Pirahã Infants Acquire Language Without Direct Input

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Abstract

To counter nativist claims about Language Acquisition (e.g., Chomsky, 1965), researchers have attempted to show the importance of rich Adult-Infant/child verbal and non-verbal interactions as an alternative explanation of how language learning is possible. Some have suggested that language learning is scaffolded with recasts and expansions of utterances that are indirect ways of correcting grammar (Bohannon & Stanowicz, 1988; Farrar, 1992). Others have suggested that joint attention is a crucial precursor to language learning (Tomasello & Farrar, 1986). However, cross-cultural studies of language interactions between adults and young children have revealed several cultures where speaking to infants and children is rare (Heath, 1983, Schieffelin & Ochs, 1986, Pye, 1986). A recent more systematic study by Schneidman and Goldin-Meadow (2012) showed that direct speech to Yucatec Mayan infants was relatively low (~ 55 utterances per hour), as compared to infants in the US, who heard a mean of 605 utterances per hour. Infants do not learn language in a vacuum. Hence, their linguistic acquisition has to come from overheard speech of other individuals in their environment (Akhtar, 2005, Lieven, 1994.) The present study originated from naturalistic observations of Pirahã tribal members in lowland Amazonia, whose language has been studied extensively by Dan Everett. In studying and living with this tribe, it is apparent that adults almost never spoke directly to preverbal infants, and only rarely to pre-teen children who had acquired language. Dan Everett has been working with the tribe for several decades, and Peter Gordon spent 3 summers working and living with them for up to 6 weeks. On 2 visits, Gordon, set up video cameras to record naturalistic interactions within the tribe, and these videos are available on Databrary (2012). Filmed sessions recorded on six 2-hour tapes included spontaneous events -- when possible, the camera was left on a tripod unattended to capture naturalistic interactions. We used ELAN to systematically analyze adult-infant/child interactions and behaviors of the Pirahã villagers from these videos. We first coded situations as Opportunities to Interact (OTI), if two or more individuals were in close proximity within a scene. From the OTIs, we coded for direct speech, overheard speech, and instances of joint attention. We categorized non-adults into “preverbal infants” and “linguistically-fluent pre-teens” (approx 4-10 years of age). Adult-to-child direct speech occurred in only 4 instances with the pre-teens. There were no direct interactions with the preverbal infants. In no cases was Joint Attention found as a precursor to direct speech. Since direct speech to infants and children was almost non-existent, their language input consisted almost entirely of indirect or overheard speech, or conversations between pre-teen children. The present data suggest that Pirahã speech of adults to infants is even more impoverished than previous studies of the Mayan Yucatec tribe or any previously documented group. These data suggest that theories of language acquisition must account for situations in which the source of input is almost entirely overheard speech, and that parental scaffolding of language is not a necessary component of the language learning process.

Introduction

- Nativist approaches to language acquisition have pointed to the problem of underdetermination, in that the language children hear is not sufficient to account for the final form of the grammar (Chomsky, 1965)
- Some researchers have suggested that language learning is scaffolded with recasts and expansions of utterances that are indirect ways of correcting grammar (Bohannon & Stanowicz, 1988; Farrar, 1992)
- Joint attention has also been proposed as a precursor to language learning (Tomasello & Farrar, 1986) that obviates problems pointed out by nativist approaches
- In general, many current researchers consider that social interactional, functionalist assumptions, and indirect correction strategies are sufficient to account for language learning in infants
- Such accounts assume that infants engage in rich interactions with adults and other children within their social context

Is Rich Input to Language Universal?

- Cross-cultural studies of language interactions between adults and young children have revealed several cultures where direct speech to infants and children is rare (Heath, 1983; Schieffelin & Ochs, 1986; Pye, 1986)
- A recent systematic study by Schneidman and Goldin-Meadow (2012) showed that direct speech to Yucatec Mayan infants was relatively low (~ 55 utterances per hour), as compared to infants in the US, who heard a mean of 605 utterances per hour. They concluded that infants do not learn language in a vacuum. Hence, their linguistic acquisition has to come from overheard speech of other individuals in their environment (Akhtar, 2005; Lieven, 1994)
- In cases of impoverished input, we still find some direct speech to children, which could be argued to be sufficient to overcome problems of underdetermination
- The present study examines the Pirahã culture, where a lack of direct speech to infants and children is quite extreme. We attempt to quantify the amount of direct speech, overheard speech, and shared attention in naturalistic everyday activities by this tribe using ELAN video data analysis

Pirahã Culture and Background

- The Pirahã are the only surviving isolated subgroup of Mura tribe who live along the banks of Maici river in the Amazon rainforest in Brazil. They live in small villages of 10-20 individuals including adults, infants and children
- They are a monolingual hunter-gatherer society that does not integrate with mainstream Brazilian culture
- There is no system of writing, counting, art, education, or even a formal social hierarchy

Left: A Pirahã group in a typical open dwelling

Right: Two young adults playing with a pet otter

History and Data Collection

- Video-recording was carried out by Peter Gordon using a SONY portable videocam during three trips to two upriver Pirahã villages and one down-river village along with Dan Everett from 1991-93
- Gordon stayed in the village 1 week and 6 weeks on the first two visits
- Everett has been continuously living and working with members of the tribe for over 40 years, is fluent in the language, has published multiple linguistic papers and academic/trade books related to the Pirahã
- When possible the camera was left on a tripod unattended to capture naturalistic interactions without the influence of researchers
- Data were coded using ELAN
- At times, Everett was speaking with villagers, but no data were included if a non-Pirahã person appeared to be directing activities in any way, and videos of numerical cognition experiments (Gordon, 2004) were not coded
- All footage is available for inspection on Databrary (2012)

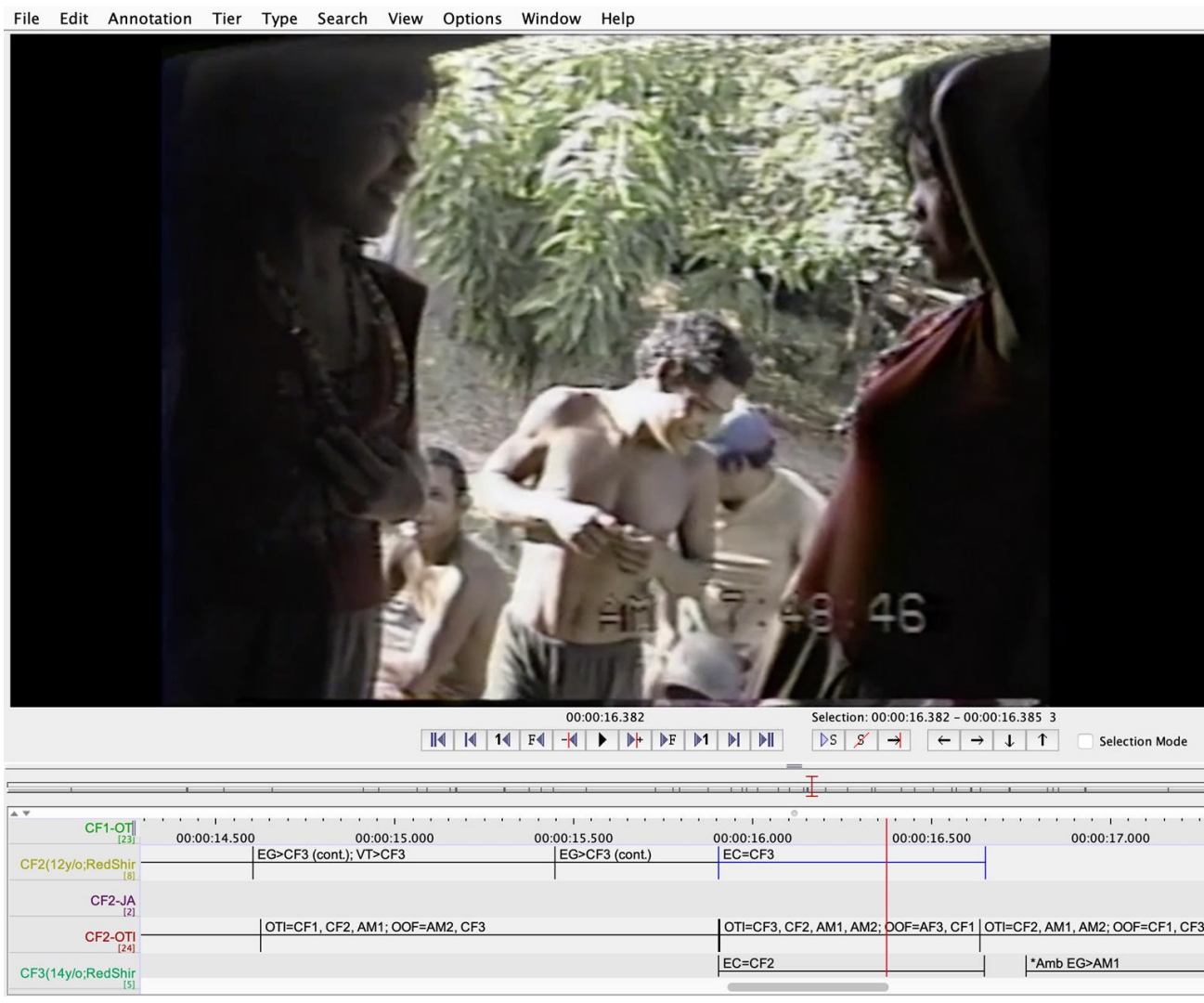
Methods: Coding System in ELAN

- The coding scheme that we developed included codes for:
  - *Verbal interactions*
  - *Verbalizations with no target*
  - *Non-verbal gesturing*
  - *Non-verbal behavior (e.g., holding, touching, grooming)*
  - *Eye gaze/contact. crying, laughing, joint attention*
- Participants were coded based on gender and age group:
  - *Adult (Female/Male)*
  - *Child (Female/Male)*
  - *Infant/Toddler (Female/Male if identifiable)*
- Since Pirahã do not count, age was estimated by the behavioral coders, with Gordon and Everett acting as consultants

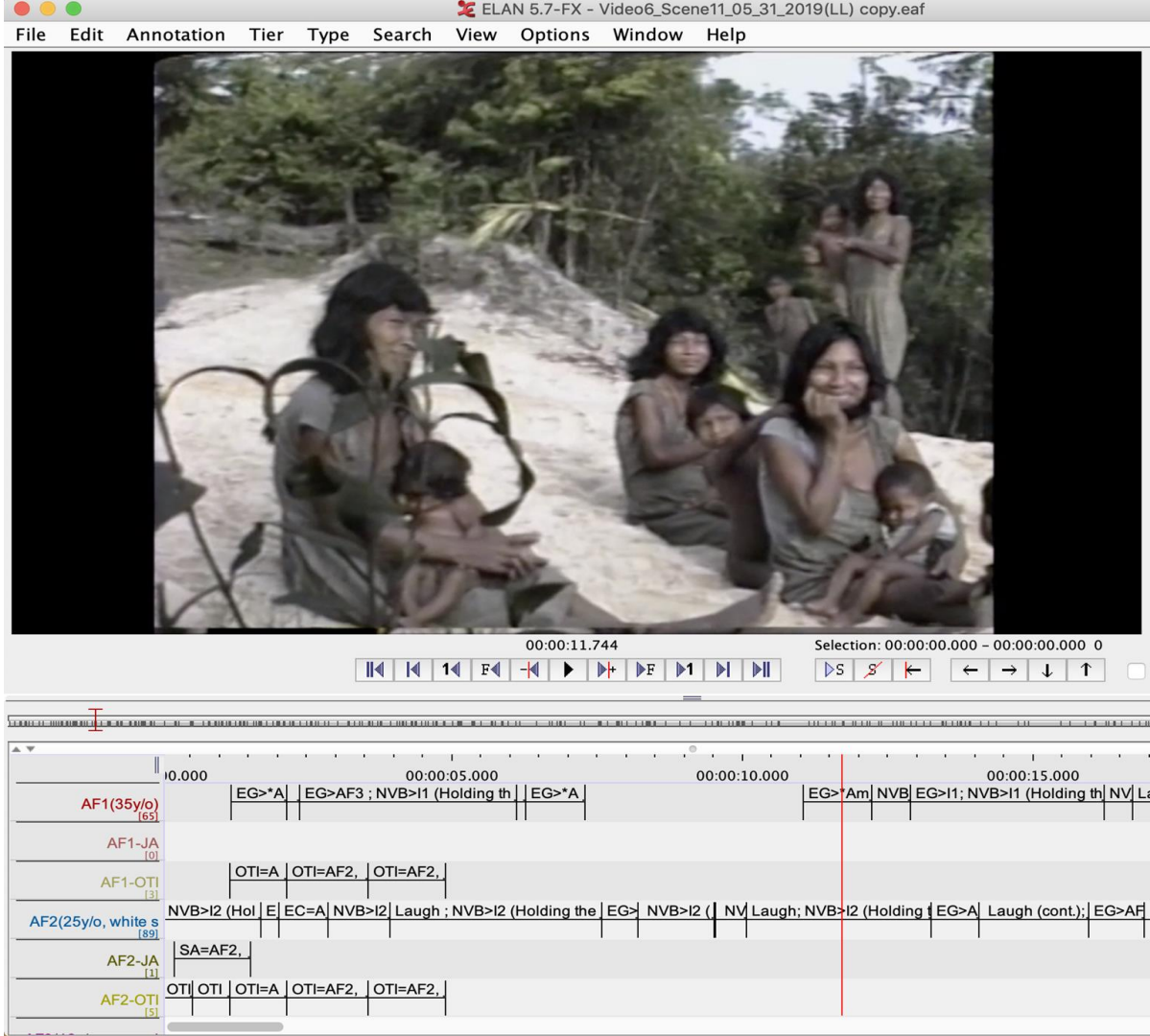
Methods: Measures of Opportunities to Interact (OTI)

- Opportunities to interact (OTI) are defined as the time that two or more individuals were in close proximity
- We coded Composition of individuals in groups present during codings of OTIs
- Durations of Verbal and non-verbal interactions were standardized by dividing duration of interaction by OTI duration for the segment
- An example coding page is present on the next panel

Screenshot of ELAN coding used to analyze a scene, where a Pirahã adult man was speaking to other tribal members and two child females were engaging in eye contact.



Screenshot from ELAN coding used to analyze a scene where a large group of Pirahã adult females, children and infants were gathering along the beach. Even though they were carrying/feeding their young, Pirahã mothers engaged in minimal eye contact with their infants



Results

- We analyzed a total of 12 hours of video recordings. Of these, only 36 minutes included multiple individuals (OTIs)
- Even though this is a fairly small sample, it is representative of everyday life within the Pirahã tribe
- Micro-coding of events (frame by frame) was highly labor intensive taking 1000’s of hours of coding and reliability checking
- 108 instances of directed speech and more than 10,000 instances of overheard speech were coded
- The distribution of these interactions is illustrated in the following Figures broken down by age group and situation type

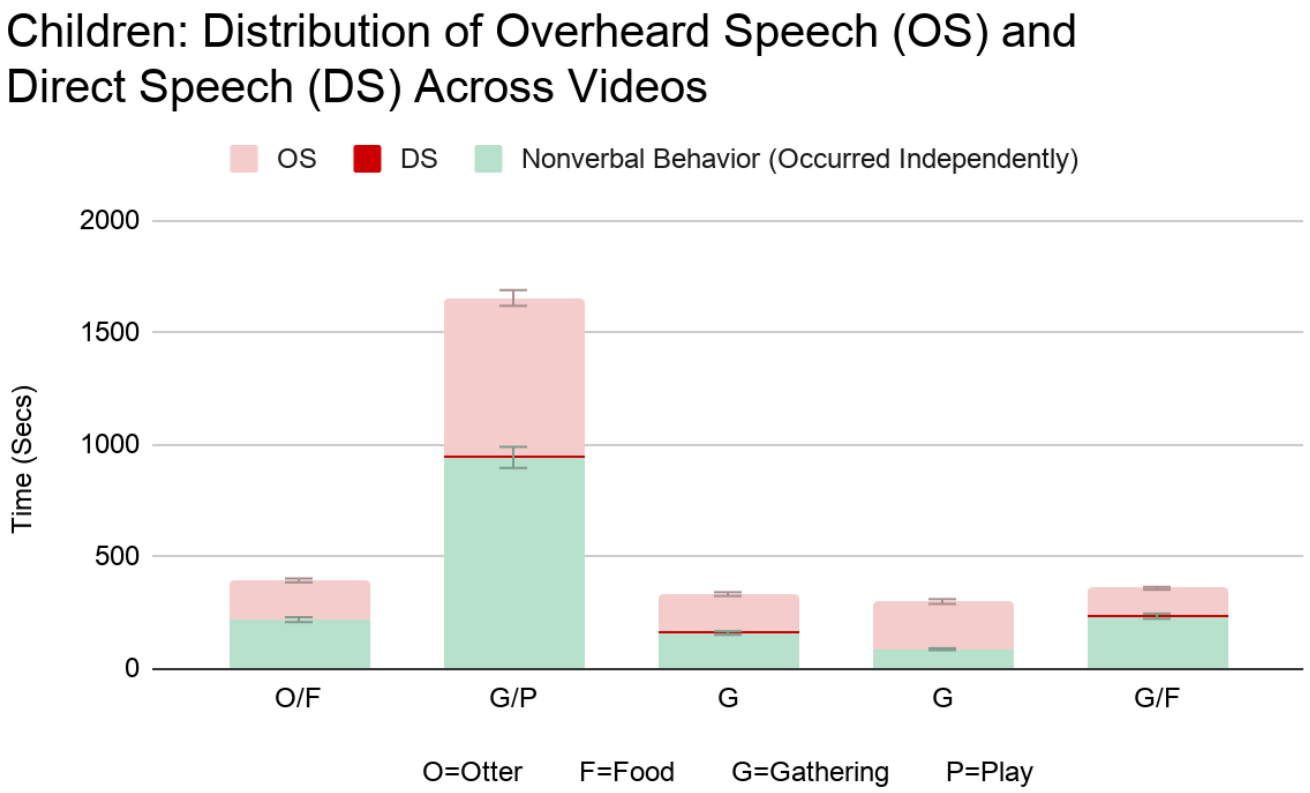


Figure 1. Pirahã children's language input: overheard speech and direct speech from adults

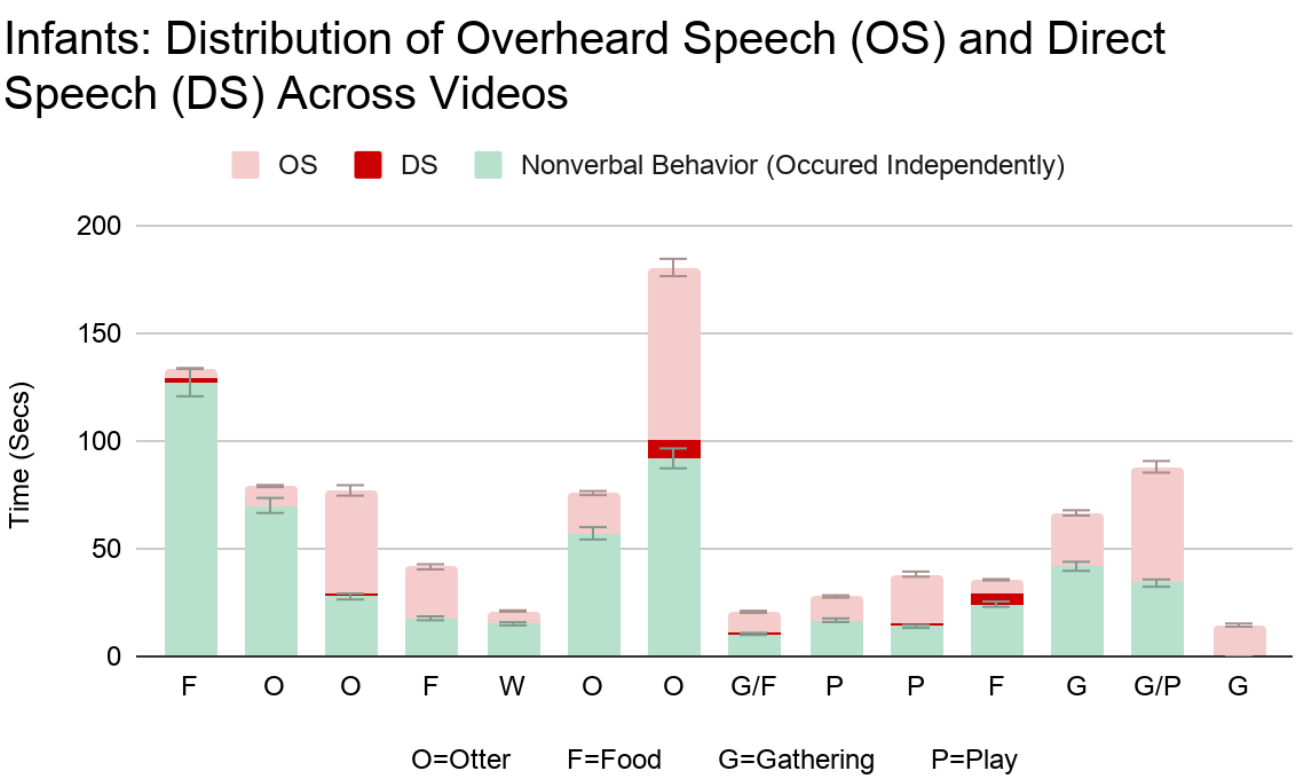
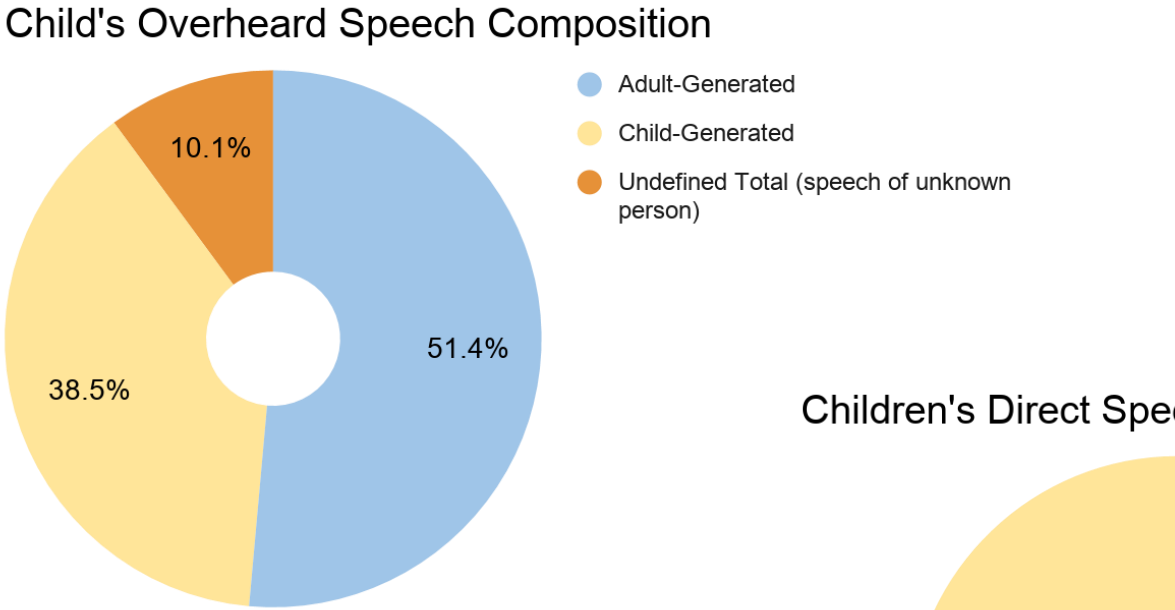
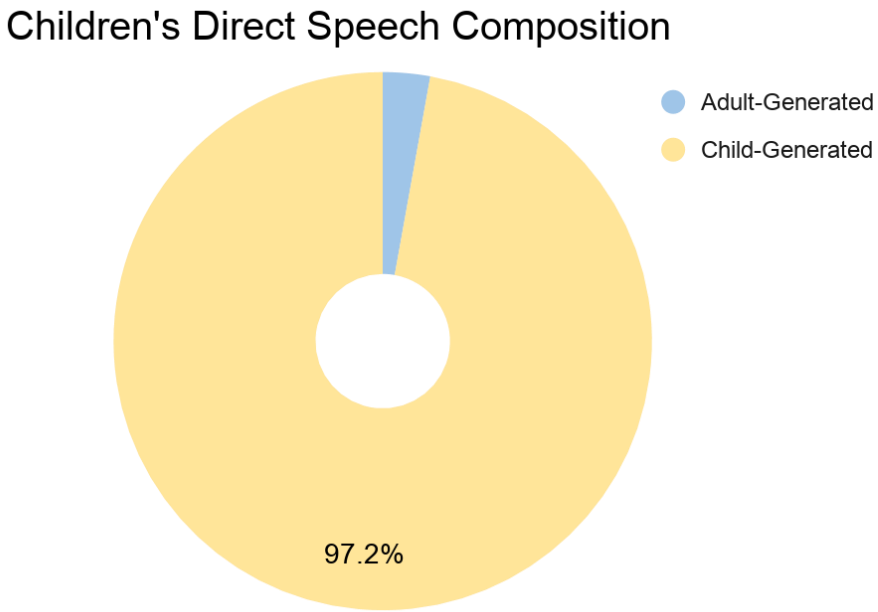
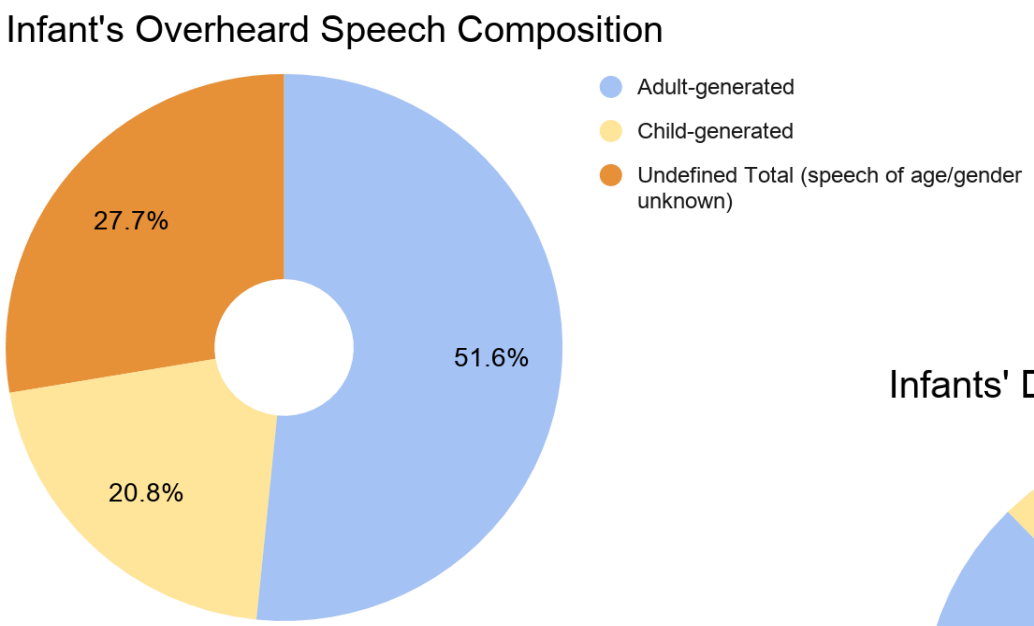


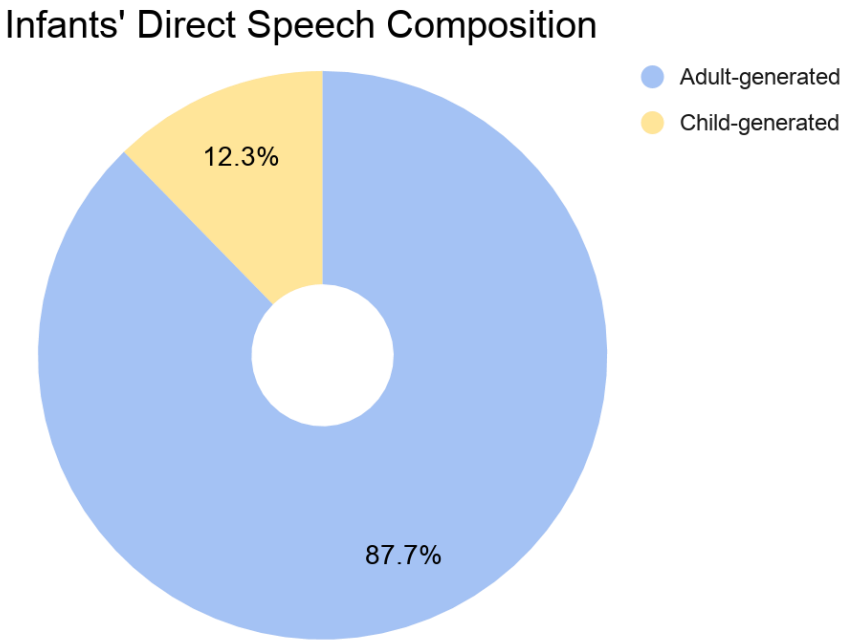
Figure 2. Pirahã infants' language input: overheard speech and direct speech from adults





Figures 3 & 4. Children's language input composition





Figures 5 & 6. Infants' language input composition

Discussion

- The present data suggest that Pirahã speech from adults to infants is even more impoverished than previous studies of the Mayan Yucatec tribe or any previously documented group
    - In cases where some directed speech existed, conversations were mostly quite short (one or two words) and purposeful, or a general comment to the situation/object, such as playing with a wheelbarrow, asking for a cup, or feeding a pet otter (translations provided by Dr. Daniel Everett)
    - None of those utterances were intended to be any form of ritualized language teaching - no conversational recasts or vocabulary expansion were found
    - Older children of the tribe also contributed to infants' overheard speech pool in addition to a small portion of the direct speech pool
    - Older children tended to talk within their own age group
- In no case was joint attention found as a precursor to direct speech within our data

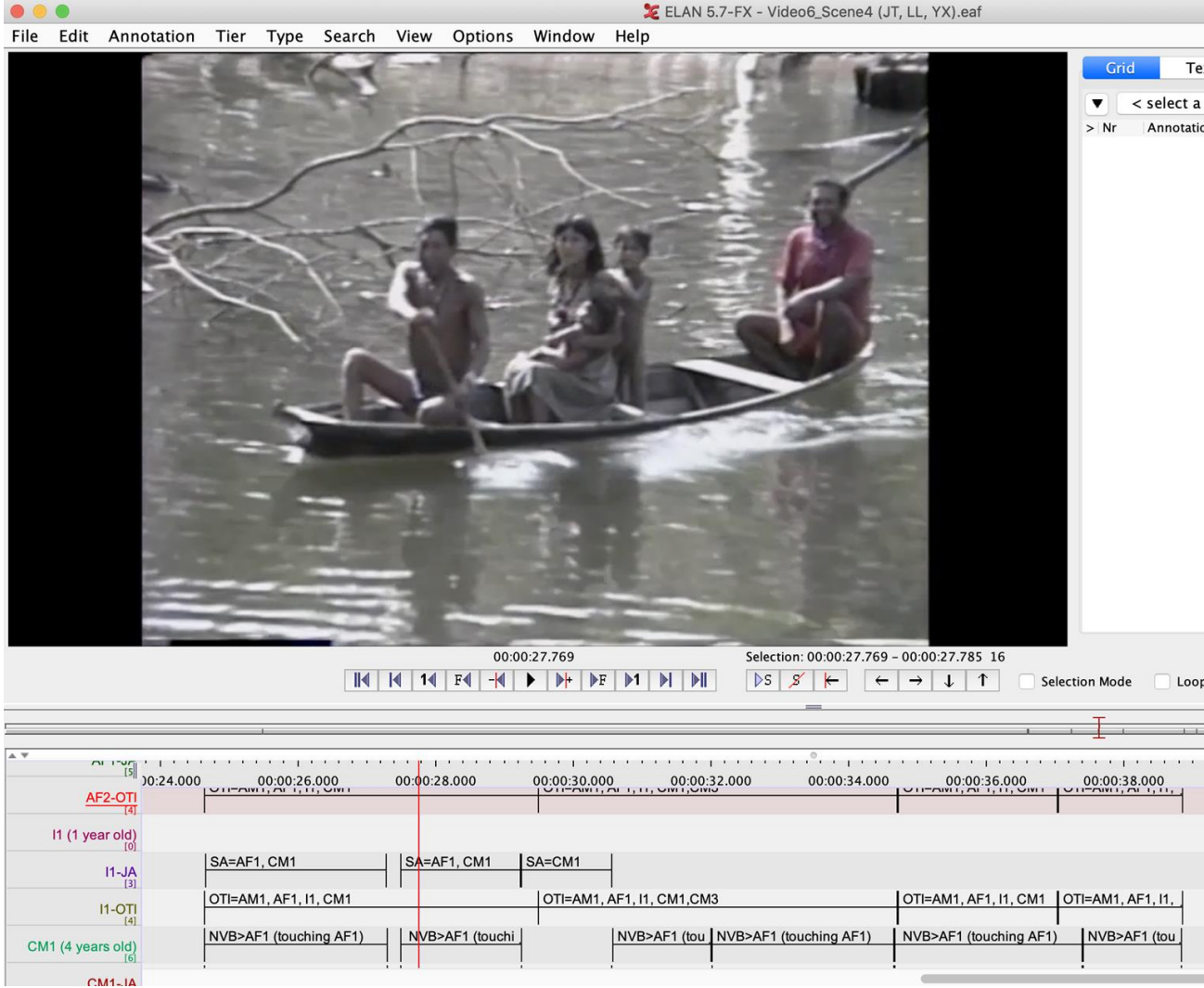
Discussion (cont.)

- In general, we found that there is very little verbal content that is specifically addressed to infants and children
    - Interaction is not absolutely zero, but is extremely sparse to serve as any form of language learning. Since direct speech to infants and children was almost non-existent, their language input consisted almost entirely of indirect or overheard speech and conversations between pre-teen children.
- Our data suggests that in the Pirahã culture, preverbal infants ought to acquire language largely through attending to the overheard speech of others around them and mapping the utterances of corresponding situations
- The data suggest that theories of language acquisition must account for situations in which the source of input is almost entirely overheard speech. Parental scaffolding of language is not available to supplement the language learning process

Representativeness of the Data

- Although the present dataset is relatively small and unstructured, the kinds of interactions we recorded are completely “normal” for everyday life for the tribe
- There are no special situations where mother-infant interaction occurs on a more intense scale. Both Everett and Gordon have spent months living amongst the tribe. Dwellings are completely open and so there are no “secret” situations where greater amounts of interaction might have taken place
- The Pirahã spend large amounts of their days sitting around and not saying very much, punctuated by more active times where multiple individuals may speak simultaneously when excited over an activity.
- When carrying babies, mother face them outward. We do not see is mothers sitting facing their infants for one-on-one interaction

Screenshot from ELAN coding used to analyze a scene where a small group, consisting of Pirahã adult males, an adult female,a child and an infant, were paddling on a boat.



References

Akhtar, N. (2005). The robustness of learning through overhearing. *Developmental Science, 8*(2), 199–209.

Bohannon, J. N., & Stanowicz, L. B. (1988). The issue of negative evidence: Adult responses to children's language errors. *Developmental Psychology, 24*(5), 684–689

Chomsky, N. (1965). *Aspects of the Theory of Syntax*. Cambridge, Mass: M.I.T. Press.

Everett, D. L. (2005). Cultural constraints on grammar and cognition in Pirahã. Current Anthropology, 46, 621–646.

Databrary. (2012). The Databrary Project: A video data library for developmental science. New York: New York University. Retrieved from http://databrary.org

Farrar, M. J. (1992). Negative evidence and grammatical morpheme acquisition. *Developmental Psychology*, *28*(1), 90–98.

Gordon, P. (2004). Numerical cognition without words: Evidence from Amazonia. *Science, 306*(5695), 496–499.

Heath, S. B. (1983). *Ways with words: language, life, and work in communities and classrooms.* Cambridge: Cambridge University Press.

Lieven, E. V. M. (1994). Crosslinguistic and crosscultural aspects of language addressed to children. In C. Gallaway & B. Richards (Eds.), *Input and Interaction in Language Acquisition*, (pp.56–73). Cambridge: Cambridge University Press.

Pye, C. (1986). Quiché Mayan speech to children. *Journal of Child Language, 13*(1), 85–100.

Schieffelin, B. B., & Ochs, E. B. (1986). *Language Socialization across Cultures*. In B. Schieffelin & E. Ochs (Eds.) *Studies in the social and cultural foundations of language, Vol. 3.* (pp. 80-96). Cambridge University Press.

Shneidman, L. A., & Goldin-Meadow, S. (2012). Language input and acquisition in a Mayan village: How important is directed speech? *Developmental Science*, *15*(5), 659–673.

Tomasello, M., & Farrar, M. J. (1986). Joint Attention and Early Language. *Child Development*, *57*(6), 1454-1463.