and Constituency in Languages of the Americas* (pp. 103–115). UBC Working Papers in Linguistics.

Katz, G. S., Cohn, J. F., & Moore, C. A. (1996). A combination of vocal f0 dynamic and summary features discriminates between three pragmatic categories of infant-directed speech. *Child Development, 67*(1), 205–217. https://doi.org/10.1111/j.1467-8624.1996.tb01729.x

Kidd, E., & Garcia, R. (2022). How diverse is child language acquisition research? *First Language, 42*(6), 703–735. https://doi.org/10.1177/01427237211066405

Kik, A., Adamec, M., Aikhenvald, A. Y., Bajzekova, J., Baro, N., Bowern, C., Colwell, R. K., Drozd, P., Duda, P., Ibalim, S., Jorge, L. R., Mogina, J., Ruli, B., Sam, K., Sarvasy, H. S., Saulei, S., Weiblen, G. D., Zrzavy, J., & Novotny, V. (2021). Language and ethnobiological skills decline precipitously in Papua New Guinea, the world's most linguistically diverse nation. *Proceedings of the National Academy of Sciences, 118*(22), Article e2100096118. https://doi.org/10.1073/pnas.2100096118

Kitamura, C., Thanavishuth, C., Burnham, D., & Luksaneeyanawin, S. (2001). Universality and specificity in infant-directed speech: Pitch modifications as a function of infant age and sex in a tonal and non-tonal language. *Infant Behavior and Development, 24*(4), 372–392. https://doi.org/10.1016/S0163-6383(02)00086-3

Kuhl, P. K., Andruski, J. E., Chistovich, I. A., Chistovich, L. A., Kozhevnikova, E. V., Ryskina, V. L., Stolyarova, E. I., Sunderg, U., & Lacerda, F. (1997). Cross-language analysis of phonetic units in language addressed to infants. *Science, 277*(5326), 684–686. https://doi.org/10.1126/science.277.5326.684

Kulick, D. (1980). Gapun/Tayap recordings. Collection DK1 at catalog.para-disec.org.au. https://doi.org/10.4225/72/56E979D6D23EA

Kulick, D. (1992). *Language shift and cultural reproduction: Socialization, self, and syncretism in a Papua New Guinea village.* Cambridge University Press.

Kulick, D., & Terrell, A. (2019). *A grammar and dictionary of Tayap: The life and death of a Papuan language.* De Gruyter. https://doi.org/10.1515/9781501512209

Laughren, M. (1984). Warlpiri baby talk. *Australian Journal of Linguistics 4*(1), 73–88. https://doi.org/10.1080/07268608408599321

Liu, H.-M., Kuhl, P. K., & Tsao, F.-M. (2003). An association between mothers' speech clarity and infants' speech discrimination skill. *Developmental Science, 6*, F1–F10. https://doi.org/10.1111/1467-7687.00275

Liu, H.-M., Tsao, F.-M., & Kuhl, P. K. (2009). Age-related changes in acoustic modifications of Mandarin maternal speech to preverbal infants and five-year-old children: A longitudinal study. *Journal of Child Language, 36*(4), 909–922. https://doi.org/10.1017/S030500090800929X

Longacre, R. E. (2007). Sentences as combinations of clauses. In T. Shopen (Ed.), *Language typology and syntactic description* (pp. 372–420). Cambridge University Press. https://doi.org/10.1017/CBO9780511619434.007

MacWhinney, B. (2000). *The CHILDES Project: Tools for Analyzing Talk.* 3rd Edition. Lawrence Erlbaum Associates.

Malsheen, B. J. (1980). Two hypotheses for phonetic clarification in the speech of mothers to children. In G. Yeni-Komshian, J. Kavanagh, & C. Ferguson (Eds.) *Child Phonology, Volume 2* (pp. 173–184). Academic Press.

Max Planck Institute for Psycholinguistics. (2024). *ELAN* (Version 6.9) [Computer software]. https://archive.mpi.nl/tla/elan

Mazuka, R., Kondo, T., & Hayashi, A. (2008). Japanese mothers' use of specialized vocabulary in infant-directed speech: infant-directed vocabulary in Japanese. In N. Masataka (Ed.), *The origins of language: Unraveling evolutionary forces* (pp. 39–58). Springer. https://doi.org/10.1007/978-4-431-79102-7_4

McAllister Byun, T. (2012). Positional velar fronting: An updated articulatory account. *Journal of Child Language 39*(5), 1043–1076.

https://doi.org/10.1017/S0305000911000468

Merlan, F., & Rumsey, A. (1991). *Ku Waru: Language and segmentary politics in the western Nebilyer Valley*. Cambridge University Press. https://doi.org/10.1017/CBO9780511518218

Ochs, E., & Schieffelin, B. (1984). Language acquisition and socialization: Three developmental stories and their implications. In R. Shweder & R. Levine (Eds.), *Culture theory: Essays on mind, self and emotion* (pp. 276–320). Cambridge University Press.

Ota, M., & Skarabela, B. (2016). Reduplicated words are easier to learn. *Language Learning and Development, 12*(4), 380–397. https://doi.org/10.1080/15475441.2016.1165100

Ota, M., & Skarabela, B. (2018). Reduplication facilitates early word segmentation. *Journal of Child Language, 45*(1), 204–218. https://doi.org/10.1017/S0305000916000660

Ota, M., Davies-Jenkins, N., & Skarabela, B. (2018). Why choo-choo is better than train: The role of register-specific words in early vocabulary growth. *Cognitive Science, 42*(6), 1974–1999. https://doi.org/10.1111/cogs.12628

Posit team. (2024). *RStudio: Integrated development environment for R*. [Computer software]. http://www.posit.co/

Réger, Z., & Gleason, J. B. (1991). Romāni child-directed speech and children's language among gypsies in Hungary. *Language in Society 20*(4), 601–617. https://doi.org/10.1017/S0047404500016742

Rosenberg, K. R., Golinkoff, R. M., & Zosh, J. M. (2004). Did australopithecines (or early Homo) sling? *Behavioral and Brain Sciences, 27*(4), 522–522. https://doi.org/10.1017/S0140525X04430118

Rowe, M. (2008). Child-directed speech: Relation to socioeconomic status, knowledge of child development and child vocabulary skill. *Journal of Child Language, 35*, 185–205. https://doi.org/10.1017/S0305000907008343

Rumsey, A. (2014). Bilingual language learning and the translation of worlds in the New Guinea Highlands and beyond. *HAU: Journal of Ethnographic Theory 4*(2), 119–140. https://doi.org/10.14318/hau4.2.006

Rumsey, A. (2017). Dependency and relative determination in children's language acquisition: The case of Ku Waru. In N. J. Enfield (Ed.), *Dependencies in language: On*

*the causal ontology of linguistic systems* (pp. 97–114). Language Science Press.

Rumsey, A., Reed, L., & Merlan, F. (2020). Ku Waru clause chaining and the acquisition of complex syntax. *Frontiers in Communication, 5,* Article 19. https://doi.org/10.3389/fcomm.2020.00019

Rumsey, A., San Roque, L., & Schieffelin, B. (2013). The acquisition of ergative marking in Kaluli, Ku Waru and Duna (Trans New Guinea). In E. L. Bavin & S. Stoll (Eds.), *The acquisition of ergativity* (pp. 133–182). John Benjamins. https://doi.org/10.1075/tilar.9.06rum

Rumsey, A., Merlan, F., Onga, J., Noma, A., Kuri, S., Reed, L. W., Devitt, D., Gonzalez Ochoa, S., van Tongeren, C., Honeyman, T., Yam, S., Ross, M. A., Kalyan, S., Peck, N., Kashima, E., Hendy, C., Cutfield, S., Strong, S., Creaghe, N., & Wang, J. (2024). *Ku Waru Child Language Socialization Study*. https://sites.google.com/view/kwclss/home

San Roque, L. (2008). *An introduction to Duna grammar* [Doctoral dissertation]. Australian National University.

San Roque, L. (2016). 'Where' questions and their responses in Duna (Papua New Guinea). *Open Linguistics 2*(1), 85–104. https://doi.org/10.1515/opli-2016-0005

San Roque, L., & Schieffelin, B. (forthcoming). Language socialisation in the Papuan context. In N. Evans & S. Fedden (Eds.), *Oxford guide to the Papuan languages*. Oxford University Press.

Sarvasy, H. S. (2017). *A grammar of Nungon: A Papuan language of northeast New Guinea*. Brill. https://doi.org/10.1163/9789004340107

Sarvasy, H. S. (2019). The root nominal stage: a case study of early Nungon verbs. *Journal of Child Language 46*(6), 1073–1101. https://doi.org/10.1017/S0305000919000357

Sarvasy, H. S. (2020). Acquisition of clause chaining in Nungon. *Frontiers in Psychology 11,* Article 1456. https://doi.org/10.3389/fpsyg.2020.01456

Sarvasy, H. S. (2021). Acquisition of multi-verb predicates in Nungon. *First Language, 41*(4). https://doi.org/10.1177/0142723720938568

Sarvasy, H. S. (2022). The near future tense in child and child-directed Nungon speech: A case study. In A. Storch & R. M. W. Dixon (Eds.), *The art of language* (pp.

275–287). Brill. https://doi.org/10.1163/9789004510395_018

Sarvasy, H. S. (2023a). Nungon child speech corpus. Western Sydney University Research Management Repository. https://doi.org/10.26183/essm-1v90

Sarvasy, H. S. (2023b). Early verb production in Nungon. *Frontiers in Psychology 14*, Article 1241447. https://doi.org/10.3389/fpsyg.2023.1241447

Sarvasy, H. S. (2023c). Verbatim narrative prompting in Nungon. In A. Y. Aikhenvald, R. Bradshaw, L. Ciucci, & P. Wangdi (Eds.), *Celebrating Indigenous voice* (pp. 121–141). De Gruyter. https://doi.org/10.1515/9783110789836-006

Sarvasy, H. S. (2024). Clause chains in Finisterre Papuan languages. In H. S. Sarvasy & A. Y. Aikhenvald (Eds.), *Clause chaining in the languages of the world* (pp. 187–229). Oxford University Press. https://doi.org/10.1093/oso/9780198870319.003.0007

Sarvasy, H. S. (forthcoming). Clause chains in Papuan languages. In N. Evans & S. Fedden (Eds.), *Oxford guide to the Papuan languages*. Oxford University Press.

Sarvasy, H. S., & Choi, S. (2020a). Beyond the two-clause sentence: Acquisition of clause chaining in six languages. *Frontiers in Psychology 11*, Article 1586. https://doi.org/10.3389/fpsyg.2020.01586

Sarvasy, H. S., & Choi, S. (Eds.). (2020b). *Acquisition of clause chaining*. Frontiers Media SA. https://doi.org/10.3389/978-2-88966-291-3

Sarvasy, H. S., & Choi, S. (2024). Acquisition of clause chaining. In H. S. Sarvasy & A. Y. Aikhenvald (Eds.), *Clause chaining in the languages of the world* (pp. 60–96). Oxford University Press. https://doi.org/10.1093/oso/9780198870319.003.0003

Sarvasy, H. S., Elvin, J., Li, W., & Escudero, P. (2019). An acoustic analysis of Nungon vowels in child-versus adult-directed speech. In *Proceedings of the 19th International Congress of Phonetic Sciences Melbourne* (pp. 3155-3159).

Sarvasy, H. S., Elvin, J., Li, W., & Escudero, P. (2020). An acoustic phonetic description of Nungon vowels. *Journal of the Acoustical Society of America 147*(4), 2891–2900. https://doi.org/10.1121/10.0001003

Sarvasy, H. S., Li, W., Elvin, J., & Escudero, P. (2022). Vowel acoustics of Nungon child-directed speech, adult dyadic conversation, and foreigner-directed monologues. *Frontiers in Psychology 13*, Article 805447. https://doi.org/10.3389/fpsyg.2022.805447

Schieffelin, B. B. (1979). Getting it together: An ethnographic approach to the study of the development of communicative competence. In E. Ochs & B. B. Schieffelin (Eds.), *Developmental pragmatics* (pp. 73–108). Academic Press.

Schieffelin, B. B. (1985). The acquisition of Kaluli. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition, Volume 1* (pp. 525–593). Erlbaum. https://doi.org/10.4324/9781315802541-6

Schieffelin, B. B. (1990). *The give and take of everyday life: Language socialization of Kaluli children*. Cambridge University Press.

Snow, C. E. (1995). Issues in the study of input: Fine-tuning, universality, individual and developmental differences and necessary causes. In P. Fletcher & B. MacWhinney (Eds.), *The handbook of child language* (pp. 180–193). Basil Blackwell. https://doi.org/10.1111/b.9780631203124.1996.00007.x

Soderstrom, M. (2007). Beyond babytalk: Re-evaluating the nature and content of speech input to preverbal infants. *Developmental Review, 27*(4), 501–532. https://doi.org/10.1016/j.dr.2007.06.002

Stebbins, T. (2011). *Mali (Baining) grammar*. The Australian National University.

Stern, D. N., Spieker, S., Barnett, R. K., & MacKain, K. (1983). The prosody of maternal speech: Infant age and context related changes. *Journal of Child Language, 10*(1), 1–15. https://doi.org/10.1017/S0305000900005092

Sundberg, U., & Lacerda, F. (1999). Voice onset time in speech to infants and adults. *Phonetica, 56*(3–4), 186–199. https://doi.org/10.1159/000028450

Tomić, D., & Mildner, V. (2015). Development of /r/ in Croatian. In *Proceedings of the 18th International Congress of Phonetic Sciences* (pp. 0716.1–0716.5). The University of Glasgow.

Turpin, M., Demuth, K., & Campbell, A. N. (2014). Phonological aspects of Arandic baby talk. In R. Pensalfini, M. Turpin, & D. Guillemin (Eds.), *Language description informed by theory* (Studies in Language Companion Series, Vol. 147, pp. 49–80). John Benjamins. https://doi.org/10.1075/slcs.147.04tur

Wang, Y., Seidl, A., & Cristia, A. (2015). Acoustic-phonetic differences between infant-and adult-directed speech: The role of stress and utterance position. *Journal of Child Language, 42*(4), 821–842. https://doi.org/10.1017/S0305000914000439

Wang, L., Kalashnikova, M., Kager, R., Lai, R., & Wong, P. C. M. (2021). Lexical and prosodic pitch modifications in Cantonese infant-directed speech. *Journal of Child Language, 48*(6), 1235–1261. https://doi.org/10.1017/S0305000920000707

Wegmann, U. (1994). *Yau-Uruwa dialect survey* [Unpublished manuscript]. Summer Institute of Linguistics.

Weinstein, N., & Baldwin, D. (2024). Reification of infant-directed speech? Exploring assumptions shaping infant-directed speech research. *Culture & Psychology, 30*(1), 216–242. https://doi.org/10.1177/1354067X221147683

Woolard, A., Benders, T., Campbell, L. E., Whalen, O. M., Mallise, C., Karayanidis, F., Barker, D., Murphy, V. E., Tait, J., Gibson, P., Korostenski, L., & Lane, A. E. (2023). The relationship between pitch contours in infant-directed speech and early signs of autism in infancy. *Infant Behavior and Development, 72*, Article 101860. https://doi.org/10.1016/j.infbeh.2023.101860

Xu, N., Burnham, D., Kitamura, C., & Vollmer-Conna, U. (2013). Vowel hyperarticulation in parrot-, dog- and infant-directed speech. *Anthrozoös, 26*(3), 373–380. https://doi.org/10.2752/175303713X13697429463592

**Abbreviations**

1, 2, 3  first, second, third person
ADS    adult-directed speech
BT      baby-talk
CDS    child-directed speech
CONJ   conjunction
CS      child speech
DEF    definite
DS      different-subject
DU     dual
ERG    ergative
FUT    future
GEN    genitive
IMP    immediate imperative
IRR    irrealis
LOC    locative
MV     medial verb form
NA     not applicable
NF     non-final
NFUT  near future

| NMZ | nominalizer |
| O | object |
| PL | plural |
| PNG | Papua New Guinea |
| PPR | present progressive |
| PRES | present |
| PRF | perfective |
| PROX | proximal |
| Q | polar question |
| RF | remote future |
| RP | remote past |
| SG | singular |
| SS | same-subject |

## Data, Code and Materials Availability Statement

The Editor, Ben Ambridge, granted (on 4 September 2024) an exemption to data-sharing for the Ku Waru corpus, on the basis that this corpus is already available, after free sign-up, at the PARADISEC site (https://catalog.paradisec.org.au/collections/AR3). The Editor also granted an exemption to data-sharing for the Nungon corpus, on the basis that these are child–parent interactions from a community who are largely unfamiliar with the workings of the internet, large-language-models etc., and who are therefore unable to provide fully-informed consent for data sharing. Applications for access to the corpus should be sent to the first author. The data for the new analyses reported here (.wav, ELAN, PRAT and spreadsheet files) as well as the analysis code are available at https://osf.io/zmchn/.

## Ethics Statement

Data discussed here were collected under the Australian National University Human Ethics approval 2013/055 (Ku Waru, Nungon) and Western Sydney University Human Ethics approval H13536 (Nungon). Written consent was obtained from families who participated.

## Authorship and Contributorship Statement

**Hannah Sarvasy** proposed the comparative study, analyzed Nungon lexical data, drafted general and Nungon data sections, and contributed to revisions. **Alan Rumsey** analyzed Ku Waru lexical data, drafted general and Ku Waru data sections, and contributed to revisions. **Josua Dahmen** analyzed Ku Waru prosodic data, contributed to drafting the general prosody and Ku Waru prosody sections, and contributed to revisions. **John Onga** collected and recorded Ku Waru lexical perception data. **Stephanie**

**Yam** analyzed Ku Waru prosodic data and contributed to drafting the general prosody and Ku Waru prosody sections.

## Acknowledgments

## License