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False Speech Reports in Pirahã: A Comprehension Experiment*

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A lively debate has ensued about syntactic recursion in the language Pirahã starting with a paper by Everett (2005) (see also Roberts 2015). Everett claims that Pirahã does not allow syntactic recursion. Furthermore he claims that a constraint that is part of Pirahã culture mitigates against the use of recursion by the Pirahã. Nevins et al. (2009a) argue that there are several problems with Everett's argumentation. Specifically they show that several arguments presented by Everett don't support his conclusions, and that in other cases there are factual contradictions between earlier work of Everett's on Pirahã and the 2005 paper. In response, Everett (2009) partially revised his analysis of some Pirahã data and made other changes to his argument, which are discussed further by Nevins et al. (2009b).

The debate has ensued for the most part without new data. In fact, most of the data the debate has rested on data that seem to be about 30 years old (though see Stapert 2007, Sauerland 2010, Rodrigues et al. 2015, Sandalo et al. 2015). Everett's (2005) arguments are based on the reevaluation of his own field data from the 1980s and on data gathered even earlier by Sidney Sheldon. Nevins *et al.* rely exclusively on data from the published literature. This paper presents new data from an experiment designed to test for the comprehension of speech reports by Pirahã speakers.

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Throughout I understand *recursion* along the lines of the formal concept *self-embedding* defined in Chomsky (1959)–a property of a language that provably requires an analysis that is not finite state.[1] Recall that a finite-state language is defined as one that can be parsed by an automaton that has only finitely many memory states, i.e. a finite state state automaton. A simple self-embedding grammar is the mirror grammar generating strings like *aa*, *abba*, *abccba*, *abcddcba*, and so on. Because a parser for this grammar needs to remember up to the middle of the string all prior symbols, finite memory would be insufficient. Sauerland & Trotzke (2011) suggest that this understanding of *Recursion* as beyond-finite-state is relevant to previous discussions of Hauser et al. (2002). The beyond-finite-state understanding is different from one based on current syntactic analyses where any sentence containing three elements or more must involve recursion at the level of the generalized transformation *Merge* (Chomsky 1995). However, current syntactic analyses assume a phrase structure analysis as necessary, while it is part of the debate concerning Pirahã whether a phrase structure analysis is necessary. Therefore the abstract, mathematical notion of Chomsky (1959), that motivates the phrase structure analysis of English, is the right starting point for the following discussion. I adopt one modification of Chomsky's approach, though, that I argue for in (Sauerland 2015): Chomsky's notion of grammar only concerned the generation of the grammatical strings. Because of this perspective, Chomsky could show that only center embedded structures require a analysis that isn't finite state. I, however, adopt the modern view that a grammar generates form-meaning pairs (Chomsky 1995 and many others). This has consequences for what a finite state analysis can accomplish. Specifically, my (Sauerland 2015) argues that a finite state analysis is insufficient for left or right embedded structures if the semantic analysis requires a memory load that grows with each level of embedding. I conclude therefore that even non-center embedded structures can be recursive in the sense of requiring a non-finite-state analysis if they require unbounded memory for the semantic interpretation.

In this paper, I address one specific aspect of recursion in Pirahã: embedded clauses, and more specifically complement clauses. I focus on this domain rather other cases of recusion for two reasons: For one, the semantics of embedded sentences clearly requires a memory load that grows with each level of embedded (Cresswell 1990), such that even right (or left) recursive embedding of sentences is beyond a finite state analysis (Sauerland 2015). Secondly, the

[1] Chomsky (1959) actually uses the notion *regular grammar*, but Chomsky & Miller (1958) showed the equivalence of the notions of regular and finite-state languages. The term *finite-state* language is more commonly used, so we adopt this terminology.

meanings of some other recursive constructions in European languages can alternately be expressed also without the use of a recursive structure, while complement clauses are sometimes essential to describe the propositional attitudes of others. For instance, single possessor recursion in (1a), double possessor recursion in (2b), and single prepositional phrase recursion in (3a) can all be expressed without recursion of this type as in (1b), (2b), (2c) and (3b).

(1) a. John's mother smiled.
b. John has a mother and she smiled.

(2) a. John's mother's car broke.
b. John has a mother and she has a car and it broke.

(3) a. The house in the village is pretty.
b. In the village is a house and it is pretty.

Some complement clauses though cannot be expressed recursion-free. This is illustrated by the failed attempt to paraphrase (4a) recursion-free as in (4b).

(4) a. John believes that he didn't do anything wrong.
b. John didn't do anything wrong and he believes/knows it.

Sentence (4a) can be uttered by an honest speaker who is certain that John in fact did something wrong. But, (4b) couldn't be uttered by an honest speaker who believes that John did something wrong. This limitation of (4b) follows directly from standard theories of speech acts such as Stalnaker (1978) where a declarative sentence must reflect the speaker's beliefs (see also Meyer 2013). A speaker who is convinced that John did something wrong couldn't utter (4b) even if *perhaps* or a possibility modal is added to the first conjunct. Therefore, embedding in complement clause structures is necessary to report other people's propositional attitudes without committing the speaker to the same attitude.

English grammar allows sequences of two apparent root clauses like (5) with roughly the same meaning as (4a) (Davidson 1968). These initially appear to not involve embedding because a colon joins the two clauses in writing. However, I believe the English rules of punctuation are a poor guide to syntactic structure and that a sequence like (5) is actually an instance of one complex syntactic structure, and therefore a case of a syntactic complementation.

(5) John believes this: He didn't do anything wrong.

Four arguments for an analysis of (5) as one single sentence come from intonation and word order facts. For one, (5) has a specific intonation contour with a rise on *this* and a subsequent fall. Secondly, if we switch around the order of the two sentence parts of (5) as in (6), the meaning is different. Namely, (6) just like (4b) is incompatible with a speaker who believes that John did something wrong.

(6) He didn't do anything wrong. John believes this.

The third argument comes from the observation that no non-embedded clause can occur between *this* and the second clause in (5). For example, the middle clause in (7) is hard to construe with an embedded interpretation, and correspondingly the final clause can also not be construed as embedded, but must reflect the speakers opinion.

(7) John believes this. He is of course wrong. He didn't do anything wrong.

Finally, a Condition C effect can be observed in such sequences: In (8), the pronoun *he* is difficult to understand as coreferent with *John*.

(8) *He$_i$ believes this: John$_i$ didn't do anything wrong.

This reasoning shows that complement clauses are crucial for false belief expression. Findings in language acquisition of complement clauses corroborate this point. Namely, work in language acquisition has shown that the mastery of complement clause syntax by children has significant effects on their social cognition (de Villiers & Pyers 2002, Schick et al. 2007, Pyers & Senghas 2009). Specifically, this work shows that one aspect of social cognition, namely Theory of Mind, is on some tests absent before the acquisition of complement clauses, and delayed when the acquisition of complement clauses is delayed (see also Corrêa et al. 2015, Hollebrandse 2015). While other works report that different tests for Theory of Mind indicate an earlier presence of Theory of Mind (e.g. Clements & Perner (1994), Southgate et al. (2007)), this likely shows that there are two related abilities one of which is supported by complement clause understanding. Therefore, a language without embedded clauses would be expected to either be strictly less expressive than well-studied

languages or to have a semantic mechanism that differs from those available in well-studied languages. Either would be a surprising finding.[2]

1 Method and Participants

In this paper, I report a study that considered the interpretation of sentences that in earlier writings of Everett (specifically, Everett 1986) were described as speech reports. One important characteristic of attitude reports is that the speaker need not share the reported attitude expressed in the embedded clause – in fact, the speaker can disagree with the content of the embedded clause. Consider for example, what I as a speaker commit to by uttering (9): I don't need to be myself committed to the truth of what Joe said, i.e. I can utter (9) even when I myself am not of the opinion that I misbehaved.

(9) Joe said that I misbehaved.

The kind of commitment a speaker takes on with an assertion is shown by what is called *Moore's problem* in the philosophical literature (see e.g. Sorensen (2013)) and is illustrated in (10a). The contrast between (10a) and (10b) shows that the speaker takes on no commitment to the truth of the embedded clause as already mentioned above.

(10) a. #I went to the pictures last Tuesday, but I don't believe that I did. (Moore 1942)
b. Joe said I went to pictures last Tuesday, but I don't believe that I did.

For the following, I operationalize the distinction between matrix and embedded sentences using true reports of a false statement. Consider the scenario indicated in (11), where speaker A utters a statement that is evidently false. A subsequent speech report with the same content in the complement clause is nevertheless true: in (11a), speaker B accurately reports what speaker A said. But, a non-embedding conjunction as in (11b) is judged differently: because in this case, speaker B takes on a commitment to the truth of the content of

[2]Note that this reasoning predicts that embedded clauses should occur across langauges independently of European influence, as e.g. Vieira (2015) shows for Tupinambá, an extinct Tupi language of the first contact between Europeans and the Brazilian indigenous population. The observation that embedding is marked in ways unfamiliar from European languages further corroborates this point (Storto et al. 2015, Seki & Nevins 2015, Duarte 2015, Stenzel 2015, Thomas 2015, Nonato 2015).

the second conjunct, (11b) is false. Utterance (11c) with two independent sentences is interpreted like a coordination of the two as for example the discourse model of Stalnaker (1978) makes explicit.

(11) Speaker A: My skin is green.

a. Speaker B: Speaker A said that his skin is green.
b. Speaker B: Speaker A was talking and his skin is green.
c. Speaker B: Speaker A was talking. His skin is green.

The distinction in (11) can be used to determine whether a Pirahã structure is understood as subordination or as two independent sentences or a coordination.[3] For this purpose, I constructed 10 short dialogs in Pirahã like the following and recorded them with Toe as the speaker A and a second Pirahã as speaker B. For the recordings, the sentences were written out by with the help of the translator and a Pirahã consultant. Then the translator read out the sentences one at a time and the Pirahã speakers repeated the sentence they just heard. These utterances of the two native Pirahã speakers were recorded and then used to create the experiment.

(12) A: ce kahápe ogéhiai igeuo
I have-been stars there
'I have been to the stars.'
B: Toi hi gái-sai ce kahápe ogéhiai igeuo
Toe 3s say 1s have-been stars there
subordination: *'Toe says "I have been to the stars."'*
coordination: *'Toe talked and I have been to the stars.'*

As in (11), the first sentence in (12a) and the other nine dialogs consisted of a single, obviously false statement. The second statement was spoken by a different speaker, and was the critical utterance. It contained a form of the verb *gái* followed by the report of Toi's utterance. If Pirahã speakers could construe this utterance as subordination, the interpretation of (12b) should be like that of subordination in English. But, if the only construal available to Pirahã speakers was coordination, then only a different interpretation ought to be available to the Pirahã speakers. In the scenario, the two interpretations are predicted to differ in truth: the subordinated interpretation is predicted

[3]Two other, frequently used, terms for the distinction between subordination and coordination are *hypotaxis* and *parataxis*. In the following, I continue to use only the Latinate terms *sub-/coordination* for consistency.

to be true because speaker B is accurately reporting the false statement that speaker A made. The coordination structure, however, would be predicted to be false because the second conjunct is false.

Sentence (12b) contains the indexical pronoun *ce/ti* ('I') as the subject of the potentially embedded clause. Therefore (12b) only is true if the interpretation of the indexical is shifted to denote Toe, the subject of *gái-sai*. A similar indexical shift is possible in English only with direct speech, which is a quotation subject to a verbatim requirement. However, recent comparative work has found that some languages allow indexical shift in complement clauses that aren't direct speech, an at least in the language Matses indexical shift is obligatory in complement clauses (Munro et al. 2012). For Pirahã, Everett (1986) reports that both direct and indirect speech are possible, but I found that most speakers used sentences with indexical shift as in (12b) in attitude reports. Hence, I used sentences like (12b) in this experiment.

The results of the comprehension task might have been affected by a number of factors other than the syntactic structure assigned to speaker B's utterance. The experiment was conducted with recorded utterance replayed from a laptop computer over loudspeakers and the participants answers were recorded with a small digital recorder. Pirahã speakers were neither used to participate in such experiments nor familiar with computer technology.[4] This may have led to the Pirahã participants not attending fully to the recordings at least at times during the experiment and therefore leads us to expect a greater amount of noise in the data than with other participant groups. An additional concern was the Pirahã's ability to accurately hear the recordings and not be distracted by environmental noises during the experiment. Nevertheless, I chose to present the items without the use of headphones and in different places within the two settlements to be able to recruit a large number of participants. Finally, the two native speakers that recorded the utterances with me were both respected, older man and some of the experiment participants might have found it hard to classify any of their utterances as false.

To eliminate the effect of the extraneous factors just mentioned on the results, I included nine control items in the experiment. The control items were similar to the experimental items, but the second speaker didn't accurately report the statement of the first speaker. (13) shows an example of such a control item. Since speaker B's statement is in this case not an accurate report

[4]In Forquilha Grande, there was no grid electricity in 2009. While I was in the village, most Pirahã were watching Brazilian DVDs after dark on a TV screen operated by staff of the FUNAI, the Brazilian government organization in charge of the native Americans. But since the Pirahã at least at the time didn't possess an electricity generator, DVD-screenings could only occur while FUNAI staff were present.

of what speaker A said, the expected response in the experiment is rejection of speaker B's utterance. I worked with the same two Pirahã speakers to record the control items as for the experimental items.

(13) A: ce kahápe kahe'ai igeuo
I have-been moon there
'I have been to the moon.'
B: Toi hi gái-sai ce kahápehai heesé igeuo
Toe 2s say 1s have-been sun there
Toe said 'I have been to the sun.'

The experimental items were generated and recorded in Forquilha Grande. For the recording, I recruited two native Pirahã speakers. They are both men, speaker A is from Forquilha Grande and speaker B from Ce'ege (in Portuegese 'Pereira'). The name of speaker A, *Toe*, occurs in almost every recording. First, speaker A recorded the 30 unembedded sentences given in the appendix. These recordings were played back to speaker B, who was instructed to produce a speech report for each of the 30 items starting with *Toe higaisai*.[5] Finally, I arranged the recorded sentences on the computer into the order used for the experiment as follows: For the experimental items, I concatenated the statement by speaker A with the corresponding speech report. For the control items, I concatenated a statement by speaker A with a speech report corresponding to a different statement. Specifically, the basic statements in the appendix are arranged in ten blocks of three. In each case, I used the c sentence with the matching speech report, while I used the a statement with the speech report corresponding to the b-statement. For example, the true report (12) was generated from (i1c) and its report, which in the following is coded as item 1cc. The false report (13) was generated from (i1a) and the report of (i1b), and is coded as item 1ab in the following. In this way, each statement or its report or both were only used in a single experimental item.

The order of presentation was pseudo-randomized manually, but fixed for all subjects. I used two items as practice items during the instruction of the participants, namely 5cc and 5ab. Then the other items were presented in the following order: 10ab, 8ab, 2cc, 1ab, 9cc, 3cc, 6ab, 4cc, 9ab, 7ab, 4ab, 6cc, 3ab, 7cc, 10cc, 2ab, 1cc, and 8cc.

[5]In one case (namely the report of item (i9c) in the appendix), speaker B's utterance starts with *Ti higaisai* with a first person pronoun, rather than the name *Toe*. However, since the prefix *hi-* is third person, we assume that listeners ignored this speech error by speaker B in the experiment. The item is included in the following analysis.

The instruction of participants itself was partially scripted, but allowed some individual variation. In English, the instruction was to answer the question 'Did Speaker B hear well?' or 'Did Speaker B say the truth?' and to answer with *ma'a* ('yes') or *maabi* ('no'). The instructions were translated into Portuguese and Pirahã and then the first practice item 5cc was played, and participants were asked to respond. Whether they gave a response or not, participants were then told that *ma'a* ('yes') would've been the correct response. In case a subject gave initially no response at all, had questions or seemed unsure, the practice item was repeated even multiple times. Then item i5ab was played. Again participants were asked to respond, but then also told about the correct response, in this case *maabi* ('no'). Again, the pratice may have been played repeatedly in case the task seemed to still be unclear. After this the experimental items were presented and subjects received no further feedback from the experimenters.

I gathered data during a seven day period in two Pirahã settlements, Forquilha Grande and Ce'ege. The participants were 16 Pirahã native speakers. Nine of the 16 participants were female and seven male. Precise ages weren't available to me for the participants, but the age of the participants varied greatly from the late teens to the oldest people living in the two villages. All participants could readily recognize both speaker A and speaker B. In fact, most of the participants were closely related to speaker A and B, e.g. the three wifes of speaker B and the father of speaker A were among the participants. Participants received a small amount of consumer items in return for their participation.

2 Results

The participants responses were recorded and subsequently transscribed from the recordings. There were no missing responses. Figure 1 displays the raw data graphically.

The results show that the Pirahã speakers distinguish between the correct and incorrect reports. Of the 288 responses overall, 153 (53.1%) were *ma'a* ('yes') and 135 (46.9%) were *mabi* ('no').[6] We applied the two-sided exact binomial test to this distribution, and found that overall the numbers of responses did not differ from chance level ($p = 0.3165$). This result was expected because the predicted responses were exactly a 50:50 split of *ma'a* and *mabi*. Then I looked at the control and experimental conditions separately,

[6] In the course of the experiment, I found that *mabi* could also express the meaning close to the English verb *lie*. But this doesn't affect the interpretation of the results.

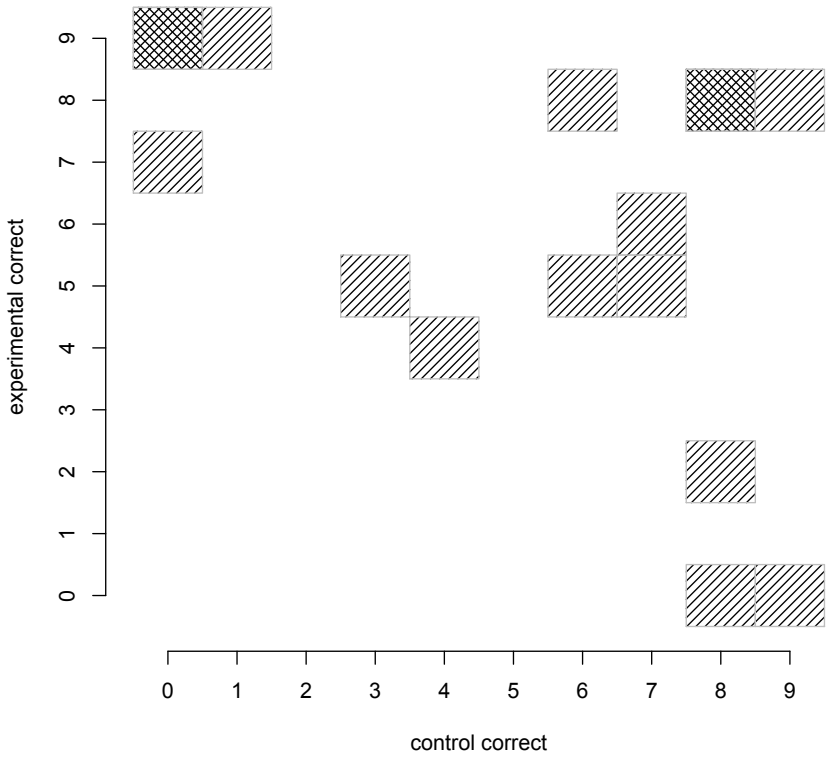

Figure 1: Raw response data from 16 participants. Single-striped boxes correspond to one participant, double-striped boxes correspond to two participants. The location of each box indicates the number of expected responses for the control condition (x-axis) and the experimental condition (y-axis). For example, the double-striped box in the top left indicates that two participants answered 0 control conditions and 9 experimental conditions as expected.

and a different distribution obtains: Out of 144 control conditions total, 84 were answered by *maabi* ('no'), i.e. we observed 58.3% expected responses. To test whether the number of expected responses was significantly different from chance, we computed a two-sided exact binomial test, and found the difference from chance to be marginally significant with p-value 0.0549. We then performed the same analysis for the 144 experimental conditions. 93 (64.6%) were answered with the expected response *ma'a* ('yes'). The exact binomial test shows that this distribution is significantly greater than chance (p-value = 0.0005851). The overall result therefore indicates that Pirahã speakers were sensitive to the difference between true and false reports.

The percentage of understanding overall seems low with only about 177 of 342 (61.5%) correct responses. The overall result furthermore hides significant variation amongst participants that can be seen in figure 1. While this doesn't affect the significance of the overall result, understanding the sources of this variation may lead to improvements in future studies.

The subjects reported in the top left quadrant responded *ma'a* most of the time, not discriminating between control and experimental items. Such subjects may have misunderstood the directions, and might be judging grammaticality or comprehensability. The subjects reported in the bottom right quadrant responded *mabi* most of the time, again not discriminating between control and experimental items. Such subjects also may have misunderstood the directions, and may be responding based on pragmatic felicity of the recorded dialogues. Subject entered in the top right quadrant exhibit close to the expected pattern. The presence of these subject drives the overall result. Equally important is that hardly any partipants fell into the bottom left quadrant. Subjects entered near the center of the graph displayed an overall chance response, and may have not understood the directions or may have been unable to hear the recordings properly.

We performed a second statistical analysis restricted to subjects whose responses didn't show a bias for either *ma'a* or *mabi*. For each subject, we recorded 18 responses. According to the strict binomial test, a frequency of 14 or higher of one of the two possible responses (and correspondingly a frequency of 4 or lower of the other response) is a significant bias for one response. Specifically, the p-value is 0.031 if 14 out 18 responses are the same. Therefore in the second analysis, we exclude the responses from the seven participants with a response-bias by this criterion. After exclusion of the response-biased subjects, we observe the expected response 57 out of 81 times for the control condition and 59 out of 81 times for the experimental condition, corresponding to 70.4% and 72.8% correct responses respectively. The exact binomial test shows that both frequencies diverge significantly from chance at the $p < 0.0005$

level. This suggest that the main result I reported above would have been even stronger if participants had been instructed to not be biased towards one of the two possible responses.

3 Conclusion

In this paper, I presented an experimental study evaluating the comprehension of embedded sentences in the Pirahã community. The study adressed the question how a sequence of a verb of speech and a second clause as in (14) would be understood.

(14) Toe hi gaisai ce a'ai kohuaipaha
Toe 3 say 1 stone eat

As I argued, if Pirahã lacked true embedding, (14) would need to be understood as the coordination (15a) or equivalently to separate sentences. However, the interpretation of the coordination in (15a) can be distinguished from that of subordination in (15b) on the basis of truth value judgments.

(15) a. Toe was talking and he has many noses.
b. Toe said that he has many noses.

Namely, (15a) is judged false since Toe can never have many noses. (15b), however, is predicted to be judged true in case Toe actually claimed to have many noses previously. The test applied in this paper operationalized this predicted difference in truth judgment. The field conditions, the need to go through translators, the unfamiliarity of the Pirahã with technology, and possibly other factors likely caused substantial variation in judgments. But overall, I found that the data from sixteen Pirahã speakers unequivocally supported the subordination analysis. The data show that Pirahã allows at least one level of subordination and falsify the proposal of Everett (2005).

Appendix A: Items

The following ten basic items were used in the comprehension experiment in the way described above. The following transscriptions are rough and the audiorecordings should be consulted.

(i1) a. ce kaháipe kahe'ai igeuo
'I have been to the moon.'

b. ce kaháp̃e heesé igeuo
'I have been to the sun.'
c. ce kaháp̃e ogéhiai igeuo
'I have been to the stars.'

(i2) a. ce aoiagaha ka huaáí
I have a car.
b. ce aoiagaha oaahabi 'iai
I have a bike.
c. ce ao naheau agaha
I have an airplane.

(i3) a. ce au kai agaha Humaita o
I live in Humaita.
b. ce au kai agaha ceege'egeo
I live in Pereira.
c. ce au kai agaha pitiao
I live in Pekeno.

(i4) a. ce hoa ahiai ipaha ahoikasi
I planted rice.
b. ce hoa ahiai ipaha cehua
I planted corn.
c. ce hoa hai kape'e soai hiaipaha
I planted coffee.

(i5) a. ce soa tobagahai iga aopapáhá
I brought a computer.
b. ce soa igaabopapáhá pihoagesai
I brought a generator.
c. ce soa igaabopapáhá peage'esai
I brought a fridge.

(i6) a. ce epe'e kuabahaipaha maihipai
I kill a jaguar now.
b. ce epe'e kuabahaipaha ka'aihi
I kill a paco now.
c. ce epe'e kuabahai paha ko'oé
I kill a monkey now.

(i7) a. ce bego kohuaipaha
I eat soil.

b. ce tabo kohuaipaha
I eat board.
c. ce a'ai kohuaipaha
I eat stone.

(i8) a. ce apai aiba koe
I have many heads.
b. ce itaoe aiba koe
I have many noses.
c. ce kaoé aiba koe
I have many mouth.

(i9) a. ce apaitau biagaha
I have white hair.
b. ce apisoe kobi'agaha
I have white skin.
c. ce epee kobi'agaha
I have a white tongue.

(i10) a. ce aitahoagaha moitohoiko
I sleep in a boat.
b. ce aitahoagaha ce'apo
I sleep in a tree.
c. ce aitahoaaha taihoa'aiko
I sleep in a pot.

Appendix B: Raw responses

The following table shows the raw responses of all 16 participants. 0 corresponds to the negative response *maabi* ('no'), 1 to the positive *ma'a* ('yes'). The order of rows represents to the order presentation. The first column shows the sequence order starting with 3 since items 1 and 2 were practice items. The second column shows the item number in the coding scheme introduced in the text. The third column shows the expected response.

			Participant														
#	item	E	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
3	10ab	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0
4	8ab	0	0	0	0	0	0	1	0	0	1	0	0	1	0	1	0	0
5	2cc	1	1	0	1	1	0	1	0	1	1	1	1	1	1	1	0	0
6	1ab	0	1	1	1	1	1	1	0	0	1	1	0	1	0	1	0	0
7	9cc	1	1	1	1	1	1	1	0	0	1	1	1	1	1	0	0	1
8	3cc	1	1	1	0	1	1	1	0	0	1	1	0	1	1	0	0	1
9	6ab	0	0	0	1	0	0	1	0	1	1	1	0	1	0	1	1	1
10	4cc	1	0	1	0	0	1	1	0	1	1	1	1	1	1	1	0	0
11	9ab	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0
12	7ab	0	1	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0
13	4ab	0	0	0	1	0	1	1	0	1	1	1	1	1	0	1	0	0
14	6cc	1	1	1	0	1	0	1	0	1	1	1	0	1	1	0	0	0
15	3ab	0	0	0	1	0	0	1	0	0	1	1	1	1	0	1	0	0
16	7cc	1	1	1	0	1	0	1	0	0	1	1	1	0	0	0	0	0
17	10cc	1	1	1	0	1	0	1	0	1	1	1	0	0	1	1	0	0
18	2ab	0	1	0	1	0	0	1	0	0	1	1	1	1	0	1	0	0
19	1cc	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0
20	8cc	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	0	0

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