Sapir, Reichenbach, and the Syntax of Tense in Pirahã

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Contents

Abstract

This paper investigates temporal interpretations in Pirahã, a Muran language spoken in the Brazilian Amazon basin. The analysis assumes the neoReichenbachian model of tense syntax proposed in Hornstein (1990) and argues that this model provides an elegant account of tense-related facts in Pirahã, iff it is parameterized. Whereas Hornstein predicts that all tense systems will have a temporal reference point (R), this paper argues that languages may be parameterized as [+R] or [-R] and that this has important implications for their temporal syntax. Moreover, the paper also argues that it is no coincidence that the Pirahã place little importance on precision time statements, or that the Pirahã have difficulty translating such statements, since their language does not draw temporal distinctions based on R. The parametrization of R among the Pirahã is argued to offer a new source of support for Sapir's linguistic relativity hypothesis.

1 Introduction

Linguistic analyses are usually classified as either "formalist" or "functionalist", as though these were mutually exclusive approaches to linguistic competence, Universal Grammar (UG), typology, or whatever best describes one's favorite object of linguistic inquiry.[1] I believe that this dichotomy is useful in most cases, that is, that the understanding of a particular phenomenon is aided by focusing on either its form or its function.[2] Unfortunately, formal studies rarely, if ever, attempt to follow up the careful formal analysis of a particular phenomenon with reflection on the "fit" of this analysis within the larger linguistic-cultural system. Does this formal system appear in a particular cultural milieu by coincidence, or is there a deeper connection between culture and formal grammar? A possible reason that such studies are rare is that formalists are often turned off by functionalism due to their perception that when function is discussed, it is often brought into the analysis too early, in an attempt to "explain" form by naive, a priori notions of the teleology or etiology of particular construction types. Moreover, the idea that culture influences the formal system of grammar is incompatible with most current theories of syntax. Thus, formal studies pay strict attention to form with little or no reference to function. Yet, this perception strikes me as overly pessimistic. There is a possible scenario compatible with formal models, namely, that grammar might itself influence the culture, as Whorf (1956a) and Sapir (1921) suggested. In this regard, it would be interesting to consider the possible cultural effect of specific choices in the constuction of a grammar, what *Government & Binding Theory* (GB) calls "parameter setting", the triggering or selection of various formal options made available by *Universal Grammar* (UG).

This latter question is interesting, in spite of the fact that the primary role of grammar may be to serve as a computational system (see, for example, Fodor (1975, 1983, 1987)) and that it is likely that this computational function, is logically prior to the communicative functions of language (since communication relies on computation of inputs and outputs of the grammar, i.e. parsing and generation). This question is also interesting, even though it is unlikely that one could ever demonstrate an unambiguous causal relation between a component of the grammar and a cultural characteristic, because it forces us to reflect more seriously on the connections of linguistics to anthropological concerns, connections which are compatible with, yet often overshadowed by, the deeper connections between linguistics and psychology.

In this paper, I address these concerns via an analysis of Pirahã temporal interpretation and the role of temporal specificity in Pirahã culture.[3] First, I am going to argue that the range of temporal constructions and interpretations found in Pirahã discourse are accounted for by the neoReichenbachian system of tense proposed in Hornstein (1990), if parameterized

in a particular way to be made clear in the paper. The central proposal in this regard is that the Pirahã tense system lacks the reference point, **R**, which is claimed to be universal by both Reichenbach (1947) and Hornstein (1990). I will argue that the best way to account for this fact within a neoReichenbachian framework is to allow languages to be parameterized as either [+R] or [-R]. Moreover, I also claim that this represents a challenge to alternative theories of tense, namely, to be able to capture the English-Pirahã tense distinction so neatly, without predicting an array of otherwise unattested tense systems.

Next, I argue that it is unlikely to be coincidental that Pirahã's particular parametrization of the neoReichenbachian tense system occurs within this particular culture, in which time is of such little salience in day to day conversation. If indeed this is not coincidental, i.e. if there is a nontrivial interaction between culture and grammar in Pirahã, then there are two options available to account for this interaction, as noted above. The first is to maintain that culture influences linguistic parametrization. This is prima facie incompatible with the modularity hypothesis (cf. interalia, Fodor (1983)). The second option is to conclude that linguistic parametrization may affect culture in a nontrivial sense. I am going to argue that such a conclusion is the most likely account of the Pirahã culture-grammar relationship, supporting the otherwise maligned Sapir-Whorf *linguistic relativity* hypothesis, i.e. the hypothesis that language influences culture.[4]

The paper is organized as follows. First, I offer a brief introduction to the Hornstein-Reichenbach (henceforth HR) model I will be assuming. Second, I present a sketch of basic tense morphemes and specialized syntactic expressions for tense in Pirahã. This is followed by an analysis of these facts in the HR model. The fourth section discusses and rejects an alternative analysis of the Pirahã facts, namely, that Pirahã lacks tense altogether. This alternative is shown to be conceptually inferior to the formal grammatical account in the preceding section. This section also discusses implications of my analysis for acquisition, the effect of syntax on culture, and for alternative models of tense syntax.

2 The Hornstein - Reichenbach Tense System

2.1 Reichenbach: The Logic of Tense

2.1.1 Introduction

There are clearly logical and real-world constraints on tense, so that, for example, we cannot have someone in the past being affected by events in the future:

(1) *John ate when he will get his meal.

Such examples might lead us to conclude that there is nothing for syntax to say about tense that logic has not already said. This is not correct, however. There are numerous constraints on temporal interpretation which linguists and philosophers have argued *not* to follow from purely logical considerations, but which are better analysed via a linguistic approach to tense. In later sections, I adduce what I consider to be convincing evidence that temporal interpretation in Pirahã is governed by linguistic principles and that Pirahã's tense system varies in an interesting way from English, best explained via the parametrization of a certain part of a universal temporal syntax. Now, if it were true that the properties of tense interpretation in natural language were all logically necessary, then there would be no language-specific variation in the tense system and thus little need for crosslinguistic studies in this area.[5] So, I have the important task in this section of distinguishing the necessary from the contingent aspects of the HR tense system, since I do not want to be found arguing that what is in fact a logically necessary component of tense is missing in a given language. This teasing out of the universal vs. nonuniversal components of tense is best accomplished in the context of a review of Reichenbach's (1947) original proposals, to which we turn now. Following this, we consider the elaboration and modification of those proposals suggested in Hornstein (1990).

2.1.2 Reichenbach's Proposal

Reichenbach (1947, 288ff) argues that tense relies on three distinct temporal points: the *event time*, **E**, the *speech time*, **S**, and the *reference time*, **R**. These are all illustrated in the English perfect tenses:

(2) John will have finished when Bill arrives.

In (2), both the events of *John*'s finishing and *Bill*'s arriving are subsequent to the moment of speech. So, both the main clause and the adjunct clause share the structure in (3):

(3) S ____ E

The representation in (3) indicates that S(peech time) precedes E(vent time). However, the event of the matrix clause, *finished*, is not situated directly in relation to S but in relation to a point of reference fixed by the adjunct clause. The temporal structure of the main clause can thus be more fully represented as in (4):

(4) S __ E __ R

That is, the event of the main clause will follow the moment of speech, but it will precede the reference point, **R**, the time of Bill's arrival, which is the **E** of the adjunct clause. **R** is also seen in past perfects:

(5) John had finished when Bill arrived.

The matrix tense structure of (5) is: E __ R __ S; the adjunct tense structure is E,

R __ S. That is, in the adjunct clause the Event (Bill's arrival) and the Reference point are simultaneous, both preceding the Moment of Speech. The main clause Event, John's finishing, takes place prior to the Reference point (the Event of the adjunct clause) which is itself prior to the Moment of Speech.

The crucial point is that the adjunct clause's temporal structure, in particular its **R** point, serves as the anchor for the **R** point of the matrix clause. Obviously, then, the **R** point is important for talk about tense. The type of temporal relations between clauses just exemplified can only be specified in this system via the **R** point. Reichenbach does so far as to claim that all tenses have **R**-points and he suggests that the basic tenses in (6) may all be accounted for straightforwardly based on relations between **E**, **S**, and **R**:

(6) a. S, R, E – present tense
    b. E, R __ S – past tense
    c. S__ R, E – future tense
    d. E __ S, R – present perfect
    e. E __ R __ S – past perfect
    f. S __ E __ R – future perfect

Note crucially though that **R** is not a logical necessity. For example, there are some tenses that we can talk about without it. So, while it is clearly important to the interpretation of perfect tenses, it is not necessary for the interpretation of the simple past, present, or future tenses. In these tenses, **R** is always simultaneous with **E**, the event time and is therefore redundant (at least for simple clauses). On the other hand, **E** and **S** *do* seem necessary if we are to interpret the world around us temporally. Without them an event cannot be situated along any temporal dimension. Indeed, it is difficult to conceive of talk about an event which had no concept of event (E) or a way to indicate whether that event precedes or follows a deictic anchor, S, at least pragmatically or contextually. If this is correct, then **E** and **S** are *epistemologically prior* to **R**. They make talk about tense possible in the first place, whereas **R** "merely" enables us to draw finer distinctions and to mark relations between these.

A further argument for conceding priority to Event over Reference point comes from work by Davidson (1967) on action sentences, as further developed by Higginbotham (1985) and Leder (1991). Both Leder and Higginbotham argue at length that E(vent) is a crucial component of all verbal (and even nominal) structures, independent of tense. Leder further argues that this independently needed notion of Event is indeed the same notion of Event that Reichenbach-influenced tense specialists refer to. If Leder and Higginbotham are on the right track, then this provides further support to my contention that E and S are the primary building blocks of temporal interpretation, while R is secondary.

4

2.2 Hornstein: The Syntax of Tense

It is not the purpose of this section, nor of this paper as a whole, to argue for the superiority of Hornstein's model over other approaches. There is certainly much more to say about tense and many more arguments that would have to be marshalled to substantiate any such claim. Rather, I want to argue that Hornstein's syntactic model makes certain predictions (if parameterized in the way I propose) that exactly capture the difference between English and Pirahã. I am unaware of any other model of tense which is able to do this. Thus, the 'burden of proof', as it were, falls on other models to express the Pirahã-English tense differences as neatly as Hornstein's model.

Many proposals on tense have arisen since Reichenbach (1947), both within philosophical logic (e.g. Montague 1974) and linguistics (for an important survey of facts about tense in English and discourse-based interpretations, see Declerck (1991)). Within GB, Hornstein (1990) is the principal proposal. Hornstein accepts most of Reichenbach's original ideas but, further develops Reichenbach's model by extending the model to account for a wider range of intrasential relations between tense in matrix and embedded clauses. I will not provide a complete introduction to Hornstein's model here, referring the reader to Hornstein (1990). I will discuss those of of his elaborations which are necessary in order to understand the implications of Pirahã for this and other formal models. Some of the more important points are discussed in the immediately following paragraphs.

(7) *Association*: Tense points x and y are *associated* iff neither x nor y temporally precedes the other.

(8) *Strong Linearity*: The linear relationship between associated tense points is fixed by the syntax; it is underdetermined by the temporal interpretation.

Association thus does not distinguish between any of the representations in (9) (because S, R, & E are simultaneous in all of them), whereas strong linearity will treat each of these as separate tenses:[6]

(9) a. S, R, E
   b. R, S, E
   c. E, S R
   d. S, E, R
   e. R, E, S

Strong linearity will not figure directly in the discussion of Pirahã tense, although it worth pointing out here since it is crucial to the claim that tense is *syntactic*, rather than exclusively semantic or pragmatic.

Other principles proposed by Hornstein include:

5

(10) *Constraint on Derived Tense Structures* (**CDTS**): *Derived Tense Structures* (**DTSs**) must preserve *Basic Tense Structures* (**BTSs**), where a BTS is preserved iff (Hornstein, p15): 1. No points are associated in DTS that are not associated in BTS and 2. The linear order of points in DTS is the same as that in BTS.

By 1, tense points (= E, S, and R) can be separated in DTS if they are associated in BTS, but they may not be associated in DTS if they are separated in BTS. To see how this works, consider example (11):

(11) *John left at this very moment.

The BTS of (11) is **E,R __ S**, since it is a simple past. The modifying expression, *at this very moment*, however, requires that **R** and **S** be associated, since it builds in a present tense meaning. However, since these are not associated in the BTS, the modification violates the **CDTS** and hence is ruled out. Example (12) illustrates the second portion of the **CDTS**:

(12) *John left tomorrow.[7]

The tense structure of *John left* is a simple past: **E,R __ S**. However, *tomorrow* requires that **R** follow **S**. Clearly the DTS would establish linear relations among the tense points that differ from the relations in BTS. Therefore, the **CDTS** rules this example out.

Two more notions form Hornstein's model are important here, the notion of *Sequence-of-Tenses* (**SOT**) and the *Rule for Temporal Connectives* (**RTC**).

(13) **RTC**: Write the BTS of TNS$_2$ (the tense of an adjunct temporal clause such as *when ... or after ...*) under the BTS of TNS$_1$ (the tense structure of the matrix clause). Associate the S points. Associate the R points by moving R$_2$ to R$_1$, placing E accordingly.

Consider what happens when the matrix structure is a simple future and the adjunct clause tense is present:

(14) S __ R$_1$, E$_1$ S __ R$_1$, E$_1$
$$\text{RTC} \rightarrow$$
   S, R$_2$, E$_2$ S __ R$_2$, E$_2$

(15) John will arrive when you eat pickles.

   TNS$_1$ (S __ R$_1$, E$_1$) TNS$_2$ (S, R$_2$, E$_2$)

Now, consider how the **RTC** rules out examples like (16):

(16) *Peter bought the tapes when you will arrive.

$$\text{TNS}_1 \ (E_1, R_1 \_ S) \quad \text{TNS}_2 \ (S \_ R_2, E_2)$$

(17) $E_1, R_1 \_S \qquad E_1, R_1 \_ S$

$\qquad\qquad \text{RTC} \rightarrow$

$\quad S \_ R_2, E_2 \qquad S, R_2, E_2.$

The **RTC** here violates the **CDTS** and the structure is thus correctly ruled out.

Finally, Hornstein argues that *Sequence of Tense* (**SOT**) structures support his new-Reichenbachian model. Consider the pairs in (18) & (19):

(18) a. John heard that Mary is pregnant.
　　b. John heard that Mary was pregnant.

(19) a. John said that Harry will leave.
　　b. John said that Harry would leave.

Under a particular reading, the a & b examples in (18) and (19) are temporally synonymous. They differ in that in the (a) examples, both matrix and subordinate S points are anchored to the actual moment of utterance. In the (b) examples, however, the S point of the subordinate clause is anchored to the E point of the (immediately) dominating clause, as in (20):[8]

(20) John heard that Mary　　　was pregnant.
　　　　$\text{TNS}_1 \ (E_1, R_1 \_ S)$ 　　　$\text{TNS}_2 \ (S, R_2, E_2)$

(21) **SOT** rule: $\text{TNS}_1 \ (E_1, R_1 \_ S)$

$$\text{TNS}_2 \ (S, R_2, E_2)$$

To conclude this summary of the HR tense model, we have seen that the tense points E, S, and R, as well as *syntactic* conditions on the ways in which these maybe ordered and related intrasentially are crucial in that model to an understanding of English tense.[9] In particular, the R point (although I have argued that it is epistemologically subsequent to S and E) must be built into the theory of tense. Hornstein (p 90-91) summarizes the evidence for R as in (22) (my paraphrase):

　(22) a. Perfect tenses fix temporal interpretation of E relative to S via R.

b. **R** is crucial to understanding how complex tense structures are formed.

c. **R** explains why only two temporal adverbs are allowed per clause.

This is so because a temporal adverb may modify only **E** or **R** and because Hornstein interprets the principle of *Full Interpretation* (Chomsky 1986, 98) as ruling out multiple modifications of a single tense point. So, consider (23):

(23) a. Tomorrow, I have been here a week.

         R   **E**

b. *Tomorrow, I have been here a week in two hours.

       R   **E**   **E or R**

This prohibition against multiple modifications of tense is not simply semantic and in fact offers important support for the HR approach, as argued in section 3.4. In the next section, I will argue that none of these arguments for **R** holds up in Pirahã. First, however, let us sum up our discussion to this point.

We have seen that tense can be understood in terms of the three points, **E**, **S**, and **R**, but that **E**, *event time*, and **S**, *speech time* are epistemologically prior to **R** in talk about tense. This might lead us to expect that tense systems crosslinguistically could vary with regard to **R** more easily than with regard to **E** or **S**. The crucial role for **R** arises not in the basic tenses (where Hornstein (1990, 112) admits that **R** has '... no interpretive reflex'), but in complex tense relations, some forms of temporal modification, and **SOT** structures.

In the next sections I am going to argue that Pirahã lacks **R** and thus lacks the tenses and tense relations which refer to it. Note that this is a very strong claim. It is not merely a claim that Pirahã simply lacks certain morphological categories. I am claiming that Pirahã lacks *interpretations* corresponding to perfect tenses, SOT structures, complex tense structures, or multiple temporal modification structures. Before going into the data which warrant this claim, let us first state just what is at stake here.

Consider first what is at stake theoretically. Hornstein's theory accounts elegantly for English and various other languages. It is an interesting theory also because its claims are simple, strong, and clear (if not always intuitively transparent). It predicts no variation crosslinguistically in the rules of tense interpretation, only in the ways in which tense is mapped to morphosyntax. So, for example, we might find a language which lacks a particular range of morphological tense distinctions, but we do *not* expect to find, by Hornstein's model, any language which lacks one of the **S**, **R**, **E** points or rules relating them. Hornstein (p.c.) speculates, however, that there might be languages which lack tense altogether, so that his theory would simply be inapplicable to them. Although I will indeed argue in the next section that Pirahã is *tenseless* in Comrie's (1985) morphological sense, it will also be clear that it

cannot be considered tenseless in Hornstein's sense. This latter point is further supported in section 3.3. below where the infinitival form is discussed.[10]

Second, consider what is at stake functionally or philosophically. If it can be shown that Pirahã lacks 'R', and thus the temporal interpretations which depend on it, then this will provide some interesting empirical support for both The Sapir-Whorf linguistic relativity hypothesis, as well as Quine's (1960) notion of the indeterminacy of translation.

3 Pirahã

3.1 Time Words & Expressions

In this section, I am going to argue that Pirahã lacks an R point. I will show that all of the temporal interpretations found in this language can be accounted for without R and that the absence of some interpretations cannot be explained unless R is missing. Let us begin by surveying some basic facts about time words and expressions in Pirahã. There are no time words in Pirahã which unambigously order an E point with regard to an S point nor that associate one R point to another. In English, such time words and expressions include *yesterday* (E precedes S) *tomorrow* (E follows S), *next year*, etc. The role of time words and expressions in Pirahã is thus crucially dependent on context. A partial list of Pirahã time words and expressions is given in (24)-(37):[11]

(24) a. so?óá 'now/already' (lit: 'time this')
b. **Ti so?óá kahápií.**
(i) 'I'm going now.'
(ii) 'I already left.'
(25) a. so?ógió 'a long time ago/from now' (lit: 'big time')
b. **?aoói so?ógió koaíí.**
'The foreigner died a long time ago.'
c. **?aoói so?ógió ?owáboihaí baósaí.**
'The foreigner will buy cloth some time from now.'
(26) a. piiáiso 'low water time' (used for summer months/dry season)
b. **?oogiái hi piiáiso ?aboópái baisíhiai.**
'?oogiái will return/returned in the summer (=low water time).'
(27) a. pibígaíso 'big water time' (used for winter months/rainy season)
b. **?oogiái hi pibígaíso ?aboópái baisíhiai.**
'?oogiái will return/returned in the winter .'
(28) a. tiihíkaobíso 'Brazil nut fall time' (used for winter months/rainy season)

b. **?aoaíbákoí tihíkaobíso.**
'There are many foreigners (here) in Brazil nut season.'
(29) a. **?ahoái** 'night'
b. **?oí kabáo ?abiíhaí ahoái.**
'Don't go out at night.'
(30) a. **hoahoíhio** 'more than one day'
b. **Hi hoahoíhio ?abiigá.**
'He is staying several days.'
(31) a. **?apaí** 'first' (literally: 'head')
b. **Gói ?apaí ?opítaáti**
'You go first.' OR 'You go in front.'
(32) a. **tiohió** 'next'
b. **Kohoi ?apaí kaopa, Poioí hi tiohió kaopá.**
'Kohoi was born first, then Poioí.'
(33) a. **gaaba** 'then/next'
b. **Kohoi ?apaí kaopa, Poioí hi gaaba kaopá.**
'Kohoi was born first, then Poioí.'
c. **Ti kohoaikabáobáo gaaba ti gi kobaisogabagaí.**
'When I finish eating, then I want to see you.'
Other examples include words like:
(34) **?ahoakohoaihio** 'early morning' (lit: 'eating the night time')
(35) **hibigíbagáiso** 'sunrise/sunset' (lit: the barriers (sky/earth) join time')
(36) **hisógiái** 'noon' (lit: 'big sun time')
(37) **pi?ái** 'now' (lit: 'this water')

There is a conspicuous lack of 'precision' time expressions like *today, tomorrow, a week ago, Sunday,* etc. There is also no morphosyntactic or other process for producing such expressions. Each of the temporal expressions in (24)- (37) can be made precise only in a specific context. Note, though, that in context each of these expressions is ultimately interpreted by ordering E before S, after S, or simultaneous to S. Yet, there is no context in which an R point is necessary to interpret these words.

3.2 The Morphosyntax of Temporal Connectives in Pirahã

Let us continue to assume that Pirahã lacks R. Then, we must account for temporal connectives in Pirahã which, as we saw in (13) above, are assumed to provide strong support for R in the HR system. As we shall see, it is indeed possible to account for temporal connectives in languages without R. Utterances in natural language may be temporally linked,

either syntactically or pragmatically. Example (38) illustrates syntactic linking, while (39) illustrates pragmatic linking:

(38) a. John came in *before* you arrived.

b. *John came in *before* you will arrive.

c. *John came in at 2PM *before* you will arrive at 3PM.

(39) John came in at 2PM. You will arrive at 3PM. (e.g. A sergeant giving instructions to a private.)

Why are (38b) and (38c) ungrammatical, while (39) is just fine? The contrast cannot be semantic in nature, since (38c) and (39) mean the same thing. The use of a temporal connective, such as 'before', establishes an overt, syntactic relationship between two sentences which is more restrictive than purely pragmatic or contextual relations such as (39). This relationship seems to be that temporal connectives require that the sentences they relate be drawn from the same *temporal domain*, where a temporal domain is established by the E, S relation. There appear to be two such domains, {E __ S} and {E,S & S __ E}. That is, the past constitutes one domain, while the future and the present compose the other domain, at least in English. In addition to (38) above, the importance of the notion of temporal domain is further illustrated in (40)-(48):

(40) *John will arrive after you came.

(41) *John will arrive before you came.

(42) *John will arrive as you came.

(43) *John arrived before you will arrive.

(44) *John arrived before you arrive.

(45) ?John arrives before/as/after you will arrive.

(46) John will arrive as/after/before you arrive.

(47) John will arrive before/as/after you will arrive.

(48) John arrived before/after/as you arrived

Hornstein (45ff) discusses similar examples (also including perfect tenses), arguing that they support the need for an R point. This notion of temporal domain is in effect a syntactic account of the truth conditions imposed by *before*. As a reviewer points out, the two clauses in (39) can be true simultaneously, whereas *before* forces the truth conditions of the first clause to be satisfied prior to those of the second clause, thus perhaps favoring a semantic account of the problem. But *before*'s truth-conditional behavior clearly follows from what I have just said about the *syntax* and thus again a syntactic account of tense obviates the need for a separate semantic account.

On the other hand, there does seem to be a pragmatic principle involved here, namely, that you should avoid using a word if it is not necessary. Such a principle is unenlightening, though, because it is too vague and obviously unable to account for the majority of cases

where redundancy or wordiness produces no sharp contrasts in acceptability or grammaticality judgments. If two items are from separate temporal domains, then either we can determine their relative order by their temporal domain, e.g. $\{E \_\_ S\}$ precedes $\{E,S \ \& \ S \_\_ E\}$, or the sentences are unrelated temporally. However, it two sentences come from the same temporal domain, then their relative order must be established via a temporal connective.[12] This is not yet an explanation of temporal connectives or why they seem to support the notion of 'temporal domain', it merely provides some of the intuition which underlies the analysis which follows. Directly, I will formalize the notions of temporal precedence and temporal succession in terms of the notion of temporal domain, for a language without R. First, though, we need to briefly examine the morphology of temporal connectives in Piraha:

Pirahã has a single, purely temporal affix, realized as $\{-so\}$ when suffixed to a vowel-final form and $\{-ao\}$ when suffixed to a consonant-final form. The suffix may be translated as 'before', 'after', 'when', or 'while'.

(49) Gí?ai kapiiga kagakabáobáo, ti gí ?ahoaisogabagaí.
'After/When you finish studying, I want to talk to you.'

(50) Gí?ai ?aboópaiso, ti so?óá kahápií.
(i) 'After/before you return, I'm going.'
(ii) 'When you return, I am already gone.'

(51) ?oogiái kapiigakagakaiso ti pío kapiigakagakaihaí.
(i) 'While you are studying, I (will) study.'
(ii) 'While you studied, I studied.'
(iii) 'As you study, I study.'
(iv) 'After you study, I (will) study.'

While the interpretation of the temporal relation established between two clauses by this suffix is relatively fluid, it is not entirely free. Temporal connectives are subject to the same restriction found in English, namely, that the connected clauses come from the same 'temporal domain'. Thus, it is impossible for (50) to mean something like '*After you return I left', since one clause is from the present/future domain and the other is from the past domain.

In Hornstein's system, this restriction is captured as a prohibition against altering linear relations among E, S, and R, as established by the RTC (cf. (13) above). Let us review how the RTC rules out the relevant English examples:

(52) *After you came, I will leave.
$$\text{TNS}_2 \qquad\qquad \text{TNS}_1$$
$$\text{E,R} \_\_ \text{S} \qquad\qquad \text{S} \_\_ \text{R,E}$$

12

$$S_1 - R_1, E_1$$
$$E_2 - R_2 \; S$$

The R points are used to anchor TNS_1 to TNS_2 and thus can be used to circumscribe the alignment of E and S. I have been arguing that Pirahã lacks an R point. But if this is true, then we must rule out interpretations corresponding to (52) some other way. Once again, the goal is to provide a syntactic basis for the notion of temporal domain, such that connectives can only relate clauses from the same temporal domain.

My proposal is to define this domain as the area circumscribed by associating all E and S points of TNS_1 and TNS_2. If these connections result in crossing association lines, then no temporal domain is possible and a temporal connective will result in ungrammaticality. More formally, I submit the following rule for temporal connectives in Pirahã:

(53) Rule for temporal connectives in Pira a:

a. Place BTS of matrix (=TNS_1) over BTS of adjunct clause (=TNS_2);

b. Link S_1 to E_2, E_1 to S_2, or E_1 to E_2.

c. Connect S_1 to S_2 and E_1 to E_2.

d. Connection lines may not cross.

This rule allows for only three possible relations:

(54) Matrix tense precedes adjunct tense (E_1 precedes E_2; before)

(55) Matrix tense follows adjunct tense (E_1 follows E_2; after).

(56) Matrix and adjunct tenses are simultaneous E_1 is simultaneous with E_2; while/as).

Consider how rule (53) derives these relations and limits their operation to the same temporal domain:

(57) John arrived after you left.

(58) John arrive before you left.

(59) John arrived as you left.

(60) John will arrive after you leave.

(61) John will arrive before you leave.

(62) John will arrive as you leave.

(63) *John arrived as you leave.

(64) *John arrived before you leave.[13]

(65) *John arrived after you leave.

The temporal structures for the relations in (57)-(65) are as given in (66)-(72):

Before (E_1 precedes E_2):

(66) E_1 — S_1

$\quad\quad\quad$ E_2 — S_2

(67) S_1 — E_1

$\quad\quad\quad$ S_2, E_2

14

After (E_1 follows E_2):

(68) E_1 ___ S_1
     E_2 ___ S_2

While/As (E_1 and E_2 are simultaneous):

(69) E_1 ___ S_1
     E_2 ___ S_2
(70) S_1 ___ E_1
     S_2 ___ E_2

(71) *John arrived after you will leave.

     E_1 ___ S_1
     S_2 ___ E_2

(72)   *John will arrive after you left.
     S_1 ___ E_1
     E_2 ___ S_2

Again, the formal reason that examples like (71) and (72) are ungrammatical is that they require crossing connection lines, disallowed by (53).

The system just sketched then is able to account for all and only the available temporal interpretations between clauses in temporal connective constructions in Pirahã without appealing to R. By linking all points and prohibiting crossing association lines (the restriction against relating structures via crossing lines was first recognized in work on *Autosegmental Phonology*), we formalize the notion of temporal domain, a graph-theoretic notion defined as the area circumscribed by the intersection of TNS_1 and TNS_2. This formal notion allows us to maintain that temporal interpretations in Pirahã are indeed syntactic, and not exclusively pragmatic, while at the same time avoiding any reference to R.

3.3 Verb Forms

Pirahã has two verb forms that might be distinguished as 'finite' vs. 'nonfinite' forms. Any verb may be nominalized (cf. Everett 1986, section 18). In this case no aspectual or other verbal endings are allowed. This form has no independent tense interpretation:

(73) Ti gí ?ibíibihaí kaisáo kai-sai.
1SG 2SG order box make-nominalizer
I order you to make a box.'

This form thus will behave just as English infinitives, in being overtly marked for the absence of temporal interpretation. In fact, the presence of infinitival forms provides strong evidence that Pirahã does treat tense as a syntactic category, even though it is not a morphological category, since the marking and behavior of infinitives would make little sense in a language which in fact lacked tense altogether (cf. (77) below). Translation of nonfinite forms into Pirahã will often use the nominalized form:

(74) a. **John ?aibogí.**
'John runs.'
b. **John ?obáa?ai ?aibogi-sai** (lit: 'John sees well to run').
'John can run.'

3.4 Temporal Modification

As further support for the hypothesis that Pirahã lacks **R**, note that only a single temporal expression may appear per sentence:

(75) *?ahoahíai, ti so?óá ?ao?aagá hoabáagiso baisíhiai.
'Tomorrow, I (have) already be(en) many days on the Maici river.'

To express this meaning, one would have to make the structure biclausal:

(76) **ti gáísai ?ahoahíai ti so?óá hoabágiso ?ao?aagá baicíhiai.**
'Tomorrow I can say that I have been on the Maici many days.'

Why should this be? The answer is straighforward if Pirahã lacks **R**. As Hornstein argues, Full Interpretation prevents multiple modification of a single temporal point.[14] So, without **R**, an adverbial expression could only modify E (S is constant and deictic and hence not subject to run of the mill adverbial modification). Then, to convey a double-modified notion, as in (75), a 'dummy clause' is needed in order to introduce another E point as a point of reference for the embedded clause, again obviating any need for **R**. This is a very important prediction and one which no other model of tense is able to integrate into the rest of the Pirahã tense system, so far as I can tell.

16

3.5 Sequence of Tenses

SOT structures depend on morphological tense, in the HR model and thus we do not expect to find them in Pirahã for this reason, apart from tense syntax or R. They are indeed not found in the language. Nevertheless, that they are absent from Pirahã is compatible with and expected by the proposal that Pirahã is [-R] since, as Hornstein argues, they rely crucially on the R point.[15]

3.6 Morphological Tense and Aspect

As already noted, Pirahã lacks any morphological reflex for tense, aside from the temporal connective suffix {-ao/- so} discussed in section 3.2. above. However, as presented in Everett (1986, 288ff), Pirahã has a rich aspectual system including suffixes to mark such notions as duration of action, realization of action, internal division of action, continuation of action, beginning of action or state, actions within and outside of the control of the speaker (which overlaps with the notion of proximate vs. remote tense), iteration of action, and resultative aspect. There are also two separate positional classes with three suffixes each to indicate the relative certainty of the speaker with regard to the action being asserted (complete certainty, relative certainty, uncertainty) and the speaker's source of evidence (deduction, observation, hearsay). Since space prevents us from going into all of these here, I will just baldly assert that the temporal nuances of these various aspectual and evidential markers can be accounted for straightforwardly by the mechanism developed in terms of E and S in 3.2. above to account for temporal connectives, without any need to posit an R point. I mention aspect here merely to refer the reader to the more detailed study of Everett (1986) and to state that there is no R-based temporal interpretation 'lurking' in some other part of Pirahã morphosyntax, e.g. aspect.

3.7 Summary of Analysis

In this section, I have provided a detailed analysis of temporal morphemes, expressions, and available interpretations in Pirahã, arguing that none of these refers to R. It cannot be coincidental that the absence of perfect tense, multiple temporal modifications, and SOT structures correlate with an absence of R-referring morphemes or morpheme combinations in Pirahã. I conclude, therefore, that the evidence strongly supports my assertion that Pirahã lacks R.

4 Implications

4.1 Syntax vs. Pragmatics/Semantics

A superficially plausible response to the above verbiage would be to assert that Pirahã lacks any tense syntax whatsoever. So, suppose that some languages, e.g. English, have an elaborate HR-type of tense syntax, while other languages, e.g. Pirahã just do not treat tense syntactically at all. For these languages, we could claim that temporal interpretations are derived semantically or pragmatically, via the context and real-world knowledge. In other words, a given utterance will be underdetermined morphosyntactically for tense, able to mean whatever the speakers want it to mean. But, this 'answer' gains us nothing in terms of a solution to the problem of understanding how it is that Pirahã talk about time. It is empirically and conceptually inferior to a syntax- based approach to temporal interpretation in Pirahã.

For example, a nonsyntactic approach is empirically inferior to the syntactic approach in that it cannot account for the fact that multiple temporal modifications of a single clause are prohibited, as we saw in 3.3. above. Nor can such an approach account for the absence of sequence-of-tense constructions and perfect tense interpretations.

An approach to tense in Pirahã based primarily on pragmatics, semantics, or discourse structure fails conceptually because it still needs the notions E and S and hence in effect 'hides' away what amounts to a *syntax* of tense in talk about *context*. As discussed in section 2.1.2., E is crucial to semantic interpretations of events crosslinguistically, according to Higginbotham (1985). More importantly, E and S are implicated in any interpretation of time. However we label it, the interpretation of a past tense, for example, requires us to know that an event transpired prior to the moment of speech. And this fact will not change in any language, not even Pirahã. Although time interpretation does not require the intermediation of an R point, at least for the basic time frames (past, present, and future), there just is no way to talk about time without an Event preceding, following, or occurring simultaneous with an S, i.e. the moment of speech. E and S just cannot be gotten rid of. But, if we need E and S and principles to order them with regard to matrix and subordinate clauses or interclausally (cf. the appendix), then this just is a syntax of tense!

The advocate of a pragmatic approach might counter by claiming that E and S are part of our real-world knowledge, not part of syntax. Their 'linear' orderings are merely the only logically possible relationships between them. There would be no need to invoke 'UG' if this were true. I think that this is a superficially reasonable reply. However, it fails again to account for the facts mentioned in the first paragraph of this section (i.e. double temporal modification in a single clause, perfect tense, SOT structures, etc.). Moreover, a nonsyntactic

approach to tense cannot account in any principled way for the notion of temporal domain and its role in temporal connectives, as discussed in section 3.2. Thus, although this final reply makes some sense, it is empirically inadequate.

An alternative, but related, proposal is to claim that R is diagnostic of tense syntax. That is, a temporal system which makes use of R is a syntactic tense system, whereas a system without R is a pragmatic temporal system. However, this alternative really is no different from claiming that all languages have a syntax of tense, but that this syntax varies such that a language can manipulate E and S or E, S, and R. Then, languages do not vary as to whether or not they have a syntax of tense but merely as to whether or not their tense syntax is 'parameterized' positively for R. Clearly, whether one assumes that languages differ according to the presence or absence of tense syntax or just the presence or absence of R, the entire issue boils down to R, as we see in (77) and (78):

(77) *Tense or no Tense*: E and S are available to all languages via real-world knowledge. R is only found in languages with tense syntax. There are thus two types of languages: 1. Tense languages, identified via the presence of E, S, and R and 2. Nontensed languages, identified by having only E and S.

(78) *R or no R*: All languages have tense syntax. However, R is parameterizable. There are thus two types of languages: 1. E, S, and R and 2. E and S.

These two alternatives are nearly identical. However, only the latter, syntactic characterization of the problem is equipped to tell explain the restriction on temporal interpretations in Pirahã that we have seen throughout this study. Therefore, I conclude that the best characterization of the difference between Pirahã vs. English-type languages is in terms of the parametrization of the reference point, R.

If this is true, then we must rethink certain claims of the HR model with regard to the mapping between tense syntax and tense morphology, since Pirahã has the syntax but not the morphology. For example, Hornstein (1990, 112ff) argues that mapping from morphemes to tense structures '... can be separated into an SR part and an RE part.' He further argues (p146) that if a tense morpheme is lacking then '... S is absent as well.' His arguments to this effect are based on the English infinitival construction, although they clearly cannot work for Pirahã. As we have seen, Pirahã has no tense morpheme at all, but this does not and cannot mean that all Pirahã clauses work like the English infinitive. A simple answer suggests itself, namely, that the mapping from tense syntax to tense morphology is optional. When there is no mapping, the morphology is absent. That is, the morphological tense is an optional, language-specific manifestation of the *universal* tense syntax. When the mapping applies, it may well be that it proceeds just as Hornstein suggests, although I have no evidence at hand that would either support or disconfirm that view.

4.2 Tense, UG, and Acquisition

4.2.1 Setting for [+/- R]

If indeed some languages are parameterized as [+R] and others are [-R], then we must ask what kind of evidence would be necessary for the child to be able to determine what kind of language it has been born into. Hornstein (p112) argues that there is not adequate evidence for the child to make such a determination and that, therefore, E, S, and R are necessarily universal.

Yet, it seems to me that Hornstein has painted the problem a bit darker than is necessary. He is concerned primarily with saying how the child will know that simple past, present, and future tenses contain an R, since R has no *interpretive reflex* in these tenses. But the answer need not be that R occurs in all languages, as Hornstein concludes (more precisely, that **R** is a nonoptional unit of UG). In fact, this can*not* be the answer, since we have seen that R does not occur in Pirahã. An alternative is that the the basic setting for all languages is [-R]. The child must assume that R is present in all tenses in a given language if it is found in at least one tense of that language. No 'exotic' data are necessary. The child need not look for evidence from SOT structures or temporal modification, for example, to determine whether R is present or not. Assume that any perfect tense will trigger a setting for [+R]. Then, a child will keep the parameter set at [+R] if it finds a perfect tense. It will set the parameter for [-R] if it finds no perfect tense or if the language in question, like Pirahã, lacks any overt tense at all. However, setting the parameter at the value [-R] does not preclude resetting it as [+R] if positive evidence for R is later encountered, e.g. double tautoclausal temporal modification. This makes the interesting (but yet untested) prediction that children will not manifest double temporal modification prior to acquisition of the perfect tense. Therefore, there does not seem to be any real force to Hornstein's argument that learnability forces us to assume that R is a universal feature of the syntax of tense, present in all languages. To the contrary, learnability requires us to posit [-R] as the default setting.

Learnability does appear to rule out an alternative view of the problem, however, namely, that tense is an abstract verb. Let us see why.

4.2.2 Tense ≠ Abstract Verb

One of the most attractive features of the HR model is that if we accept the analysis argued for here, then we predict two and only two types of tense systems to be available in UG - those with R and those without R. Any theory which treats tense differently must achieve this result also or it must show instead that (i) I am wrong and that there is only a single tense system needed crosslinguistically or that (ii) there are more than two possible tense

systems, that is, that English and Pirahã merely instantiate two of the multiple systems available. I will reject the latter possibility, since it is the weaker hypothesis and there seems to be no evidence that would support it. In the absence of evidence which would support a wider range of tense systems, theories which analyze tense as a higher verb are too powerful.[16]

The HR theory defines a small set of possible tenses, based on linear relations between E, S, and R. To better appreciate this result, let us consider a specific example of an alternative analysis, which Hornstein calls the 'Generative Semantics' (GS) analysis. In this type of model, tenses are treated as the 'higher' verbs, 'PAST' and 'FUT'. Present tense is the unmarked tense, that is, the tense not governed by one of these two 'verbs'. Consider how this model might represent the various tenses:

(79) $[_S$ John leave the office] = 'present tense'
'John leaves/is leaving the office.'

(80) $[_{S_1}$ $[_{NP}$ $[_{S_2}$ John leave the office]$[_{VP}$ PAST]] = 'past tense'
'John left/was leaving the office.'

(81) $[_{S_1}$ $[_{NP}$ $[_{S_2}$ John leave the office]$[_{VP}$ FUT]] = 'future tense'
'John will leave the office.'

(82) $[_{S_1}$ $[_{NP}$ $[_{S_2}$ John leave the office]$[_{VP}$ PAST]$[_{VP}$ FUT]] = 'future perfect tense'
'John will have left the office.'

(83) $[_{S_1}$ $[_{NP}$ $[_{S_2}$ John leave the office]$[_{VP}$ PAST]$[_{VP}$ PAST]] = 'perfect tense'
'John had left the office.'

We might account for Pirahã in this theory by simply stating that Pirahã prohibits embedding. Since the only nonembedded tenses are 'past', 'present', and 'future', this analysis is superficially quite attractive. Its attractiveness is enhanced when we consider that Pirahã avoids embedding generally (Everett 1986), expressing biclausal relationships almost exclusively by parataxis.

However, as H points out, this iterative-verb theory must explain why there are not more degrees of embedding. In other words, why are there not more language types than merely those represented by Pirahã and English? This theory also seems to make the unlikely prediction that Pirahã- type tense systems will be more common than English-type systems since they are simpler formally. Also, if we were to argue that Pirahã lacks embedding in tense because it lacks embedding generally, we would still be unable to account for the fact that English embedding of tense verbs is limited to only two degrees of embedding (since English allows multiple degrees of embedding, yet multiple tense verbs would produce more tenses than actually exist in English). A related question is why no one has yet observed languages in which n-number of embeddings in a grammar correlates with m-number of tenses. Another problem for this account is that it fails to explain why perfect tense could

21

not be built up paratactically in Pirahã (just as multiple temporal modifications can be built via parataxis, cf. section 3.4.) or result from correlative-type structures, as are exploited for relative clauses (Everett 1986, 275ff).

An alternative analysis which analyzes tense as a predicate but avoids the 'recursion problem' might claim that tense is predicated of 'E', not the sentence. This would give a structure like (using a model along the lines of Higginbotham (1985) or Leder (1991)):

(84) a. John arrived before I arrived.

b. arrive(John,E) & Past(E) E<(any E') [arrive(I,E') & Past(E')][17]

This proposal indeed avoids the recursion problem noted above. But it fails to integrate the S-point (and other facts mentioned in this section), which I have argued to be crucial to the interpretation of tense relations on independent grounds. Moreover, the predicate 'Past' seems to me to be question- begging. It does not tell us what 'Past' means. When it attempts to answer this question, it must say that 'Past' just means that the moment of speech (or other anchor point for S) precedes the E(vent), getting us circumlocutiously back to the primitives of the HR model.

To sum up, the problem with any approach to tense based on iteration of tense verbs is to place exactly the right limitation on the degree of iteration allowed of such verbs and simultaneously account for the other facts of Pirahã tense. As far as I can tell, any such limitation would be purely stipulative, unlike the HR approach developed here. Therefore, I conclude that Pirahã-type languages raise a critical question regarding the adequacy of tense theories which abstract predicate-based theories are unable to answer.

4.3 Cultural Implications

4.3.1 Culture, communicative burden, and formal complexity

Given our analysis of Pirahã tense, and its interesting differences from English-type systems, we now turn to ask if there is any relationship between Pirahã's tense system and its culture. It is instructive as we begin, to reconsider Sapir's seminal statment on the relationship between culture and language. Sapir's (1921) essay on language is rich and important for its sensitive appreciation of the subtle connections between language and culture. Yet, he was careful enough to maintain a clear view of the complexity and systemic coherence manifested by each separately. Perhaps one of his best known passages on the connection of language and culture is the following (Sapir 1931, 578; reprinted in Hymes 1964, p128)):

"... language is very much like a mathematical system, which, also, records experience, in the true sense of the word, only in its crudest beginnings but, as time goes on, becomes elaborated into a self-contained conceptual system which previsages all possible experience

22

in accordance with certain accepted formal limitations. Such categories as number, gender, case, tense, mode, voice, 'aspect' and a host of others ... are not so much discovered in experience as imposed upon it becuase of the tyrannical hold that linguistic form has upon our orientation in the world.'

A striking feature of Sapir's assertion here is his claim that it is *language which affects culture*, rather than culture affecting language.[18] One way that language might affect culture is for formal or substantive components of a grammar to affect the way people can talk about the world and thus, ultimately, their culture. This would be in addition to the grammar's influence through overt or covert (Whorf's (1956b) 'cryptotypes') classes of words.

The relationship between the complexity of a particular component and the communicative richness of that component (measured in part at least by the number of contrasts available to the component) is expressed in a well-known formula of communication theory: $N = A^\lambda$, where N is the number of types (e.g. utterances or words), A is the number of paradigmatic units (e.g. words or phonemes) and λ is the maximum length of a type. If a particular value for N, N_1, represents a threshold number of utterances or words necessary to talk about a phenomenon, then the output of A^λ must be large enough to guarantee N_1 utterances. This all just says that the code must be rich enough to convey the message.

Now, in the area of temporal interpretations, by analogy, the temporal interpretive template of a language (E, S, and R or E and S) made available by UG imposes an upper limit on the basic tenses and temporal syntactic operations available. The absence of one component of the template (R) deprives the culture of an ability to discuss notions based on this component. Pirahã cannot express (or by extension interpret) perfect tenses if this reasoning is correct. If this is correct, then it is very significant, offering support for Sapir's hypothesis on the relationship of language and culture. Moreover, it would mean that perfect tense cannot be translated into Pirahã, a nontrivial example of Quine's (1960) view of the 'indeterminacy of translation.'

4.3.2 Culture and formal system matches

Let us think about this implication from a common-sense, nonspecialist perspective for a moment. There is a group of Amazonian jungle-dwellers who have no schedules to keep and for whom time-keeping and time talk are relatively insignificant.[19] It turns out that the principal components of tense syntax of this group is formally a subset of the tense syntax components of other groups, e.g. English, i.e. that Pirahã's tense syntax is simpler than that of English. This would not suprise the 'man-on- the-street'. (Nor would it surprise the man-on-the-street to learn that Pirahã tense syntax was *as complex* as English syntax. Both states of affairs are reasonable, a priori.) But it *would* surprise the man-on-the-street to learn

that the tense syntax of, say, North American culture, where time and precise chronological ordering of events is significant to the talk of the average member of the culture, was less complex and less expressive than Pirahã's. Common sense is likely not far off when it favors the conclusion that there is a relationship between talk about time in a culture and the morphosyntactic tools available for such talk.

Let us assume, therefore, that the state of affairs we have observed is not a coincidence. Then, either Pirahã grammar affected Pirahã culture, the culture influenced the grammar, or there was a mutual interaction with each affecting the other.

The first option, that culture directly influences something so deeply embedded in the formal grammar of a language as the setting of parameters such as [+/-R], is not very appealing. This would lead to an impossible situation for the language-learner. If culture affected parameters, then the child could not learn the syntax of its language until it mastered its culture. But the acquisition of culture, unlike the acquisition of grammar (which ends more or less at puberty), is arguably a life-long process. This does not deny that knowledge of *language* increases with age throughout life, only that mastery of *grammar* does not. If we assumed that culture influenced syntactic parameters then, this would lead us to the unlikely scenario in which Pirahã children would not be able to interpret temporal notions in their language until adulthood. Moreover, the view that culture could set syntactic parameters is at variance both with the notion that grammatical competence is *informationally encapsulated* (Fodor 1983, 64ff) and with the concept of a *trigger*. Parameter-setting is a delicate, formal process and items which may trigger it are explicit and formally definable - they are never general qualities of the cultural milieu and (cf. Pinker 1990 for a detailed treatment of language-learnability problems) there are many good arguments that they could not be.

Notice too that one cannot counter that it is possible to allow culture to influence grammar, if only we adopt a diachronic perspective. Let us grant that is likely that historical communicative needs or pressures could affect adult speech in such a way as to lead children to make a new analytical hypothesis on the structure of the language in question, based on the 'coincidental' absence of certain structures in adult grammar (absent, say, because the culture has changed so that people no longer talk about time the way the used to). Moreover, this new hypothesis of the next generation could represent an alternative parametrization of the relevant aspect of the grammar. But the historical 'cause' of parametrization is irrelevant here, since the real issue to be dealt with is synchronic, L1 acquisition. This is so because we are concerned in accounting for *what speakers know* in our analyses of linguistic subsystems, and how that knowledge can be accounted for. People's knowledge of their language and our statements about it cannot take historical facts into account, since people's knowledge of their language's history is usually nonexistent. Thus, culture and history can play no causal role in the acquisition or representation of a synchronic grammatical system. Moreover, as

24

we saw in section 4.2.1. above, learnability *requires* that children initially hypothesize [-R] in all languages. If this is so, the cultural pressures that might have led to it, if indeed it makes sense to talk this way about any parametrization, are only relevant in some prehistoric, evolutionary sense. If I am correct, 'R' is never present then deleted in any grammar at any developmental stage; it is only added to the grammar if there is adequate positive evidence. I therefore conclude that the absence of [-R] in Pirahã is only handled by the parametrization of Hornstein's model, and not as merely a historical change in the grammar or direct cultural influences on the language.

On the other hand, Sapir's idea that language (more precisely, *grammar*) affects culture would indeed be compatible with what we know about acquisition, informational encapsulation, and parameter-setting. Then, we are forced to say either that the fact that Pirahã culture does not talk about time or quantify it in any obvious way and the fact that Pirahã grammar lacks R is coincidental or that Pirahã grammar affects Pirahã culture. The application of Sapir's ideas to Pirahã in the theoretical framework I am assuming would then mean that while the fact that a given language might parameterize for [-R] is itself a random fact, the consequences of this fact for the culture are potentially severe.

5   Conclusion

In this paper, I have provided a detailed analysis of temporal reference and the syntax which underlies it in the Amazonian language Pirahã. I have argued that the neoReichenbachian model of tense developed in Hornstein (1990) provides a useful tool for analysing Pirahã tense, if modified. In particular, I have argued that Pirahã utilizes both the E(vent) point and S(peech) point in constructing tenses inter and intraclausally (cf. the appendix), but that it lacks R, the reference point proposed by Reichenbach and Hornstein to account for perfect tenses, multiple tautoclausal temporal modifications, and sequence-of-tense structures. If correct, this analysis leads us to speculate that Pirahã grammar may have affected Pirahã culture by making certain temporal interpretations unavailable to the people, supporting a weak version of the Sapir-Whorf linguistic relativity hypothesis.

6 Appendix: Pirahã text

6.1 Introduction

This story tells of the death of **Xopísi**'s wife, **Xaogíoso**.[20] She died in the early morning, while giving birth to a baby. She was all alone giving birth at the river's edge when she died. Her sister, **Baígipóhoasi**, did not help her at all. **Xabagi** took her some medicine, but did not return to check on her later on. **Xabagi** called to **Hoagaixóxai** (the lady's son-in-law), but he did not respond nor go see her before she died. **Xopisi**, her husband, was down river fishing for piranha when the death occurred, so was no watching after her.

1. Xoii hi - aigía - gá - sai Xopísi
Xoii he - rel - say - prog. Xopísi
hiabi - kaá - haaga
neg. - ? - ?
Xoii said, Xopísi is not here.
2. Xoii hi - aigia - ga -xai Xaogíosohoagi
Xoii he - re. - say - prog. Xaogíoso
i - oa - a - kaa - haaga
she - die - stat - ? - ?
Xoii then said, Xaogíoso is dead.
3. aigia hi - aitibíi
rel. him - call
Well he was called.
4. ti - hi - gi - aitibíi - gao - ai Xoii
I - him - real. - call - mov - prog. Xoii
hoi - hiai
one - is
I called only one, and that was Xoii.
5. Xoii hi - aigía ti - ga - xai aogíosohoagi
Xoii he - rel I - say - prog. Xaogíoso
i - oa - baa - hoi - hoi Xaogíoso
she - die - mov - become Xaogíoso
Well Xoii, I said, Xaogíoso has died.
6. Xoii i - bo - ai - pai - hiaba - hai Xoii
Xoii she - see - prog. - float - neg - incomp. Xoii
Xoii did not go to see her on the floating dock.
7. Xaogíosohoagi i - oa - i - koi

Xaogíoso she - die - stat- emph.
Xaogíoso is really dead.
8. ti - aigía aitagob - ai
I - rel. fearful - prog.
Well, I am really fearful.
9. Xoii hi - aigia - ga - xai - sai Xitaíbígaí
Oi he - rel. - say - prog. - rest. Xitaíbígaí
hi - aítisi aab - ahá
she - tell heg. - incept.
Xoii then said, Xitaíbígaí did not tell about it.
10. hi - ga - xai - si aab - ahá
he - say - prog. ? neg. - incep.
He said, she did not tell.
11. Xaogíosohoagi i - hoi - sahaxaí
Xaogíoso she - go - neg.
Xaogíoso you must not die.
12. ti - xaigía - ga - xaiai Xaogíosohoagí
I - rel. - say - ? Xaogíoso
ia - hoaga
dead - becomes
I then said, Xaogíoso has become dead.
13. aab - aob - aha
neg. - comlp. - incep.
She is no longer here.
14. Xoii hi - i ob - ai - pai - hiaba - xai
Xoii he - she - see - prog - float - neg. - prog.
Xoii did not go to see her on the floating dock.
15. Xopísi hi xiaso - aihi hi - gixai igihí
Xopísi he - look after - inter her - you man
Xopísi did you the man look after her?
16. i - oa - íxi Xaogióso]
she - die - stat Xaogíoso
Xaogíoso is dead.
17. Ti - xaigíai hi - aitibíi - gaóp - ai Xoii
I - rel. him - call - mov - prog. Xoii
i - ob - ái pápaí

her - see - prog. - ?
Well I called to Xoii to go and see her.
18. Xaogíosogoagí ia - hoagái
Xaogíoso dead - becomes
Xaogíoso has become dead.
19. aab - aob - áhá
neg. - comp. - incep.
She is no longer here.
20. Xaogíosohoagí hi - aigía kai - hia - gó - haaxá
Xaogíoso she - rel. child - drop - there - ?
Xaogíoso dropped her child.
21. Xoii ti - xaigía - gá - xaiai Xoii hi - xioi
Xoii I - rel. - say - ? Xoii he - with
aipi - hoaip - ái Xoii
medicine - give - prog. Xoii
hi - ob - ágá - ta - xai - hiaba - xai
her - see - ? - recur. - prog. - neg - prog.
I said to Xoii, you gave her medicine, but you did not go see her again.
23. Xoii hi - aigía - gá - xai Hoagaixóxai
Xoii he - rel. - say - prog. Hoagaixóxai
hi - gá - xisi - aab - áhá Hoagaixósai
he - say - hear - neg. - incep. Hoagaixósai
Xoii then said, Hoagaixósai said nothing.
24. Xaogióso i - ai - hi - ábahíoxoi
Xaogíoso she - is - very - sick
Xaogíoso is very, very sick.
25. i - xaipi - hoaip - aáti i - hiab - ahá
it - medicine - give - mom - it - neg. incept.
The medicine was not given to her.
26. hi - ai hi - ahoai - hiab - ahá
he - do he - speak - neg. - incept.
gíxa - pixáagi - xi
you -younger - stat.
He, the younger one, (Hoagaixóxai) did not tell anyone.
27. Xaogióso hi - ábahíoxoi - sahaxaí
Xaogíoso she - very sick - neg.
Xaogíoso is very sick.

28. hi - gá - aisi - aab - ahá.

he - say - hear - neg. - incep.

He did not say anything.

29. hi - abaasi hi - gíxai - tai - sahaxaí

he - people they - you - do - neg.

You did nothing for "the people".

30. Xabaxaí hoi - haí

alone go - incomp.

All alone she went.

31. Baígipóhoasi hi - aigía - gá - xai

Baígipóhoasi she - rel - say - prog.

Xaogiósohoagí

Xaogióoso

i - ábahíoxoi hi - aigía hói - haa

she - very sick she - rel. one - ?

Baígipohasi then said, Xaogíoso is very very sick, and all alone.

32. Ti - aigía hi - aitibíi - gaóp - aí

I - rel - her - call - mov - prog.

Baígipóhoasi

Baígipóhoasi

i - ob - aí - paí - hiab - ai

she - see - prog - float - neg - prog.

Well I (Xitaíbígaí) called Baigipóhoasi, but she did not go to see her.

33. Xoii hi - aigía - gá - xai - ao

Xoii he - rel - say - prog - when

hi - ob - aabóp - í - ha

he - see - come - stat - incep.

hi - aigía Xaogiósohoagí i - oa - í i - oi - í

she - rel Xaogíoso she - die - stat. she - die - stat.

When Xoii came up from seeing her he said, Xaogíoso is dead, yes she's dead.

34. Xopísi hi - xiaiso - xai hi - gíxa - igihí

Xopísi he - looks after - prog. her - you - man

Xopísi, did you the man look after her?

35. hi - oa - bái - kaa - hoagá - xaí

she - die - very - ? - become - prog.

She has become very dead.

36. Xaogiósohoagí hi - kaháp - i

Xaogíoso she - go - stat.

Aogioso is gone.

37. Xoii hi - aigía i - ositig - aop - ábau - haa

Xoii he - rel she - straight - put - nearly - ?

Xoii then nearly straightened her out.

38. hi - gá - xai Xaogióso i - iaíhiag - aí

he (Xoii) - say - prog. Xaogíoso she - adult - is

Koaí - si

(the) dead one

He (Xoii) said Xaogíoso the adult is dead.

39. ia - hoí - xi koxipo - paóa

die - become - stat good one - ?

áb - iig - ábai - xi

remain - cont. - nearly - stat.

She was a good one, for this reason she died.

40. Xapisíoi hi - agía - gaá - xai - sai

Xapisío he - rel - say - prog - rest.

Xaogiósohoagí

Xaogiósohoagí

i - ai - hi - ábahío - i - ai

she - si - she - very - she - is sick

Xapisíoi said, 'Xaogíoso is very very sick'.

41. i - aigía hóo - kaa - hoí - sáoí

she - rel go - ? - mov - interr

Was this the reason she died?

42. Xoii hi - i - ob - ai - hiab - aó

Xoii he - her - see - prog - neg - when

abop - ap - oxoihí

return - ? - inter.

When Xoii came up, he did not return to see her.

43. hi - gá - xai hiab - aí

he - say - prog neg - prog

He said, she is not here.

44. hi - ob - aí - paí - taa - xá i - hiab - aó

he - see - prog. - float - recur - prog. he - neg - when

abop - ai

return - prog.
After I came up I did not go see her again.

6.2 Discussion

Temporal progression is obviously an important notion in Pirahã, judging from the text just given. However, note that no two lines require the intermediation of an **R** point, but that all pairs of lines in the text can be related temporally via simple precedence or succession. To express these notions, **E** and **S** suffice. For any two sentences, if the **E** point of one is lined up with the **S** point of the other, then the first is said to follow the second. It is further interesting to note that all the sentences in the texts in my corpus (abstracting away from quotative constructions) come from the same temporal domain, as defined in above (i.e. in their interpretations, not in their overt tense since Pirahã lacks overt tense).

7 Notes

1. This dichotomy of 'formalist' vs. 'functionalist' reflects the current polarization of North American linguistics and is not necessarily the same as the well-known 'structuralism' vs. 'functionalism' distinction. I would like to thank Norbert Hornstein, Ian Roberts, Carol Tenny, Bob Carpenter, Frank Heny, Geoffrey Pullum, and two anonymous P & C reviewers for comments on versions of the ideas presented here. I would also like to thank audiences at the University of Michigan and the Center for Philosophy of Science, University of Pittsburgh, for helpful comments and encouragement. Especially, I want to thank the Pirahã for their constant patience and graciousness over the past fourteen years, especially my principal helpers: Kohoibiíhai, approximately 40 years old, head of the village of Posto Novo; Xahoapati, approximately 40 years old, head of the village of Santa Cruz; and Kaioá, an approximately 18 year-old boy, who lived with my family in various locations for nearly six months as a close friend of my own son. This is in spite of their own worsening circumstances. Three Pirahã women from the same village of 20 people have died in the past eight months and more illnesses are being brought in from settlers along the TransAmazon Highway. Collection of the data for this paper was supported in part by a grant from the *Center for Latin American Studies* at the University of Pittsburgh, via a grant from the U.S. Department of Education. I also want to acknowledge the support of the Dean of the Faculty of Arts and Sciences at Pitt for his administrative support of this research.

2. On the other hand, it seems clear that form is epistemologically prior to function in evolution and synchronic grammars and that therefore any study of function necessarily presupposes at least a rudimentary analysis of the forms involved, although the converse does not hold. See Everett (1992) for argumentation.

3. Pirahã, the only surviving member of the Mura language family, is spoken by approximately 150 people along the Maici river in the state of Amazonas, Brazil. I have worked among the Pirahã for over 14 years (four years of actual village living) and speak the language fluently.

4. A referee notes, accurately, that Sapir learned this perspective from his professor, Boas, who in turn learned it from Humboldt. However, since the hypothesis, for better or for worse, has become so closely associated with Sapir, I will continue to give him credit here. Of course, it is really not the idea that matters so much as what one does with it. Ideas are a dime a dozen, after all. It is the development of the idea and the integration of the idea into a theory that is important. Humboldt made numerous brilliant observations, but his failure to elaborate any real theory of language in which these ideas are embedded, something which Sapir did do, at least partially justifies crediting the latter with the idea as a hypothesis of linguistic theory.

5. I of course am abstracting away from the well-known temporal paradoxes of quantum theory. These are irrelevant for the logic of natural language or the nonsubatomic world.

6. This range of tenses is too large, since natural languages do not distinguish among all these possibilities. Hornstein argues, though, that the range can be limited appropriately on independent grounds.

7. This is not to say that such examples are not also potentially ruled out by a 'semantic' theory. However, if the syntactic theory of tense is independently necessary (cf. below for arguments to this effect), then it is interesting that it can also handle this type of example quite easily, trivially in fact, as they deserve. Thus, there may be no need for an independent semantic account of examples like (12).

8. That is, under the interpretation where Mary *is* pregnant.

9. Other 'tenses', such as the 'historical present', as in 'It is 1969 and Woodstock is about to happen' are indeed contextually determined in a way that I have not discussed here. So, one might object that I am being naive about the role of context in tense interpretation. However, this misses the point. The 'historical present' for example, just IS present tense. The S, E, and R points are all the same. It is just that the S point has been shifted. Remember, the moment of speech is the default anchor for S, not the only one, as various examples above have shown. I do not believe that discourse analyses of tense really have much more to add than this, despite claims to the contrary (e.g. Givón 1984 (272ff).

10. Comrie (1985, 50ff) characterizes "tenseless languages" as languages "...where time reference per se is not grammaticalized...", i.e. where there is time reference but it is not reflected morphosyntactically.

11. In the body of the text, I represent glottal stop as '?'. However, in the appendix, the Pirahã text in the practical orthography, where glottal is represented as 'x'.

12. Present tense is possibly in the same domain as future for another reason. According to the CDTS (cf. (10) above), the present tense structure can be modified to allow E to follow S, by placing a space between S and E. This is allowed since it neither associates previously unassociate points, nor does it reorder two points, since E still follows S. On the other hand, the past cannot be altered to fit the present, nor the present the past, without violating the CDTS, or my constraint against crossing connection lines for languages without R.

13. Note that this example makes perfectly good sense semantically. John's arrival took place in the past and your leaving takes place in the present, so that there is no reason why his arrival could not precede your leaving, in fact, this is what had to have happened. Nevertheless, the example is ungrammatical, because it violates the constraint noted above that temporal connectives can only link sentences of the same temporal domain (or, in languages with R, if the CDTS is not violated).

14. Apparent counterexamples to this actually involve adverbial units: 'Tomorrow, John will have been here [for [three semesters [past the winter solstice']]]], where 'three semesters...' counts as a single adverbial constituent. Moreover, note that Pirahã does otherwise allow multiple adverbials in a single clause:

(i) Kohoi **báíhiigí baiahiabiso ʔapisibigaíso** kagáíhiaí koabáipí.

'Kohoi slowly, without fear, with strength kills the jaguar.'

15. As one P & C referee pointed out, however, SOT generalizations also hold for nominals: 'John's statement that Mary was/is pregnant came at a bad time', thus perhaps weakening the SOT argument for Hornstein's model across the board.

16. Hornstein (p166) also presents a number of English-internal arguments against analysing tense as an operator. I will not repeat these here. However, he also (p94) provides a more general type of argument against the 'tense-as-a-verb' hypothesis, based on generative power which is relevant to this section.

17. Thanks to an anonymous P & C reader for pointing this out.

18. This is to sharply distinguished, for example, from Whorf's (1956b, 65) position that language is an 'especially cohesive aggregate of cultural phenomena'.

19. Work in progress by the present author and Peter Gordon, also of the University of Pittsburgh, on quantification of time and space among the Pirahã supports these assertions. Moreover, this may ultimately turn out to be related to a reduced quantificational system generally. The Pirahã also lack a counting system, special quantificational words, e.g. 'all', 'every', 'each', 'which', etc., and, as already mentioned, the grammar rarely allows embedding.

20. This text comes from a corpus of texts collected from 1967-1976 by Steve and Linda Sheldon of the *Summer Institute of Linguistics*.

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