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A Hypothetical Proof Account of Chamorro Wh-agreement

Abstract

Chamorro is an Austronesian Language spoken primarily in Guam, which is generally taken to have VSO word order. It displays an interesting pattern of agreement in unbounded dependency constructions, whereby the verb agrees via infixation and/or suffixation with one of its dependents, be it subject, object, or oblique, from which an element has been extracted. Convergent Grammar (CVG) is a relational, multi-modal, type-theoretic, resource sensitive grammatical framework which "can be seen as a coming together of ideas of widely varying provenances, be they transformational, phrase-structural, or categorial." (Pollard (2007a)) The question of how a verbal head can agree with a dependent out of which an element has been extracted can be accounted for in this framework using a combination of lexical specification and rules of natural deduction, in particular the notion of hypothetical proof. Embedded constructions are of particular interest, as each verb's agreement morphology varies with the corresponding variance in the grammatical role of the dependent from which extraction has occurred. [1]

1 Introduction

Chamorro is an Austronesian language, spoken primarily in Guam, which is generally taken to have primarily VSO word order. It displays an interesting pattern of agreement in certain unbounded dependency constructions, whereby "the verb ... agrees in grammatical function with the gap" (Chung and Georgopoulos (1984)), be it subject, object, or oblique. Chung (1998) revises this to agreement with a trace, but both of these are a slightly incorrect formulation, as agreement is based not on the verb's relation to the gap (or trace), but with the verb's relation to whichever of its dependents (syntactic argument or adjunct) **contains** a gap. In some cases the gap may be the entire dependent itself. The question of how a verbal head can agree with an element from which extraction has taken place can be accounted for in a framework using a combination of lexical specification and rules of natural deduction, in particular the notion of hypothetical proof. This

[1]The ideas presented in this paper would no doubt be poorer were it not for the gracious help of Carl Pollard, David Dowty, Bob Levine, Judith Tonhauser, Scott Martin, Andy Plummer, Vedrana Mihalicek, and Lia Mansfield. Special thanks are due to several anonymous reviewers, the participants of the LMNLDS workshop at DGfS 30, and to Sandra Chung, whose timely email helped clarify a puzzling piece of data. Anything misleading or untrue is undoubtedly the responsibility of the author.

type of analysis has the benefit of accounting for the data in a way which is based on generally accepted logical principles, without resorting to explicitly movement-based strategies. Convergent Grammar (CVG) provides a natural way to show that phenomena like wh-agreement can be given a straightforward and logically precise analysis in a categorial framework with rules of hypothetical proof.

In the second section, I lay out relevant data which is exemplary of the wh-agreement phenomenon, which is then summarized in section three — "The Wh-agreement Paradigm". Section four explores the basic issues presented by the phenomenon. The fifth section is an introduction to the basics of CVG syntax and semantics, with examples from English and Chamorro. The sixth section, "Basic Strategy" outlines the ideas underlying my analysis, and section seven discusses the importance of hypothetical proof for this account. In section eight, I discuss the CVG perspective on linear word order, and define the operation 'right wrap'. Section nine consists of a CVG sample derivation for the most complicated example from section two. Sections ten and eleven summarize the analysis, and lay out questions for future research.

2 Examples

Morphology relevant to the wh-agreement phenomenon appears in boldface in the following examples.

2.1 Canonical Declaratives

(1) a. Ha-fa'gasi si Juan i kareta.
agr-wash UNM Juan the car
'Juan washed the car.' (Chung (1998) ch.6 ex.(52))

b. Ha-ottu i petta i patas-su.
agr-bang the door the foot-agr
'The door banged my foot' (Chung (1998) ch.2 ex.(31)a)

c. Mang-ákati i famagu'un.
agr-cry.Prog the children
'The children are crying.' (Chung (1998) ch.2 ex.(23)a)

In (1a), we see an ordinary transitive verb construction. The verb is sentence initial, with the third singular realis subject-agreement prefix *ha-*. It is followed by the subject, *Juan*, and the object, *i kareta*. The reader will note the case marker *si*, used to indicate that a proper name is in the unmarked case. Unmarked case, perhaps obviously, typically has no explicit marking. This is the case with the common nouns in (1b), where the transitive verb *ha-ottu* is followed by its unmarked subject *i petta* and unmarked object *i patas-su*. Example (1c) shows an intransitive construction, with an unmarked subject.

2.2 Subject Extraction

(2) a. Hayi f**um**a'gasi ___ i kareta?
who? *WH*[nom].wash the car
'Who washed the car?' (Chung (1998) ch.6 ex.(53)a)

b. Hayi **um**-ayuda hao ___ ?
who? *WH*[nom]-help you
'Who helped you?' (Chung (1998) ch.5 ex(41)c)

Both (2a) and (2b) illustrate similar constructions. In (2a), the fronted Wh-word is followed by a wh-agreeing verb *fuma'gasi*, and followed by un unmarked common noun phrase. In (2b), we have a Wh-word followed by a wh-agreeing verb and an overt pronoun, indicating that the choice of noun phrase type is unimportant to the wh-agreement phenomenon.

2.3 Object Extraction

(3) a. Hafa f**in**a'tinas-**ñiha** i famalao'an ___ ?
what? *WH*[obj].make-agr the women
'What did the women cook?' (Chung (1998) ch.5 ex.(39)a)

b. Hafa s-**in**-angane-**nña** si Maria nu hagu ___ ?
what? *WH*[obj2].say.to-agr UNM Maria OBL you
'What did Maria tell you?' (Chung (1998) ch.6 ex.(73)a)

c. Hafa k**in**annóno'-**mu** ___ ?
what? *WH*[obj].eat.Prog-agr
'What are you eating?' (Chung (1998) ch.6 ex.(58))

In (3a), we see a constituent question where an object extraction has taken place. The Wh-word is followed by the wh-agreeing verb, which exhibits the *-in-* infix, and the suffix *-ñiha*, a nominalization suffix, which appears in a form agreeing with the subject *i famalao'an*. A slightly more complicated example is presented in (3b). Here, the verb shows the same essential morphology as in (3a), albeit with a differently agreeing nominalization suffix. The subject, *Maria*, is in unmarked case, and the first object *hagu* is marked by the oblique case marker for pronouns, *nu*. As previously noted, first objects typically appear in unmarked case. This anomalous case marking is required by the nominalization of the verb, which has the effect of forcing all of the verb's complements to be marked as oblique (Chung, p.c.). In (3c), we see a wh-agreeing verb with no overt subject. Chamorro allows for 'understood' pronominal subjects; in this case, we can tell that the subject corresponds to second person singular by the form of the nominalization marker *-mu*.

2.4 Adjunct Extraction

(4) a. Hafa pära fa'gase-**mmu** ni kareta __ ?
what? FUT *WH*[obl].wash-agr OBL car
'What are you going to wash the car with?' (Chung (1998) ch.6 ex.(53)c)

b. Hayi ma'a'ñao-**mu** __ ?
who? *WH*[obl].afraid-agr
'Who are you afraid of?' (Chung (1998) ch.6 ex.(5)a)

In (4a), we see a constituent question based on an extracted instrument. The Wh-word is followed by a future marker, and the wh-agreeing verb *fa'gase-mmu*. It is important to note that, as with (3c), the subject is understood. The verb does **not** appear with the infix *-in-*, which is mandatory for transitive verbs with object extractions. It is only this fact that indicates that *kareta* is the first object, and that the extracted dependent is something else, in this case, an instrument. We consider an intransitive verb in (4b), which appears with an understood subject, and an extracted oblique.

2.5 Embedded Constructions

(5) a. Hafa s**in**angan-**ã** si Juan pära godde-**tta** ni
what? *WH*[obj].say.his-agr UNM Juan Fut *WH*[obl].tie.our-agr OBL
chiba __ ?
goat
'What did Juan say that we should tie up the goat with?' (Levine & Hukari (2006) ch.3 ex.(63))

In an embedded construction, we see differing agreement markings on the verbs. The Wh-word is followed by a verb bearing wh-agreement for an extracted object. This verb is followed by its subject, *Juan*, and then by a clausal object. This clause is headed by a verb bearing oblique agreement morphology. The subject of the lower clause is understood to be first person dual, and it is followed by the first object *chiba*, which is marked oblique by the case marker *ni*. As with (4a), the verb does not bear morphology indicative of object extraction (the infix *-in-*). So the extracted element bears an oblique relationship to the lower verb, namely that of an instrument. The wh-agreement on the higher verb, however, does appear with the marking characteristic of an object extraction, indicating that the extraction has taken place within its own object.

3 The Wh-agreement Paradigm

The wh-agreement paradigm is characterized through a combination of infixation and suffixation on the agreeing verbs. The agreement marking patterns according to the relationship the verb has to whichever of its dependents contains the gap from which extraction has taken place. In all cases, the wh-agreement marking supersedes whatever agreement marking would be typical for the verb and its dependents. If the dependent dominating the gap is nominative (that is, corresponds to the subject of the verb), then the verb appears with the infix *-um-*, as illustrated by the examples in (2). If the dependent dominating the gap is a first (direct) object, the the verb appears with the infix *-in-*, and is optionally nominalized, typically by a number of markers corresponding to the agreement markers for possessor-noun agreement. This is illustrated by the examples in (3). If the dependent dominating the gap is oblique (e.g., an instrument, or second (indirect) object), then the verb is mandatorily nominalized, as shown in the examples in (4). Additionally, if the verb is unaccusative, it may occur with the optional infix *-in-*. In a declarative sentence, subjects and first objects appear in the unmarked case, while second objects and instruments appear in the oblique case. When verbs are nominalized, their complements appear in oblique case.

4 The Central Issues

The marking of extraction on items along the extraction path has been well documented, notably by McCloskey's work on Irish complementizer alternation. As noted by Levine and Hukari (2006), Irish complementizers present a parallel case to Chamorro wh-agreeing verbs; they exhibit the same patterns regardless of whether the extractees are arguments or adjuncts. These examples are similar to the phenomenon of wh-agreement in that certain constituents along the extraction path are morphosyntactically different than corresponding constituents in non-extraction contexts. The following examples from Irish illustrate this point:

(6) a. Deir siad gur ghoid na síogaí í
say they C-[PAST] stole the fairies her
'They say that the fairies stole her away.' (McCloskey (2001) ex.(1))

b. an ghirseach a ghoid na síogaí __
the girl aL stole the fairies
'the girl that the fairies stole away' (McCloskey (2001) ex.(2))

c. Cá fhad a bhí siad fá Bhaile Átha Cliath __ ?
WH length aL be[PST] they around Dublin
'How long were they in Dublin?' (McCloskey (2001) ex.(7))

In (6a), a declarative sentence, we see the complementizer *gur*. In (6b), a relative clause construction with an extracted object, the complementizer appears in the form of the particle glossed *aL*. The complementizer takes the same form in (6c), a constituent question which contains an adjunct extraction.

Chamorro presents a subtly different problem. While verbal agreement with various complements is certainly not a rare phenomenon, the issue of agreement with adjuncts is somewhat more problematic. If adjuncts are taken to adjoin at the VP level, then by what mechanism can the verbal head 'see' the adjunct? It is noteworthy that the Irish complementizers mark entire clauses, and as such, may be immediately sensitive to adjunct material. But this is not the case with Chamorro – how is it possible that a verb can be required to agree with material that does not appear to be accessible by the verb itself?

An additional complication is presented by the fact that the agreement paradigm varies according to the grammatical relationships between each verb and its **own** particular dependents, rather than the relationships between the verb and and the gap itself. Chamorro verbs are sensitive not only to the fact that there has been an extraction somewhere, but to which of their dependents it has occurred in.

5 An Overview of Convergent Grammar

Convergent Grammar (CVG) is a grammatical framework whose basic setup should be familiar to anyone with a background in phrase structure or categorial grammars. CVG itself is essentially a categorial grammar; it is proof-theoretic and derivational in character. A full CVG proof term is a triple, consisting of a 'phonological' or 'prosodic' term, a syntactic term, and a semantic term (each of which is typed). Each proof term is asserted by the turnstile ($\vdash$) to be axiomatic, or to follow from natural deduction rule schemata. In CVG, the syntactic proof term is one which is made explicit, making it slightly dissimilar to most other categorial grammars, where it is typically omitted. Grammatical features such as case, number, etc. are realized as syntactic types, with underspecified types (such as the NP type of proper names) treated as intersections of these more basic types.

Dependencies are modeled with implication-type connectives of various modalities ('flavors'), each of which represents different types of grammatical dependencies such as subject, complement, modifier, etc. These are roughly analogous to the 'left' and 'right' connectives in most categorial grammars, although CVG connectives exist in abstract syntax, and do not necessarily themselves completely specify linear word order. Instead, this is envisioned as part of the interface between the syntactic and phonological derivations, a discussion of which follows in the "Linearization and Wrapping" section.

Each syntactic mode of implication has its own natural deduction rules associated with it. Local dependencies are modeled with flavors of implication that have implication elimination (*modus ponens*), or 'merge' rules. Nonlocal dependencies are modeled with flavors of implication with no elimination rule ('move'), in conjunction with hypothetical proof (implication introduction) rules. Nonlocal dependencies are discussed further in the section "The Role of Hypothetical Proof".

5.1 English Syntactic Technicalia

Some basic CVG syntactic types and connectives for English:
Fin – a finite sentence
Nom – a nominative noun phrase
Acc – an accusative noun phrase
$\multimap_{\mathrm{SU}}$ – an implication operator for subjects
$\multimap_{\mathrm{C}}$ – an implication operator for complements

In the upcoming example, I intentionally obscure the distinction between the two types of NP, instead treating both as simple NPs. This is not intended to be any kind of theoretical claim, merely a way to more easily illustrate how a CVG derivation proceeds.

Some basic CVG lexical entries for English:
$\vdash$ Sylvester : NP
$\vdash$ Tweety : NP
$\vdash$ chased : NP $\multimap_{\mathrm{C}}$ (NP $\multimap_{\mathrm{SU}}$ Fin)

Natural deduction rule schemata for English:
Subject Merge: If $\Gamma \vdash v : A \multimap_{\mathrm{SU}} B$, and $\Delta \vdash s : A$, then $\Gamma, \Delta \vdash (^{\mathrm{SU}}\ s\ v) : B$.
Complement Merge (C–Merge):
If $\Gamma \vdash v : A \multimap_{\mathrm{C}} B$, and $\Gamma' \vdash o : A$, then $\Gamma, \Gamma' \vdash (v\ o\ ^{\mathrm{C}}) : B$.

A sample CVG syntactic derivation for English follows. For purposes of legibility, these tree-style proofs contains only the numbers which correspond to the line numbers of the line-by-line derivation below.

$$\dfrac{\dfrac{1 \quad 2}{3}\,\text{C-Merge} \qquad 4}{5}\,\text{SU-Merge}$$

1.	$\vdash$ chased : NP $\multimap_{\mathrm{C}}$ (NP $\multimap_{\mathrm{SU}}$ Fin)	(**Lexical**)
2.	$\vdash$ Tweety : NP	(**Lexical**)
3.	$\vdash$ (chased Tweety $^{\mathrm{C}}$) : NP $\multimap_{\mathrm{SU}}$ Fin	(**C–Merge**)
4.	$\vdash$ Sylvester : NP	(**Lexical**)
5.	$\vdash$ ($^{\mathrm{SU}}$ Sylvester (chased Tweety $^{\mathrm{C}}$)) : Fin	(**SU–Merge**)

Lines 1 and 2 assert the lexical entries for ‘chased’ and ‘Tweety’. Line 3 shows their combination by the merge rule for complements, yielding the type of a nearly-saturated VP, NP $\multimap_{\mathrm{SU}}$ Fin. Line 4 asserts the lexical entry for ‘Sylvester’, and line 5 shows its combination with ‘chased Tweety’ via the merge rule for subjects, to yield a proof of the finite sentence ‘Sylvester chased Tweety’.

5.2 English Semantic Technicalia

A compositional semantics may be given for this fragment of English in a fairly straightforward manner. Here, the lexical entries from the previous example are additionally given semantic terms and types in the calculus of Responsibility and Commitment (RC), a thorough introduction to which is given in Pollard (2008). These should be familiar to those with a general background in Montague semantics and Typed Lambda Calculi in general. It may be useful to the reader to think of the RC type ι as Montague’s type e of individuals, and the RC type π as Monatague’s t, the type which will be interpreted as propositions in the model. The usual axioms of α and η-conversion hold, as does β-reduction. The reader will note that the semantic ND rules corresponding to Subject Merge and Complement Merge have been relabeled ($\rightarrow E$), since both syntactic Merge rules correspond to implication elimination rules in the semantics.

The syntax-semantics interface itself is envisioned as a number of ND rules specifying in the ways that derivations in both logics may proceed in parallel. The theorems are of the form $\vdash$ syn_term, *sem_term* : Syn_type, *sem_type*.

Some basic CVG lexical entries (with semantics) for English:
$\vdash$ Sylvester, $sylvester'$: NP, ι
$\vdash$ Tweety, $tweety'$: NP, ι

$\vdash$ chased, $\lambda_y \lambda_x chase'(y)(x) : \text{NP} \multimap_{\text{C}} (\text{NP} \multimap_{\text{SU}} \text{Fin}), \iota \to (\iota \to \pi)$

Natural deduction rule schemata for English (with semantics):
Subject Merge: If $\Gamma \vdash v, f : A \multimap_{\text{SU}} B, C \to D$, and $\Gamma' \vdash s, a : A, C$, then $\Gamma, \Gamma' \vdash ({}^{\text{SU}}\ s\ v), f(a) : B, D$.
Complement Merge (C–Merge):
If $\Gamma \vdash v, f : A \multimap_{\text{C}} B, C \to D$, and $\Gamma' \vdash o, a : A, C$, then $\Gamma, \Gamma' \vdash (v\ o\ {}^{\text{C}}), f(a) : B, D$.

In the following example, only the semantic derivation will be given here, as the syntactic derivation was given above.

$$\dfrac{{\to}\text{E}\ \dfrac{1 \qquad 2}{3} \qquad 4}{5}\ {\to}\text{E}$$

1.	$\vdash \lambda_y \lambda_x chase'(y)(x) : \iota \to (\iota \to \pi)$	(**Lexical**)
2.	$\vdash tweety' : \iota$	(**Lexical**)
3.	$\vdash \lambda_y \lambda_x chase'(y)(x)[tweety']$	($\to$ **E**)
	$\vdash \lambda_x chase'(tweety')(x) : \iota \to \pi$	(β)
4.	$\vdash sylvester' : \iota$	(**Lexical**)
5.	$\vdash \lambda_x chase'(tweety')(x)[sylvester']$	($\to$ **E**)
	$\vdash chase'(tweety')(sylvester') : \pi$	(β)

5.3 Chamorro Technicalia

Some basic CVG types and connectives for Chamorro:
Unm – a noun phrase of ‘Unmarked’ case.
Obl – a noun phrase of ‘Oblique’ case.
Fin – a finite sentence
Det – a determiner
$\multimap_{\text{C}}$ – an implication operator for complements
$\multimap_{\text{SP}}$ – an implication operator for specifiers (used here for determiners)

Chamorro has a complicated morphological nominal case system, with three cases, ‘unmarked’, ‘oblique’, and ‘local’. Each of these is realized differently on common nouns, proper names, and pronouns. Local case is not discussed here. The choice to treat ‘unmarked’ as a case specification is motivated by several factors. In a typical finite sentence, subjects and first objects appear in unmarked case, with instruments and other oblique nominal material appearing in (explicitly marked) oblique case. With common nouns and pronouns, unmarked case is morphologically exactly that. However, unmarked case is realized on proper names through an overt case marker, *si*.

The reader will note the absence of an implication connective for subjects. In the context of a VSO language, I consider the grammatical ‘subject’ to be simply the least oblique element of a series of the verb’s syntactic dependents. While Chamorro is not rigidly VSO with respect to subjects, I take the surface VSO order to be the normal state of affairs, and stipulate that an implication connective for subject modality could easily be defined, with different phonological linearization rules as needed.

Some basic CVG lexical entries for Chamorro:
$\vdash \mathsf{petta} : \mathrm{Det} \multimap_{\mathrm{SP}} \mathrm{Unm}$
$\vdash \mathsf{patas-su} : \mathrm{Det} \multimap_{\mathrm{SP}} \mathrm{Unm}$
$\vdash \mathsf{i} : \mathrm{Det}$
$\vdash \mathsf{ha-ottu} : \mathrm{Unm} \multimap_{\mathrm{C}} (\mathrm{Unm} \multimap_{\mathrm{C}} \mathrm{Fin})$

Natural deduction rule schemata for Chamorro:
Specifiee Merge (SP–Merge):
If $\Gamma \vdash n : A \multimap_{\mathrm{SP}} B$, and $\Gamma' \vdash d : A$, then $\Gamma, \Gamma' \vdash ({}^{\mathrm{SP}}\ d\ n) : B$.
Complement Merge (C–Merge):
If $\Gamma \vdash v : A \multimap_{\mathrm{C}} B$, and $\Gamma' \vdash o : A$, then $\Gamma, \Gamma' \vdash (v\ o\ ^{\mathrm{C}}) : B$.

Since the semantics of Chamorro noun phrases themselves are not the primary topic of discussion in this paper, I hope that the reader will grant me the latitude to treat them as semantically primitive, in order to better illustrate the analysis of the wh-agreement phenomenon. To that end, I propose the following with respect to noun phrases:
$\vdash ({}^{\mathrm{SP}}\ \mathsf{i\ petta}), door' : \mathrm{Unm}, \iota$
$\vdash ({}^{\mathrm{SP}}\ \mathsf{i\ patas-su}), foot' : \mathrm{Unm}, \iota$

As before, syntactic and semantic derivations are written separately for purposes of legibility.

5.4 A Sample Chamorro CVG derivation

A syntactic derivation of (1b) *Ha-ottu i petta i patas-su* — ‘the door banged my foot’.

$$\dfrac{\dfrac{4 \quad \dfrac{1 \quad 2}{3}\,\text{SP-Merge}}{5}\,\text{C-Merge} \qquad \dfrac{6 \quad 7}{8}\,\text{SP-Merge}}{9}\,\text{C-Merge}$$

1.	$\vdash \mathsf{patas-su} : \mathrm{Det} \multimap_{SP} \mathrm{Unm}$	(**Lexical**)
2.	$\vdash \mathsf{i} : \mathrm{Det}$	(**Lexical**)
3.	$\vdash (^{SP}\ \mathsf{i\ patas-su}) : \mathrm{Unm}$	(**SP–Merge**)
4.	$\vdash \mathsf{ha-ottu} : \mathrm{Unm} \multimap_{C} (\mathrm{Unm} \multimap_{C} \mathrm{Fin})$	(**Lexical**)
5.	$\vdash (\mathsf{ha-ottu}\ (^{SP}\ \mathsf{i\ patas-su})\ ^{C}) : \mathrm{Unm} \multimap_{C} \mathrm{Fin}$	**(C–Merge)**
6.	$\vdash \mathsf{petta} : \mathrm{Det} \multimap_{SP} \mathrm{Unm}$	(**Lexical**)
7.	$\vdash \mathsf{i} : \mathrm{Det}$	(**Lexical**)
8.	$\vdash (^{SP}\ \mathsf{i\ petta}) : \mathrm{Unm}$	(**SP–Merge**)
9.	$\vdash ((\mathsf{ha-ottu}\ (^{SP}\ \mathsf{i\ patas-su})\ ^{C})\ (^{SP}\ \mathsf{i\ petta})\ ^{C}) : \mathrm{Fin}$	**(C–Merge)**

Lines 1 through 3 and 6 through 8 show the creation of two unmarked case NPs through the process of common nouns taking determiners as their arguments, via specifiee merge. Line 4 asserts the lexical entry for the main verb of the sentence. In Line 5, the object argument is taken as a complement. The final line shows the verb taking its subject argument to yield a finite sentence, through complement merge.

The corresponding semantic derviation is as follows:

$$\dfrac{\to E\ \dfrac{1 \qquad 2}{3} \qquad 4}{5} \to E$$

1.	$\vdash \lambda_y \lambda_x bang'(y)(x) : \iota \to (\iota \to \pi)$	(**Lexical**)
2.	$\vdash foot' : \iota$	(**Lexical**)
3.	$\vdash \lambda_y \lambda_x bang'(y)(x)[foot']$	($\to$ **E**)
	$\vdash \lambda_x bang'(foot')(x) : \iota \to \pi$	(β)
4.	$\vdash door' : \iota$	(**Lexical**)
5.	$\vdash \lambda_x bang'(foot')(x)[door']$	($\to$ **E**)
	$\vdash bang'(foot')(door') : \pi$	(β)

6 Basic Strategy

Since the cases we are examining are ones where wh-agreement is morphologically marked on the verbs, it is possible to think of the differing verb forms as having slightly different lexical specifications. Each verb must be sensitive to which one of its dependents (arguments and adjuncts) has something 'missing' and must in turn report that fact that to 'higher' material, in order to preserve the informational pathway between filler and gap.

Of course, this still fails to address the issue of adjunct extraction. Chamorro's system for nominal case marking provides a tantalizing hint of how the empirical phenomenon may be captured. We have already noted that nominalized verbs force their complements to be marked with oblique case, rendering the complements morphologically similar to adjuncts in sentences which do not involve extraction.

It is a fairly small step to assume, then, that the difference between argument and adjunct in extracted contexts is less than one initially expects. Those items which would be adjuncts in ordinary declarative sentences are actually arguments to wh-agreeing verbs.

While it may initially seem counterintuitive to treat a verb as selecting for what would otherwise be an adjunct, I note that the wh-extracted adjunct agreement morphology in Chamorro appears in exactly the contexts where there is an adjunct gap, indicating that effectively, the verbs **do** require that the otherwise adjunctive material be present. As such, there is nothing terribly odd about analyzing adjuncts as arguments in these specific cases. This proposal is in some ways a spiritual successor to Bouma, Malouf, and Sag (2001), which differs somewhat from the standard treatment of unbounded dependency constructions in HPSG. In HPSG, UDCs are modeled as a list of values for the SLASH feature, which is a **nonlocal** feature. The subcategorization requirements of various verbs are listed in SUBCAT (or COMPS / SUBJ, etc.), which is taken to be a **local** feature. Only local features are accessible for purposes of subcategorization, making it difficult to subcategorize for phrases which bear explicit gaps, which seems to be exactly what wh-agreeing Chamorro verbs do. That is, for purposes of subcategorization, there initially appears to be no way to differentiate between phrases with gaps and phrases without gaps in HPSG without modification to the framework. Bouma et al. (and subsequent work by Sag) do present a way to account for these facts in a phrase-structural manner. However, the purpose of the present work is not to debate the relative merits of different grammatical frameworks per se, but instead to illustrate how CVG provides a natural way of accounting for phenomena like wh-agreement.

It would be possible to argue, instead, that adjuncts select for characteristically marked verbs. This has two unappealing consequences. First, in situations where the entire adjunct-corresponding constituent is extracted, it seems odd to think of 'missing' material subcategorizing for other material which is overt. Second, this fails to address the issue of the morphological difference between the verbs themselves. If there is fundamentally no difference between the verbs, other than marking, then this would incorrectly allow one to construct grammatical sentences using wh-agreeing verbs where **no extraction has taken place**.

Take, for example, the following lexical entry for the verb *godde-tta* 'tie (up)':

(7) $e : A \vdash \mathsf{godde-tta} : (\text{Obl} \multimap_{\text{SL}} \text{Obl}) \multimap_{\text{C}} (\text{Obl} \multimap_{\text{C}} (\text{Unm} \multimap_{\text{C}} \text{Fin}))$

From the right of the turnstile, we read this as '*godde-tta* takes, as its sequential list of complements, an oblique argument gap (Obl $\multimap_{\text{SL}}$ Obl), then an oblique NP (Obl, corresponding to a direct object), and finally an unmarked NP (Unm - corresponding to a subject), and yields a (hypothetical) finite sentence'. Here, (Obl $\multimap_{\text{SL}}$ Obl) represents the extracted instrument.

The issue of filler-gap connectivity is also addressed in a partially lexical manner. Verb forms which select for extracted material must contain the information that 'something is missing'. I propose to treat this as a lexical specification: the verb forms themselves maintain the 'gappy' nature of their argument structure. This is represented in the lexical entry (7) above by the 'slashed' variable e appearing as a hypothesis to the left of the turnstile.

I take the semantics of wh-agreeing verbs to be similar to those of their non-wh-agreeing counterparts, with one significant difference; the translation and typing of the dependent containing the gap is slightly more complicated. This is illustrated in the semantics for *godde-tta*:

(8) $z : \iota \vdash \lambda_f \lambda_y \lambda_x tie'(with'(f(z)))(y)(x) : (\iota \rightarrow \iota) \rightarrow (\iota \rightarrow (\iota \rightarrow \pi))$

In a non-wh-agreeing context, the semantic type of the dependent in question would be ι, an individual. Here, the argument which would otherwise correspond to the "missing" NP is represented by the hypothetical variable z, and the semantics of the gap itself are a function f of type $\iota \rightarrow \iota$. Eventually, an identity function will arise as a result of the invocation of a hypothetical proof rule in the semantic logic. We will wish the verb to take this function as an argument which will be predicated of z, thus preserving the semantic connection between the original gap site and its ultimate binding.

7 The Role of Hypothetical Proof

The use of hypothetical proof in CVG allows us to distinguish phrases with gaps from 'intact' phrases in our syntactic typing, and it is possible to write lexical entries for the wh-agreeing verbs that effectively select for phrases with gaps of the requisite type. Since the logical formalism on which CVG is based is one which contains logical rules of hypothetical proof, it is possible to model wh-extraction using the introduction of hypotheses and their subsequent withdrawal via natural deduction rules analogous to implication introduction (here called a 'move' rule). The strategy is to treat a trace as a variable of a certain syntactic type which is stored in the SLASH field of the variable context. The label of this field will be systematically omitted in the rest of this paper for purposes of increasing legibility. We write 'move' rules which correspond to rules of hypothetical proof, which have the effect of modifying the syntactic typing as to encode the fact that the term in question contains a hypothetical variable.

(9) If $t : A, \Gamma \vdash s : B$, then $\Gamma \vdash \lambda_t^{\mathrm{SL}} s : A \multimap_{\mathrm{SL}} B$.

It is precisely this mechanism that allows phrases with gaps to be subcategorized for. We now have a syntactic type, $A \multimap_{\mathrm{SL}} B$, which represents a syntactic term of type B that contains a gap of type A. However, it is important to note that the hypothesis has been discharged. Once a verb takes a constituent of this type as an argument, all record that it contains a gap is lost, since 'traces' are characterized by undischarged hypotheses in CVG. But the information that a gap exists must still be available to 'higher' material, for purposes of subsequent agreement and eventual association with a filler.

The question remains: how may this information be maintained? The final step is to specify that the lexical entries for wh-agreeing verbs contain hypotheses of their own, allowing for selection from and embedding within higher material. This is illustrated, as previously noted, by the material to the left of the turnstile in (7). Verbs which subcategorize for material containing gaps themselves carry hypotheses. These are **different** from the hypotheses which have been withdrawn to create gaps in the typing of the material which is selected for. This has the nice benefit of providing a straightforward account of how multiple verbs along an extraction path may have differing agreement morphology. Since each verb which subcategorizes for a gap has its own hypothesis, it is possible to subsequently withdraw **that** hypothesis as well, etc.

The semantic ND rule of hypothetical proof corresponding to (9) 'move' is straightforward:

(10) If $x : A, \Gamma \vdash s : B$, then $\Gamma \vdash \lambda_x s : A \to B$ (x fresh).

In the cases under examination, the hypothesizing and withdrawal of a syntactic variable is represented similarly in the semantics, albeit with a *semantic* variable instead. Using this hypothetical proof rule immediately after assuming a semantic variable results in the creation of an identity function on terms of the type of that variable. Since the variables in question here are of type ι, we this rule yields a function of type $\iota \to \iota$, corresponding to the $A \multimap_{\mathrm{SL}} A$ typing in the syntax. Recall the lexical entry given jointly in (7) and (8). Semantically, the verb takes this identity function as its first argument, as it takes the first gap as its argument in the syntax. This identity is predicated of the argument in the semantics corresponding to the 'missing' dependent subcateorized for by the verb. Thus the gap is also maintained in the semantics, and a variable corresponding to that argument is returned intact and still available for eventual binding.

Now we can see that the agreement between verbs and arguments containing gaps can easily and naturally be described by this iterative hypothesis introduction and withdrawal strategy. Once the hypothesis is withdrawn for the first time, it is no longer important what type it is, since the filler in all of these cases will just be a wh-word which is not marked for specific grammatical function. This lack of specific syntactic connectivity between filler and gap in wh-agreement phenomena is described by Chung (1998) as "not prototypical ... they do not involve covarying values for the features of person or number" (p. 58). What is important to maintain is the knowledge that somewhere down the line, there is a gap. We now have everything we need to account for (5a). A line-by-line derivation of the syntax and semantics for (5a)follows in the "Derivation of Selected Examples" section.

8 Linearization and Wrapping

VSO languages present an interesting problem for categorial grammars which do not make a distinction between syntactic dependency and word order. While it would be possible to maintain that verbs take their subjects as first arguments, this strategy has unpleasant semantic consequences. Dowty (2006) points out that doing things in this way considerably complicates the semantics with respect to the accessibility of arguments to adverbial modifiers, as well as violating cross-linguistic facts about syntactic obliqueness.

One alternative is to treat dependency and word order as separate phenomena, the utility of which has been recognized at least since Curry (1961). It is possible to posit a 'right wrap' operation, originally formulated in Bach (1979), which is the basic strategy pursued by Dowty with respect to English, and which is the strategy I wish to pursue here, although with some additional complications. The syntactic term of the CVG triple is understood to model only syntactic dependencies (tectogrammar), with the actual linear word order represented in the phenogrammatical term (henceforth ϕ-term). The connectives of the syntactic logic are not prosodically interpreted themselves; instead, linearization takes place in a multi-step process. A separate phenogrammatical derivation proceeds in parallel to the syntactic derivation – resulting in the creation of "structured phonologies" which are subsequently given a linear, string-based interpretation. In this paper I have endeavored to make the syntactic analysis of Chamorro as simple as possible, although I grant the complete facts about word order in Chamorro are somewhat more complicated.

The phonological logic of CVG is similar to that proposed in Oehrle (1994), although it is a positive typed lambda calculus rather than a higher order logic, and incorporates ideas from Morrill and Solias (1993). It has as its types both strings (of type St) and wrappers (type Wr, defined to be St $\times$ St), as well as constants for phonological words (written WORD), the empty string (ϵ), and concatenation ($\circ$). Importantly, CVG also contains the idea of an "insertion point" which is potentially maintained through various stages of a derivation. The insertion point is represented by the connective ($\circ_{\uparrow}$). This marks the position in the ϕ-term where wrapped constituents will be appear. A word which is a wrapper (as are verbs in Chamorro) is assumed to have a slightly more complicated form:

(11) $\vdash$ HA-OTTU $\circ_{\uparrow} \epsilon$: Wr

It is important to note in the term above that ϵ, the empty string, is only taken to be identity on the concatenation operator, and *not* on an insertion point. This allows for a consistent definition of right wrap, and ensures that wrappers can be thought of as pairs of strings into which another string may be inserted. It is assumed that only strings are themselves pronounceable; of course, every word of a language is in principle pronounceable. This necessitates the definition of a function $\mathsf{say}_{\mathrm{P}}$ which has the effect of taking ϕ-terms and transforming them into strings:

$\mathsf{say}_{\mathrm{St}} = \lambda_x x$
$\mathsf{say}_{\mathrm{Wr}} = \lambda_u(\pi(u) \circ \pi'(u))$

Here, π and π' are the first and second projections of the ϕ-term, roughly, the left and right side of a wrapper, respectively. It is now possible to give a right wrap a formal definition: the function rwrap of type $\mathrm{Wr} \rightarrow \mathrm{St} \rightarrow \mathrm{Wr}$ is the term $\lambda_u\lambda_x(\pi(u) \circ_{\uparrow} (x \circ \pi'(u)))$ (Mansfield et al. 2009).

What remains is to specify how this operation works with respect to Chamorro. My earlier assumption that all verbal dependents are effectively complements allows an easy interface between syntax and phenogrammar. Effectively, all complements are wrapped. An insertion point is maintained as long as is necessary, but multiple insertion points are disallowed. Since the subject corresponds to the final argument taken by the verb, it will appear to the verb's immediate right, with objects to the right of the subject. The interface between syntax and phonology (or tectogrammar and phenogrammar) is envisioned similarly to the syntax-semantics interface. A series of ND rules is given detailing how the syntactic and phonological derivations may proceed. For the most part, I assume that simple concatenation is the method by which most phonological words combine in Chamorro. However, the verbs are different, and an enhanced rule of Complement Merge is required (where P is a metavariable ranging over ϕ-types):

Complement Merge (C–Merge):
If $\Gamma \vdash w, v : \mathrm{Wr}, A \multimap_{\mathrm{C}} B$, and $\Gamma' \vdash u, o : P, A$,
then $\Gamma, \Gamma' \vdash \mathsf{rwrap}(w)(\mathsf{say}(v)),\ (v\ o^{\mathrm{C}}) : \mathrm{Wr}, B$.

In order to complete the illustration of the mechanics of wrap in Chamorro, I offer the following phenogrammatical derivation of (1b) *Ha-ottu i petta i patas-su* — 'the door banged my foot'. As before, for expository simplicity, I hope that the reader will grant me the latitude to treat noun phrases as simple combinations of the form $\textsc{d} \circ \textsc{n}$.

$$\dfrac{\text{C-Merge}\ \dfrac{1 \qquad 2}{3} \qquad 4}{5}\ \text{C-Merge}$$

1. $\vdash$ HA-OTTU $\circ_{\uparrow} \epsilon$: Wr (**Lexical**)
2. $\vdash$ I $\circ$ PATAS-SU : St
3. $\vdash$ rwrap(HA-OTTU $\circ_{\uparrow} \epsilon$)(say((I $\circ$ PATAS-SU))) (**C–Merge**)
   $\vdash$ HA-OTTU $\circ_{\uparrow}$ ((I $\circ$ PATAS-SU) $\circ$ ϵ) : Wr
4. $\vdash$ I $\circ$ PETTA : St
5. $\vdash$ rwrap(HA-OTTU $\circ_{\uparrow}$ ((I $\circ$ PATAS-SU) $\circ$ ϵ))(say(I $\circ$ PETTA)) (**C–Merge**)
   $\vdash$ HA-OTTU $\circ_{\uparrow}$ ((I $\circ$ PETTA) $\circ$ ((I $\circ$ PATAS-SU) $\circ$ ϵ)) : Wr

Subjected finally to say, the resulting string (with $\circ$ replaced by a space and parentheses eliminated) is, as expected, "ha-ottu i petta i patas-su".

9 Derivation of Selected Example

9.1 Rules

The first three rules (Right Merge, Case Merge, and Specifiee Merge) are given as syntactic proof rules only. This is not in any way intended to be a claim about the insignificance of their semantics. Right Merge is used with the past tense marker *pära*, and Case Merge and Specifiee Merge are concerned with the formation of noun phrases. As noted previously, I do not wish to discuss the semantics of these particular constructions, as such are not immediately relevant to the phenomenon under discussion. All other rules are written as interface rules, specifying both syntax and semantics.

Right Merge (R–Merge):
If $\Gamma \vdash m : A \multimap_{R} B$, and $\Gamma' \vdash n : A$, then $\Gamma, \Gamma' \vdash (m\, n\, ^{R}) : B$.
This is a simple *modus ponens* (implication elimination) rule schema that is specifically relative to the $\multimap_{R}$ connective. This will allow for VP modification, used here with respect to the past tense marker *pära*.

Case Merge (CA–Merge):
If $\Gamma \vdash m : A \multimap_{CA} B$, and $\Gamma' \vdash n : A$, then $\Gamma, \Gamma' \vdash (m\, n\, ^{CA}) : B$.
As above, but relative to the $\multimap_{CA}$ connective. This will allow case marking of NPs.

Specifiee Merge (SP–Merge):
If $\Gamma \vdash n : A \multimap_{SP} B$, and $\Gamma' \vdash d : A$, then $\Gamma, \Gamma' \vdash (^{SP}\, d\, n) : B$.
As above, but relative to the $\multimap_{SP}$ connective. This will allow for the combination of nouns and determiners.

Lexical Entry / Axiom:
$\vdash a, a' : A, B$.
This allows us to assert axioms, or lexical entries for words.

Complement Merge (C–Merge):
If $\Gamma \vdash v, v' : A \multimap_{C} B, C \to D$, and $\Gamma' \vdash o, o' : A, C$, then $\Gamma, \Gamma' \vdash (v\, o\, ^{C}), v'(o') : B, D$.

This is a *modus ponens* (implication elimination) rule schema that is specifically relative to the $\multimap_{\mathrm{C}}$ connective. This will be used to allow verbs to take their complements. In the semantic logic, it corresponds to function application.

Trace: $t, t' : A, B \vdash t, t' : A, B$

This rule schema introduces syntactic and semantic hypotheses, which we conceive as typed variables in each logic.

Move: If $t, x : A, A', \Gamma \vdash s, s' : B, B'$, then $\Gamma \vdash \lambda_t^{\mathrm{SL}} s, \lambda_x s' : A \multimap_{\mathrm{SL}} B, A' \to B'$ (x fresh).

This rule schema is a rule of hypothetical proof (implication introduction), relative syntactically to the SL (SLASH) flavor of implication, for terms of type A, where A represents a metavariable ranging over the set of type {Unm, Obl} (unmarked or oblique case NPs, respectively). Semantically, this implication introduction is the lambda-binding of a hypothetical semantic variable.

Wh- Question Rule: If $\vdash w, w' : \mathrm{Wh}, (\iota \to \pi) \to \kappa_1$, and $\vdash s, s' : A \multimap_{\mathrm{SL}} \mathrm{Fin}, \iota \to \pi$, then $\vdash q(w, s), w'(s') : \mathrm{Q}, \kappa_1$.

This is a non-logical rule (or term constructor) schema allowing the formation of Wh-questions. Semantically, it corresponds to function application, yielding a κ_1-type, the type of unary constituent questions.

9.2 Embedded Constructions:

(12) Hafa s**in**angan-**ã** si Juan pära godde-**tta** ni chiba
what? *WH*[obj].say.his-agr UNM Juan FUT *WH*[obl].tie.our-agr OBL goat
— ?

'What did Juan say that we should tie up the goat with?' (Levine & Hukari (2006) ch.3 ex.(63))

This example exhibits extraction across more than one verb. The lower verb, *godde-tta*, is nominalized (by *-tta*), but the infix *-in-* is absent, indicating that the agreement pattern is for an extracted oblique (an instrument, in this case). The higher verb *sinangan-ã* bears the *-in-* infix as well as nominalization (*-ã*). This is the agreement pattern for an extracted object. The object, in this case, is the clausal complement headed by the lower verb.

9.3 Axioms / Lexical Entries

Syntax

$\vdash$ Hafa : Wh

$g : A \vdash$ sinangan – ã : $(A \multimap_{SL} \mathrm{Fin}) \multimap_{C} (\mathrm{Unm} \multimap_{C} \mathrm{Fin})$

si : $\mathrm{Name} \multimap_{CA} \mathrm{Unm}$

Juan : Name

$\vdash$ pära : $(C \multimap_{C} \mathrm{Fin}) \multimap_{R} (C \multimap_{C} \mathrm{Fin})$

$e : A \vdash$ godde – tta : $(\mathrm{Obl} \multimap_{SL} \mathrm{Obl}) \multimap_{C} (\mathrm{Obl} \multimap_{C} (\mathrm{Unm} \multimap_{C} \mathrm{Fin}))$

$\vdash$ *pro* : Unm

$\vdash$ ni : $(\mathrm{Det} \multimap_{SP} \mathrm{Unm}) \multimap_{CA} \mathrm{Obl}$

$\vdash$ chiba : $\mathrm{Det} \multimap_{SP} \mathrm{Unm}$

Semantics

$\vdash what' : (\iota \to \pi) \to \kappa_1$

$y' : \iota \vdash \lambda_{f'}\lambda_{x'} say'(f'(y'))(x') : (\iota \to \pi) \to (\iota \to \pi)$

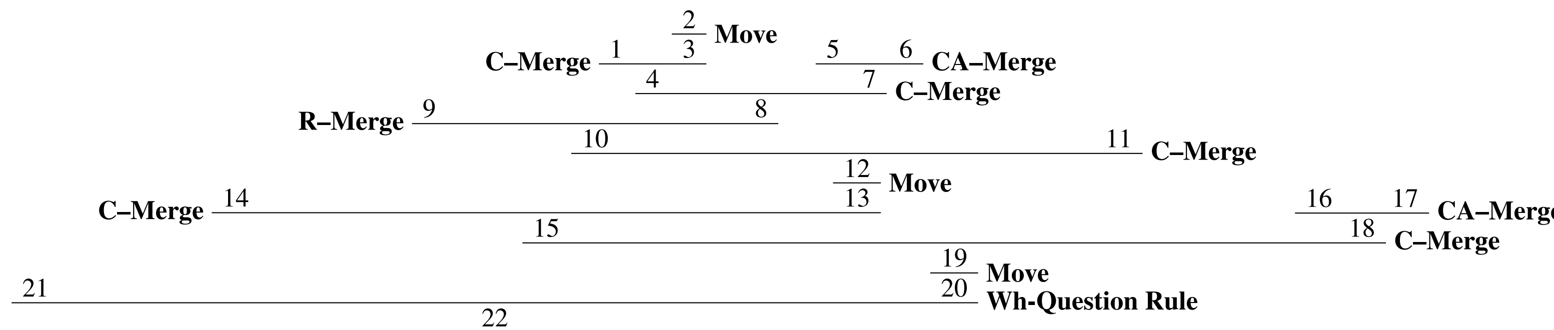
$\vdash j : \iota$

$z : \iota \vdash \lambda_f \lambda_y \lambda_x tie'(with'(f(z)))(y)(x) : (\iota \to \iota) \to (\iota \to (\iota \to \pi))$

$\vdash we' : \iota$

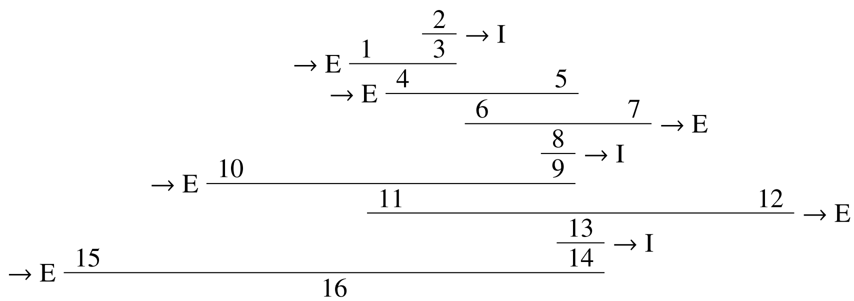
$\vdash goat' : \iota$

9.4 Syntax



1.	$e : A \vdash$ godde – tta : $(\mathrm{Obl} \multimap_{\mathrm{SL}} \mathrm{Obl}) \multimap_{\mathrm{C}} (\mathrm{Obl} \multimap_{\mathrm{C}} (\mathrm{Unm} \multimap_{\mathrm{C}} \mathrm{Fin}))$	(**Lexical**)
2.	$t : \mathrm{Obl} \vdash t : \mathrm{Obl}$	(**Trace**)
3.	$\vdash \lambda_t^{\mathrm{SL}} t : \mathrm{Obl} \multimap_{\mathrm{SL}} \mathrm{Obl}$	(**Move**)
4.	$e : A \vdash$ (godde – tta $\lambda_t^{\mathrm{SL}} t$ $^{\mathrm{C}}$) : $\mathrm{Obl} \multimap_{\mathrm{C}} (\mathrm{Unm} \multimap_{\mathrm{C}} \mathrm{Fin})$	(**C–Merge**)
5.	$\vdash$ ni : $(\mathrm{Det} \multimap_{\mathrm{SP}} \mathrm{Unm}) \multimap_{\mathrm{CA}} \mathrm{Obl}$	(**Lexical**)
6.	$\vdash$ chiba : $\mathrm{Det} \multimap_{\mathrm{SP}} \mathrm{Unm}$	(**Lexical**)
7.	$\vdash$ (ni chiba $^{\mathrm{CA}}$) : Obl	(**CA–Merge**)
8.	$e : A \vdash$ ((godde – tta $\lambda_t^{\mathrm{SL}} t$ $^{\mathrm{C}}$) (ni chiba $^{\mathrm{CA}}$) $^{\mathrm{C}}$) : $\mathrm{Unm} \multimap_{\mathrm{C}} \mathrm{Fin}$	(**C–Merge**)
9.	$\vdash$ pära : $(C \multimap_{\mathrm{C}} \mathrm{Fin}) \multimap_{\mathrm{R}} (C \multimap_{\mathrm{C}} \mathrm{Fin})$	((**Lexical**))
10.	$e : A \vdash$ (pära ((godde – tta $\lambda_t^{\mathrm{SL}} t$ $^{\mathrm{C}}$) (ni chiba $^{\mathrm{CA}}$) $^{\mathrm{C}}$) $^{\mathrm{R}}$) : $\mathrm{Unm} \multimap_{\mathrm{C}} \mathrm{Fin}$	(**R–Merge**)
11.	$\vdash$ *pro* : Unm	(**Lexical**)
12.	$e : A \vdash$ ((pära ((godde – tta $\lambda_t^{\mathrm{SL}} t$ $^{\mathrm{C}}$) (ni chiba $^{\mathrm{CA}}$) $^{\mathrm{C}}$) $^{\mathrm{R}}$) *pro* $^{\mathrm{C}}$) : Fin	(**C–Merge**)
13.	$\vdash \lambda_e^{\mathrm{SL}}$ ((pära ((godde – tta $\lambda_t^{\mathrm{SL}} t$ $^{\mathrm{C}}$) (ni chiba $^{\mathrm{CA}}$) $^{\mathrm{C}}$) $^{\mathrm{R}}$) *pro* $^{\mathrm{C}}$) : $A \multimap_{\mathrm{SL}} \mathrm{Fin}$	(**Move**)
14.	$g : A \vdash$ sinangan – ã : $(A \multimap_{\mathrm{SL}} \mathrm{Fin}) \multimap_{\mathrm{C}} (\mathrm{Unm} \multimap_{\mathrm{C}} \mathrm{Fin})$	(**Lexical**)
15.	$g : A \vdash$ (sinangan – ã (λ_e^{SL}((pära ((godde – tta $\lambda_t^{\mathrm{SL}} t$ $^{\mathrm{C}}$) (ni chiba $^{\mathrm{CA}}$) $^{\mathrm{C}}$) $^{\mathrm{R}}$) *pro* $^{\mathrm{C}}$)) $^{\mathrm{C}}$) : $\mathrm{Unm} \multimap_{\mathrm{C}} \mathrm{Fin}$	(**C–Merge**)
16.	$\vdash$ si : $\mathrm{Name} \multimap_{\mathrm{CA}} \mathrm{Unm}$	(**Lexical**)
17.	$\vdash$ Juan : Name	(**Lexical**)
18.	$\vdash$ (si Juan $^{\mathrm{CA}}$) : Unm	(**CA–Merge**)
19.	$g : A \vdash$ ((sinangan – ã (λ_e^{SL} ((pära ((godde – tta $\lambda_t^{\mathrm{SL}} t$ $^{\mathrm{C}}$) (ni chiba $^{\mathrm{CA}}$) $^{\mathrm{C}}$) $^{\mathrm{R}}$) *pro* $^{\mathrm{C}}$)) $^{\mathrm{C}}$) (si Juan $^{\mathrm{CA}}$) $^{\mathrm{C}}$) : Fin	(**C–Merge**)
20.	$\vdash \lambda_g^{\mathrm{SL}}$ ((sinangan – ã (λ_e^{SL} ((pära((godde – tta $\lambda_t^{\mathrm{SL}} t$ $^{\mathrm{C}}$) (ni chiba $^{\mathrm{CA}}$) $^{\mathrm{C}}$) $^{\mathrm{R}}$) *pro* $^{\mathrm{C}}$)) $^{\mathrm{C}}$) (si Juan $^{\mathrm{CA}}$) $^{\mathrm{C}}$) : $A \multimap_{\mathrm{SL}} \mathrm{Fin}$	(**Move**)
21.	$\vdash$ Hafa : Wh	(**Lexical**)
22.	$\vdash q$(Hafa, λ_g^{SL} ((sinangan – ã (λ_e^{SL} ((pära ((godde – tta $\lambda_t^{\mathrm{SL}} t$ $^{\mathrm{C}}$) (ni chiba $^{\mathrm{CA}}$) $^{\mathrm{C}}$) $^{\mathrm{R}}$) *pro* $^{\mathrm{C}}$)) $^{\mathrm{C}}$) (si Juan $^{\mathrm{CA}}$) $^{\mathrm{C}}$) : Q	(**Wh-Question Rule**)

9.5 Semantics



1.	$z : \iota \vdash \lambda_f \lambda_y \lambda_x tie'(with'(f(z)))(y)(x) : (\iota \to \iota) \to (\iota \to (\iota \to \pi))$	(**Axiom**)
2.	$z' : \iota \vdash z' : \iota$	(**Hypothesis**)
3.	$\vdash \lambda_{z'} z' : \iota \to \iota$	($\to$ **I**)
4.	$z : \iota \vdash \lambda_f \lambda_y \lambda_x tie'(with'(f(z)))(y)(x)[\lambda_{z'} z']$	($\to$ **E**)
	$\lambda_y \lambda_x tie'(with'(\lambda_{z'} z'[z]))(y)(x)$	(β)
	$\lambda_y \lambda_x tie'(with'(z))(y)(x) : (\iota \to (\iota \to \pi))$	(β)
5.	$\vdash goat' : \iota$	(**Axiom**)
6.	$z : \iota \vdash \lambda_y \lambda_x tie'(with'(z))(y)(x)[goat']$	($\to$ **E**)
	$\lambda_x tie'(with'(z))(goat')(x) : \iota \to \pi$	(β)
7.	$\vdash we' : \iota$	(**Axiom**)
8.	$z : \iota \vdash \lambda_x tie'(with'(z))(goat')(x)[we']$	($\to$ **E**)
	$tie'(with'(z))(goat')(we') : \pi$	(β)
9.	$\vdash \lambda_z tie'(with'(z))(goat')(we') : \iota \to \pi$	($\to$ **I**)
10.	$y' : \iota \vdash \lambda_{f'} \lambda_{x'} say'(f'(y'))(x') : (\iota \to \pi) \to (\iota \to \pi)$	(**Axiom**)
11.	$y' : \iota \vdash \lambda_{f'} \lambda_{x'} say'(f'(y'))(x')[\lambda_z tie'(with'(z))(goat')(we')]$	($\to$ **E**)
	$\lambda_{x'} say'(\lambda_z tie'(with'(z))(goat')(we')[y'])(x')$	(β)
	$\lambda_{x'} say'(tie'(with'(y'))(goat')(we'))(x') : \iota \to \pi$	(β)
12.	$\vdash j : \iota$	(**Axiom**)
13.	$y' : \iota \vdash \lambda_{x'} say'(tie'(with'(y'))(goat')(we'))(x')[j]$	($\to$ **E**)
	$say'(tie'(with'(y'))(goat')(we'))(j) : \pi$	(β)
14.	$\vdash \lambda_{y'} say'(tie'(with'(y'))(goat')(we'))(j) : \iota \to \pi$	($\to$ **I**)
15.	$\vdash what' : (\iota \to \pi) \to \kappa_1$	(**Axiom**)
16.	$\vdash what'(\lambda_{y'} say'(tie'(with'(y'))(goat')(we'))(j)) : \kappa_1$	($\to$ **E**)

10 Summary

We have seen how a combination of natural-deduction-style hypothetical proof rules and lexical subcategorization for extraction sites can begin to model the initially puzzling facts about Chamorro wh-agreement. While it at first seems odd to treat verbs which do not ordinarily select for certain elements (say, instruments) as selecting for exactly those elements, this conclusion is motivated by the facts concerning verbal agreement morphology and extracted elements. Since the various verb forms appear with different syntactic structures, there is nothing unnatural about treating their selectional properties as different as well. A hypothetical-proof-based strategy therefore accounts effectively for the phenomenon of wh-agreement.

11 Future Research

While this paper is intended to account only for the syntactic structure of constituent questions, the wh-agreement phenomenon also occurs in relative clauses and focus constructions. This analysis could plausibly be extended to those areas as well, although the entire paradigm for wh-agreement is more complicated than can be dealt with in the present forum. The following example has been pointed out to me by an anonymous reviewer:

(13) Hafa na patti gi atumobit malägu' hao u-ma-fa'maolik — ?
What part LOC car AGR-want you Wh-Nom-Agr-Pass-fix ?
'Which part of the car do you want to be fixed?'

Cases where the verbal nominalization is optional, as well as unbounded dependency constructions where wh-agreement does not occur are additional topics of current research. I consider these to be somewhat simpler, and assume that they are most likely accounted for in a manner similar to the one described in Pollard (2007a). In this approach, syntactic hypotheses are simply maintained up until the point at which they are withdrawn and bound (by a wh-word, for example). This stands in mild contrast to the successive 'hypothesize and withdraw' strategy I have pursued here. In the above example, I assume that only the embedded verb actually subcategorizes for a gap. While such a strategy will likely account for the grammaticality of (13), it remains to be seen whether the ungrammaticality of a similar sentence with a non-agreeing embedding verb can be captured.

It has been suggested to me (by participants at the LMNLDS workshop at DGfS 30) that the wh-agreement phenomenon is similar to the morphological voice system in other Western Austronesian languages. Chung (1998) contends that the Chamorro voice system is fairly uncomplicated by comparison to languages like Tagalog, and that wh-agreement is not simply a voicing alternation, but further examination of the Chamorro voice constructions (passive and antipassive) is necessary.

One further issue is the precise nature of Chamorro NP structure. Chamorro has a complicated morphological case marking system which interacts with different categories of NPs (common nouns, pronouns, and proper names) and determiners in interesting ways.

There is absolutely no doubt that these are deserving of greater attention on both the syntactic and semantic fronts than has been given here. While the internal construction of NPs is beyond the scope of this work, it is certainly of importance.

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