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Chamorro evidence for compositional asymmetry

Sandra Chung · William A. Ladusaw

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Abstract In earlier work, we developed an approach to clause-internal composition in which predicates can be composed with arguments by operations other than Function Application, and it makes a difference which composition operation is employed. Here we take our approach further by examining two nonsaturating operations that combine property contents: Restrict, which composes a predicate with the property content of an indefinite; and Modify, which is involved in predicate modification. Nonsaturating operations that combine property contents are often formalized in terms of predicate intersection, which is commutative. Using evidence from the Austronesian language Chamorro, we argue that Restrict and Modify are not 'commutative', but instead incorporate an asymmetry: they take one content to supply a domain that is narrowed further by combination with the other content. Syntactically, it is transparent which category's content supplies the domain. But semantically, this information can be recovered only from the

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S. Chung (✉) · W. A. Ladusaw
Department of Linguistics,
University of California, Santa Cruz,
Santa Cruz, CA 95064, USA
e-mail: schung@ucsc.edu

W. A. Ladusaw
e-mail: ladusaw@ucsc.edu

way in which the composition operation affects the contents that it composes, since—as we show—the same contents can be composed with distinct results.

Keywords Semantic composition · Incorporation · Modification · Chamorro

1 Introduction

The broad outlines of the program that has shaped research in formal semantics for the last 35 years were set forth by Richard Montague in 'Universal Grammar' (1970; henceforth UG). For Montague, a language is a set of expressions based on some algebra of basic expressions and combinatorics. The purpose of a theory of meaning is to relate semantic content to extralinguistic context through a theory of reference, the theory of the contents that expressions have relative to models or situations. Fundamental to the theory of reference is compositionality, the thesis that the meaning or content of an expression is based on the meaning or content of its parts relative to its structure.

In UG, compositionality is realized by a syntax-semantics interface in which the algebra of syntactic expressions is homomorphically mapped into an algebra of meanings or contents. Thus, an expression α which is constructed from its subparts, β and γ, via a syntactic operation F

(1) $\alpha = F(\beta,\gamma)$

has an interpretation (μ) determined by the application of a semantic composition operation G to the interpretations of β and γ.

(2) $\mu(\alpha) = \mu(F(\beta,\gamma)) = G(\mu(\beta),\mu(\gamma))$

A key property of the UG program is its generality. Nothing is stipulated about how to model contents; hence, nothing follows about what the composition operations are.

In point of fact, the tradition of formal semantics has adopted a far more restrictive view of the inventory of composition operations. In this, it essentially follows the theory elaborated by Montague in 'The Proper Treatment of Quantification in Ordinary English' (1973; henceforth PTQ). In PTQ, just as expressions are defined in terms of a set of syntactic categories generated from the basic categories N(ame) and S(entence), meanings are given a Fregean definition in terms of a set of extensional semantic types generated from the basic types e(ntity) and t(ruth value). (Intensions are handled via a 'lift' with world indices.) Both the derived syntactic categories and the derived semantic types are functions, and the mapping from categories into types is one-to-one. For instance, noun phrases (DPs) have the syntactic category S/(S/N); their contents (generalized quantifiers) are assigned the type <<e,t>,t>.

The PTQ theory recognizes just one core operation for semantic composition, namely, Function Application. From this, it follows that all predicate-argument composition is the elimination of functional incompleteness. The homomorphism between syntactic categories and semantic types guarantees that predicates are semantically saturated when, and only when, they are syntactically complete. Further, because the inventory of composition operations is so limited, semantic composition can be viewed as fundamentally type-driven (see Klein and Sag 1985). More generally, in a system in which semantic composition is reduced, whenever possible, to Function Application, all the burden of explanation falls on the theory of semantic contents. Mismatches among contents to be combined are remedied by multiplying types, via type-shifting (see Partee 1987) or other means, so as to make it possible for Function Application to occur.

What would the consequences be of recalibrating such a system to shift more of the burden of explanation to the composition operations? We raised this question in Chung and Ladusaw (2004) (henceforth C&L). There we claimed that predicates can be composed with arguments by operations other than Function Application, and that it makes a difference which composition operation is employed. In particular, we argued for an operation, Restrict, which composes a predicate with the property content of an indefinite or bare NP without eliminating any functional incompleteness. Restrict combines a semantically incomplete predicate relation R with a property P by targeting one of R's relata and restricting it to P's extension. In (3), the result of using Restrict to combine the meaning of *feed* with the property supplied by *(a) cat* is that the so-called internal argument of *feed′*, represented by the variable *y*, is restricted to the extension of *cat′* (C&L 2004, p. 5).[1]

(3) $\mathrm{RESTRICT}(\lambda y \lambda x \lambda e[\mathrm{feed}'(y)(x)(e)], \mathrm{cat}') = \lambda y \lambda x \lambda e[\mathrm{feed}'(y)(x)(e) \wedge \mathrm{cat}'(y)]$

Notice that Restrict does not fix the value of the targeted relatum of the predicate, but merely narrows the domain within which this value can be located—in (3), to the domain of cats. In this way, the C&L system decouples semantic saturation from syntactic completeness.[2] If the targeted relatum does not have its value fixed by further composition, saturation is achieved by existential closure over a designated domain (see C&L for details).

Although it might seem unexpected for an operation with this profile to be involved in predicate-argument composition, there is another perspective from which Restrict is not at all surprising. It belongs to a family of nonsaturating composition operations that manipulate property contents, the best known of which can be seen at work in predicate modification

[1] For some further thoughts on the formulation of Restrict, see Sect. 5.

[2] It is standardly recognized that indefinites can be interpreted as referential (type e), predicational (type <e,t>), or quantificational (type <<e,t>,t>) (see e.g., Partee 1987). The C&L system adds a new subtype to this taxonomy: indefinites can be interpreted as properties, which we claim are type e, but of a new sort.

(see Heim and Kratzer 1998). That operation, which we call Modify, combines, e.g., the contents of *black* and *cat* to derive the content of the expression *black cat*. Here we investigate Restrict and Modify with the goal of revealing another way in which it makes a difference how contents are composed.

In the simplest cases, nonsaturating operations that combine property contents are often formalized in terms of predicate intersection (see e.g., Kratzer 1994; Heim and Kratzer 1998; C&L). Now, intersection is commutative: the operation responsible for it is indifferent to whether the content of A or B is presented first. (If intersection is modeled as a two-place function from pairs of sets to their intersection, the function returns the same value for <A,B> as for <B,A>.) We examine some evidence that argues that Restrict and Modify are not 'commutative' in the relevant sense, but instead incorporate an asymmetry: they take the content of A to supply a domain that is narrowed further by combination with the content of B. Syntactically, it is transparent which category's content supplies the domain. But semantically, this information can be recovered only from *the way in which the composition operation affects the contents that it composes*, since—as we show—the same contents can be composed with distinct results. In other words, what C&L call *mode of composition* matters.

Our claim that Restrict and Modify use the contents they compose to narrow a domain is reminiscent of proposals made by Keenan (1974) concerning the interpretation of restrictive relative clauses, and by Kamp and Partee (1995) concerning the interpretation of vague predicates. It also resonates with Bittner's (2001) attempt to recast semantic composition in the interior of the clause in terms of the context-change potentials and bridging mechanisms of dynamic discourse. We conclude by surveying some of the issues that must be resolved before Restrict and Modify can be formalized as domain-narrowing operations, and by speculating that the asymmetry they introduce might well be characteristic of composition operations more generally.

Most of the evidence we discuss is drawn from Chamorro, an Austronesian language of the Mariana Islands. Section 2 summarizes the C&L analysis of object incorporation in Chamorro, and then uses incorporation to argue that Restrict introduces an asymmetry when it combines contents. Section 3 turns to modifiers of NP in Chamorro. After describing their distinctive morphosyntax, we use intersective modifiers to argue that Modify likewise introduces an asymmetry when it combines contents. In Sect. 4, the claim that each of these operations serves to narrow a domain is supported by evidence from class inclusion. Section 5 presents some design specifications for the formal representation of Restrict, Modify, and their domain-narrowing character. Finally, Sects. 6 and 7 offer some extensions and speculations.

2 An asymmetry in Restrict

2.1 Object incorporation in Chamorro

Chamorro is a head-initial language with a range of null argument DPs. Clauses are projected from a syntactic category Infl(ection), which occurs at the left and indicates tense-aspect-mood. Infl is followed by the predicate, which can be of any category type, and then by argument and adjunct XPs. When the predicate is a verb, the relative order of these XPs is flexible, but the unmarked and most frequent surface order is [Verb Subject Object Other].[3]

(4)a.	Pära	u-fañ-akki	i	dos	pugua'		siha.
	Fut	*agr-AP-steal*	*the*	*two*	*betelnut*		*Pl*
	'The two were going to steal betelnuts.'						
b.	S*um*aga	ha'	i	palao'an	guini	gi	gima'
	agr.stay	*Emp*	*the*	*woman*	*here*	*Loc*	*house*
	i	biha	asta	i	sigienti		dia.
	the	*old.woman*	*until*	*the*	*next*		*day*
	'The woman stayed at the old lady's house until the next day.'						
c.	Kulan	ha-na'i	hit	siñát	esti	i	chi'lu-ta.
	sort.of	*agr-give*	*us*	*sign*	*this*	*the*	*sibling-agr*
	'Our sister had sort of given us a sign.' (Cooreman 1983, p. 187)						

As in C&L, we ignore the flexibility of surface word order and assume that Chamorro has a hierarchical phrase structure of the familiar type (see Chung 1998, for supporting evidence).

Chamorro's version of object incorporation is examined in some detail in C&L. This construction is formed from the verbs of possession, *gäi-* 'have' and *täi-* 'not have', which select two arguments, one corresponding to the possessor and the other to the possessed. The possessor argument is linked to the subject; the argument corresponding to the possessed—henceforth, the internal argument—is linked to an object that must be incorporated. The incorporated object is bracketed below.

(5)a.	Hayi	gäi-[patgun]?
	who?	*WH[nom].agr.have-child*
	'Who has a child?'	

[3] The following abbreviations are used in the morpheme-by-morpheme glosses: agr 'finite subject-verb agreement or possessor-noun agreement', AP 'antipassive', Comp 'complementizer', Compar 'comparative', Emp 'emphatic', Fut 'future', Infin 'nonfinite subject-verb agreement', LN 'linker', Loc 'local morphological case', modL 'modifier on the left', modR 'modifier on the right', nom 'nominative form of WH-Agreement', obj 'objective form of WH-Agreement', Obl 'oblique morphological case', Pass 'passive', Pl 'plural', Prog 'progressive', Q 'question', WH 'WH-Agreement'. Prefixes and suffixes are separated from the rest of the word by dashes; infixes are italicized.

b. Hu-li'i' na gäi-[inanakku'] esti na tiempu-n maipi.
agr-see that agr.have-length this LN time-LN hot
'I see that this is a long dry season (lit. this dry season has length).'
(*Saipan Tribune* 4/13/01)

c. Man-täi-[letchun] siha.
agr-not.have-baby.pig they
'They don't have any baby pigs.'

Of interest is the fact that Chamorro incorporation is of the 'doubling' type. The incorporated object can be doubled by an independent DP (italicized below), which we refer to as the extra object.

(6)a. Hayi gäi-[patgun] *si Carmen* ?
who? WH[nom].agr.have-child Carmen
'Whose child is Carmen (lit. who child-has Carmen)?'

b. Gäi-[kareta] yu' *agäga' na kareta.*
agr.have-car I red LN car
'I own a red car (lit. I car-have a red car).'

c. Kao hagu gäi-[iyu] *i kareta?*
Q you WH[nom].agr.have-possession the car
'Is it you who owns the car (lit. who possession-has the car)?'

In C&L, we show that this construction has all the syntactic earmarks of object incorporation (see e.g., Baker 1988): the incorporated object is a bare (determinerless) NP, the complex verb is intransitive, and the optional extra object is syntactically adjoined. But we also show that the extra object behaves semantically as an argument of the verb of possession. The result is that in incorporation structures of type (6), the verb's internal argument is linked to the extra object as well as to the incorporated object, in apparent violation of the Fregean assumption that semantic saturation and syntactic completeness go hand in hand.

This multiple linking, we claim, is well-formed and semantically coherent precisely because the inventory of composition operations includes Restrict. In our system, Restrict composes the predicate supplied by the verb of possession with the property supplied by the incorporated object, with the result that the verb's internal argument is restricted but not saturated. We illustrate this composition below for (5a) and (6a), in which the verb is *gäi-* 'have' and the incorporated object is *patgun* 'child'. (Here and elsewhere, we assume that the predicate relation supplied by the verb includes a Davidsonian event argument.)

(7) $\lambda y \lambda x \lambda e$ [have′(y)(x)(e)] child′

$\lambda y \lambda x \lambda e$ [have′(y)(x)(e) ∧ child′(y)]

Because Restrict does not eliminate any functional incompleteness, the internal argument remains available for further composition. In (6a), this relatum becomes saturated when Function Application composes it with the entity supplied by the extra object *si Carmen*, as shown in (8).

(8) $\lambda y \lambda x \lambda e\ [\text{have}'(y)(x)(e) \wedge \text{child}'(y)]$ $\qquad$ c

$\lambda x \lambda e\ [\text{have}'(c)(x)(e) \wedge \text{child}'(c)]$

In (5a), there are no additional contents that can combine with the internal argument, so saturation is delayed until existential closure occurs over the domain defined by the event argument.

2.2 The evidence

What concerns us here is that the extra object in incorporation can itself be a property-content expression. Consider (6b) and the following.

(9)a. Kao gäi-[atungu'] *médiku*?
Q agr.have-friend doctor
'Does she have any doctors as friends (lit. does she friend-have doctors)?'

b. Guäha taotagui siha man-gäi-[ga'chung] *taotaomo'na*.
agr.exist person Pl WH[nom].agr-have-companion ancient.spirit
'There are people who have ancient spirits as companions (lit. who companion-have ancient spirits).' (Onedera 1994, p. 15)

c. Täi-[ga'] si nana-hu *gayu*.
agr.not.have-pet mother-agr rooster
'My mother doesn't own any roosters.'

d. Esti na patgun täi-[iyu] *ni*
this LN child agr.not.have-possession not
sikera dos na hugeti.
even two LN toy
'This child doesn't have even two toys.'

The extra objects in (6b) and (9a–c) are indefinite DPs headed by the null nonspecific article. The extra object in (9d) is a negative concord DP, which—following Ladusaw (1992, 1996)—we analyze as an indefinite under the scope of a negation operator (see also Kratzer 2004).

These particular sorts of Chamorro indefinites cannot have their contents composed by Function Application, either directly or via the compound (type-shifting) mode of composition we called Specify in C&L. Rather, their contents *must* be composed by Restrict. Various empirical patterns can be used to motivate this claim. For instance, like other DPs composed by

Restrict, DPs headed by the null nonspecific article must have narrowest scope; they can serve as pivots of existential clauses; they cannot serve as subjects of individual-level predicates; and so on. The same is true of DPs headed by negative concord determiners. Following the analysis of Maori indefinites in C&L, we assume that in Chamorro, the null nonspecific article and the negative concord determiners explicitly signal that the property content of their NP complement must be composed with the targeted relatum via Restrict.

What does this mean for the examples in (9), in which an indefinite of this sort serves as the extra object of incorporation? We claim that in such cases, Restrict targets the verb's internal argument twice, narrowing its domain by combining it first with the property supplied by the incorporated object and then with the property supplied by the extra object. As in (5a), this relatum is ultimately saturated by existential closure over the domain defined by the event argument.

The claim that Restrict can target the verb's internal argument twice leads to a prediction. Suppose that Restrict does not introduce any asymmetry when it combines contents, but merely composes the predicate relation with the property via intersection, as shown in (3). Then it shouldn't ultimately matter in what order the properties supplied by the incorporated object and the extra object are composed with the verb's internal argument in cases like (9). The commutativity and associativity of intersection should cause the two possible ways of successively restricting this relatum to give rise to equivalent results, as is shown below for example (9a).

(10) $\lambda y \lambda x \lambda e\ [(\text{have}'(y)(x)(e) \wedge \text{friend}'(y)) \wedge \text{doctor}'(y)] =$
$\lambda y \lambda x \lambda e\ [(\text{have}'(y)(x)(e) \wedge \text{doctor}'(y)) \wedge \text{friend}'(y)]$

Therefore, switching the contents of the incorporated object and the extra object in such cases shouldn't make a difference to the meaning.

In fact, it does make a difference. Consider the examples of incorporation in (11), in which the extra object is a property-content expression. These incorporation clauses are embedded in larger sentences in which they are semantically and pragmatically completely natural.[4]

(11)a. Yänggin gäi-[patgun] hao *doktu*, mu-mäguf
if *agr.have-child* *you* *doctor* *agr-happy*
hao gi inamko'-mu.
you *Loc* *old.age-agr*
'If you have a child who's a doctor (lit. if you child-have a doctor), you'll be happy in your old age.'

[4] Example (11c) could also be translated: ' If you don't have Filipina maids, they won't know how to make adobo.' The discourse anaphora seen here is reminiscent of that discussed for English by Devlin (1997).

b. Kumu gäi-[amiga] hao *Chamoru*, siempri
if agr.have-friend you Chamorro surely
ma-kumbíbida hao pära meggai na guput.
agr.Pass-invite.Prog you to many LN party
'If you have Chamorro friends, you'll be invited to lots of parties.'

c. Kumu täi-[muchacha] hao *Filipina*, siempri ti
if agr.not.have-maid you Filipina surely not
ma-tungu' f*um*a'tinas i adobu.
agr-know Infin.make the adobo
'If you don't have maids who are Filipinas, they won't know how to make adobo.'

d. Yänggin täi-[amigu] hao *ni un Chamoru,*
if agr.not.have-friend you not a Chamorro
siempri ti un-ma-kumbíbida pära i giput siha.
surely not agr-Pass-invite.Prog to the party Pl
'If you don't have even one Chamorro friend, you won't be invited to parties.'

In (12), the examples of incorporation are embedded in exactly the same sentences, but the contents of the extra object and the incorporated object have been switched. Speakers reject these sentences, describing them as strange, weird, understandable but not right, in language that strongly suggests that they are anomalous. (The English translations below are ours.)

(12)a. ?*Yänggin gäi-[doktu] hao *patgun*, mu-mäguf hao
if agr.have-doctor you child agr.happy you
gi inamko'-mu.
Loc old.age-agr
('If you have a doctor who's a child (lit. if you doctor-have a child), you'll be happy in your old age.')

b. ?*Kumu gäi-[Chamoru] hao *amiga*, siempri
if agr.have-Chamorro you friend surely
ma-kumbíbida hao pära meggai na guput.
agr.Pass-invite.Prog you to many LN party
('If you have friend Chamorros, you'll be invited to lots of parties.')

c. ?*Kumu täi-[Filipina] hao *muchacha*, ti
if agr.not.have-Filipina you maid not
ma-tungu' f*um*a'tinas i adobu.
agr-know Infin.make the adobo
('If you don't have Filipinas who are maids, they won't know how to make adobo.')

d. *Yänggin täi-[Chamoru] hao *ni un amigu,*
if agr.not.have-Chamorro you not a friend
siempri ti un-ma-kumbíbida pära i giput siha.
surely not agr-Pass-invite.Prog to the party Pl
('If you don't have even one friend as Chamorro, you won't be invited to parties.')

The contrast between (11) and (12) reveals that it does matter, after all, which property is composed first with the verb's internal argument. We take this as evidence that Restrict introduces an asymmetry when it combines these contents, an asymmetry not captured in our initial formulation of this operation in C&L. The asymmetry can be perceived when several applications of Restrict target the same relatum, because in such cases, switching the extra object and the incorporated object gives rise to a well-formed syntactic structure with a coherent interpretation—one which could, in principle, be related to the interpretation of the original structure in the way shown in (10). The situation is different when Restrict targets a relatum which is then saturated by Function Application—as, for example, in (6a). In such cases, it is difficult or impossible to detect any asymmetry, because the result of switching the extra object and the incorporated object is not well-formed. The 'new' incorporated object, a DP, would violate the syntactic requirement that the incorporee must be an NP but not a DP (see C&L: 85-88). And the fact that its content *saturates* the relatum would leave no (appropriate) relatum for the content of the 'new' extra object to be composed with.

We can go a step further in describing the asymmetry by observing that intuitively, the relation between possessor and possessed presented in (11)–(12) is fixed by the content of the incorporated object, not the extra object. In (11a), for instance, the hearer is predicted to have a happy old age if s/he stands in a parent–child relation of a certain sort, not if s/he stands in a patient–doctor relation of a certain sort. In (11b), the hearer is predicted to be invited to many parties if s/he participates in friend–friend relations of a certain sort, not if s/he participates in individual-Chamorro relations of a certain sort. Intuitively, in other words, the truth of *gäi-patgun hao doktu* 'you child-have a doctor' doesn't depend on facts about individuals other than the hearer and the hearer's children; the truth of *täi-amigu hao ni un Chamoru* 'you don't friend-have any Chamorro' doesn't depend on facts about individuals other than the hearer and the hearer's friends.

These observations suggest that the content of the incorporated object supplies an initial domain for the internal argument that is narrowed further by combination with the content of the extra object. We will return to this suggestion in due course.

3 An asymmetry in Modify

Some Chamorro evidence that Modify too introduces an asymmetry when it combines contents is provided by intersective modifiers of NPs. Before presenting the evidence, we take a moment to say what we mean by modification.

What linguists call restrictive modification can be defined perspicuously in Boolean algebra terms (see especially Keenan 1983). Following Keenan (1983, pp. 60–67), we call a function f (from an algebra A into A) *restrictive* if and

only if f(a) ≤ a, for all a ∈ A.[5] A great many modifiers have meanings that are restrictive functions. In English, all manner adverbs are restrictive: if someone *thinks clearly*, then she *thinks*; if he *stirs the soup slowly*, then he *stirs the soup*. All postnominal modifiers of NPs are restrictive: *books about music* are *books*, *philosophers who have read Chomsky* are *philosophers*, and *dancers hired recently* are *dancers*. With the exception of e.g., *fake, virtual*, *self-styled, former*, most prenominal adjectives are restrictive: *small cats* are *cats, green sofas* are *sofas, typical administrators* are *administrators*, and so on.

Intersective modification is a subtype of restrictive modification. Again following Keenan, we call a function f (from an algebra A into A) *intersective* if and only if f(a) = a ∧ f(1), for all a ∈ A, where 1, the unit element, is used here to represent the property that all individuals have. Only some restrictive modifiers have meanings that are intersective functions: for instance, *male, green*, and *who have read Chomsky* are intersective, but *typical, unusual*, and *dangerous* are not.

In the following discussion, the spotlight is on intersective modification. Section 3.1 describes the morphosyntax of Chamorro's modifiers of NPs. Section 3.2 uses intersective modifiers to investigate the workings of Modify.

3.1 The morphosyntax of modifiers of NPs in Chamorro

Like other syntactic categories in Chamorro, DPs are head-initial. They are projected from the category D(eterminer), which occurs at the left and is followed first by the NP and then, optionally, by the possessor. Modifiers of the NP are adjoined to the NP and can be of various category types. Of interest here is the fact that most restrictive modifiers, and all intersective modifiers, are freely ordered with respect to the NP they modify.[6] Whether the modifier precedes or follows, it is separated from the head NP by the so-called linker, a morpheme whose phonological shape reveals whether the modifier surfaces to the left or to the right. The shape of the linker will be important in what follows.

When the modifier precedes the head NP, the linker is realized as the proclitic *na*. The following examples illustrate this for intersective modifiers of various syntactic categories: an AP in (13a), an NP in (13b), and a relative clause CP in (13c). (Here and elsewhere, in an attempt to make the data more transparent, we italicize the modifiers and annotate the linker's gloss (LN) to indicate whether the modifier lies to the left (modL) or the right (modR) of the head NP.)

(13)a.	i	*agäga*	na	kareta
	the	*red*	*LN(modL)*	*car*
	'the red car'			

[5] Adjectives interpreted by restrictive functions are called *subsective* by Kamp (1975).

[6] Our efforts to investigate nonrestrictive modifiers of NP in Chamorro have been hampered by the fact that the language seems to have few, if any, adjectives of this type. Chamorro expresses 'former' and 'future' via the content of Inflection, and seems to have no words from major class categories corresponding exactly to 'alleged', 'virtual', fake', and the like.

b. *hayu* na guma'
wood *LN(modL)* *house*
'wood house'

c. i *matáta'chung* na taotao
the *WH[nom].agr.sit.Prog* *LN(modL)* *person*
'the person who is sitting down'

When the modifier follows the head NP, the realization of the linker is conditioned by further sorts of information. If the modifier is an AP or NP, the linker's shape is determined by the morphology and phonology of the head noun: when the head noun is not inflected for agreement and ends in a vowel, the linker is spelled out as the suffix *-n*; otherwise it is unpronounced. If the modifier is a relative clause CP, the linker fuses with C to produce the relative clause complementizer *ni (*see Chung 1998 pp. 232–233). These realizations are illustrated below for the same intersective modifiers as were shown in (13).

(14)a. i kareta-n *agäga'*
the *car-LN(modR)* *red*
'the red car'

b. guma' *hayu*
house.LN(modR) *wood*
'wood house'

c. i taotao ni *matáta'*chung
the *person* *LN(modR).Comp* *WH[nom].agr.sit.Prog*
'the person who is sitting down'

The linker's shape reveals whether a modifier precedes or follows the head NP even when free ordering is not an option. For instance, certain restrictive but nonintersective modifiers, such as *tétehnan* 'last (remaining)' and *sigienti* 'next', must precede the head NP, as the contrast between (15) and (16) shows.[7] When such modifiers occur, the linker signals that they surface to the left.

(15)a. i *tétehnan* na gimin
the *last.remaining* *LN(modL)* *drink*
'the last drink'

b. i *sigienti* na che'chu'-ñiha
the *next* *LN(modL)* *work-agr*
'their next job'

(16)a. *i gimin *tétehnan*
the *drink.LN(modR)* *last.remaining*
('the last drink')

[7] Word order contrasts like those in (15)–(16) raise the question of whether modifiers of NPs in Chamorro could be given a syntactic analysis along the lines suggested by Cinque (2003) for English and Romance. We must leave this syntactic question for another time.

b. *i che'chu'-ñiha *sigienti*
the *work-agr.LN(modR)* *next*
('their next job')

Possessor DPs, which must follow the head NP, have the option of displaying the morphology of modifiers. When this option is chosen, the linker signals that they surface to the right.[8]

(17)a. i lepblu-n *Susa*
the *book-LN(modR)* *Susan*
'Susan's book'
b. i gima' *i* *ma'estru*
the *house.LN(modR)* *the* *teacher*
'the teacher's house'

(18)a. *i *Susa* na lepblu
the *Susan* *LN(modL)* *book*
('Susan's book')
b. *i *(i)* *ma'estru* na guma'
the *the* *teacher* *LN(modL)* *house*
('the teacher's house')

The fact that the linker consistently flags the relative order of modifier and head means that it can be used to distinguish between the two even when both happen to be NPs. This information will become useful shortly.

3.2 The evidence

We can now recreate our experiment from Sect. 2.2 with respect to Modify, the nonsaturating operation that composes the property content of an NP with the property content of a modifier. Recall that we are proceeding from the assumption that in the simplest cases, Modify combines a property P and a property Q by creating a new property from their intersection. (19) shows the result of using Modify to combine the contents of *cat* and the intersective modifier *black*.

(19) $\text{MODIFY}(\lambda x[\text{cat}'(x)], \text{black}') = \lambda x[\text{cat}'(x) \wedge \text{black}'(x)]$

Behind this rather straightforward initial conception lie some further assumptions that we should make explicit at this point. First, in the composition of DP meanings, the property content of the NP invariably supplies a restriction. In the case of generalized quantifiers, the restriction is to a determiner meaning; in the case of indefinites composed by C&L's operation

[8] Irrelevantly for current purposes, the postnominal forms of the linker shown in (17) have the prosodic effect of converting the head noun into a prosodically bound form; see Chung (2003, p. 582).

Specify, it is the domain of a choice function; in the case of indefinites composed by Restrict, it is a restriction pure and simple. Second, the content of the NP is combined with the contents of its modifiers before it or the higher DP meaning is targeted for predicate-argument composition (a standard assumption; but see Bittner 2001, for a different view).

This complex of assumptions leads to a prediction. Suppose, as we did earlier for Restrict, that Modify does not introduce any asymmetry when it combines contents. Then in the simplest cases, when the contents of an NP and its modifier are combined by intersection, it shouldn't ultimately matter which property is supplied by the modifier and which by the head NP. The commutativity of intersection should guarantee that the two possible ways of combining these property contents lead to equivalent results, as (20) is intended to suggest.

(20) $\lambda x[\text{cat}'(x) \wedge \text{black}'(x)] = \lambda x[\text{black}'(x) \wedge \text{cat}'(x)]$

But then switching the contents of the head NP and the modifier shouldn't make a difference to the meaning.

In fact, it does make a difference. Even when an NP has an intersective modifier that is itself an NP, using the realization of the linker that identifies the 'wrong' constituent as the modifier leads to clear effects of dissonance. This can be seen from the following examples, which illustrate the full range of morphosyntactic options that Chamorro makes available for expressing intersective modification of an NP. Consider first (21), in which both the head and its modifier are NPs and the linker's shape (*na*) signals that the modifier *precedes* the head. These sentences are grammatical and completely natural.

(21)a. Malägu' si Jose um-äsagua yan un *pilotu*
agr.want Jose Infin-marry with a pilot
na palao'an.
LN(modL) woman
'Jose wants to marry a woman who's a pilot.'

b. Maseha hafa na *oru* na alahas, maolik
whatever gold LN(modL) jewelry agr.good
ma-ätan gias Carmen.
agr.Pass-perceive Loc Carmen
'Any gold jewelry looks good on Carmen.'

In the corresponding sentences in (22), the two NPs have changed places, so that now the linker identifies what had formerly been the modifier as the head, and vice versa. These sentences are rejected by speakers as strange, deviant, somehow wrong, or simply ungrammatical.[9] (Once again, the English translations are ours.)

[9] Speakers evaluate examples of the type shown in (22) and (24) as significantly more deviant than the examples discussed in Sect. 2.2. This might be because examples like (22) and (24) are judged to have a morphological defect—they exhibit the 'wrong' form of the linker—whereas the examples in Sect. 2.2 are judged to have a defect that can be remedied less easily.

(22)a. *Malägu' si Jose um-äsagua yan un *palao'an*
agr.want Jose Infin-marry with a woman
na pilotu.
LN(modL) pilot
('Jose wants to marry a pilot who's a woman.')

b. *Maseha hafa na *alahas* na oru, maolik
whatever jewelry LN(modL) gold agr.good
ma-ätan gias Carmen.
agr.Pass-perceive Loc Carmen
('Any gold that's jewelry looks good on Carmen.')

Consider next (23), in which both the head and its modifier are NPs and the linker's shape signals that the modifier follows the head. These sentences are just as grammatical and natural as those in (21). (They simultaneously illustrate a point of detail: in postnominal position, speakers often prefer to realize an NP modifier not simply as NP, but rather as the NP predicate of a relative clause. Compare the NP *oru* 'gold' in (23b) with the relative clause CP *ni pilotu* 'who is a pilot' in (23a).)

(23)a. Malägu' si Jose um-äsagua yan un palao'an
agr.want Jose Infin-marry with a woman
ni *pilotu.*
LN(modR).Comp pilot
'Jose wants to marry a woman who's a pilot.'

b. Sa′nä-nña si Carmen ni alahas *oru*
agr.look.good-Compar Carmen Obl jewelry.LN(modR) gold
kini diamenti.
than diamond
'Carmen looks better with gold jewelry than diamonds.'

In the corresponding sentences in (24), the two NPs have once again changed places, so that now the linker's shape identifies what had formerly been the head as (part of) the modifier, and vice versa. These sentences are rejected by speakers as strange, somehow wrong, or simply ungrammatical—just as deviant as the examples in (22).

(24)a. *Malägu' si Jose um-äsagua yan un pilotu
agr.want Jose Infin-marry with a pilot
ni *palao'an.*
LN(modR).Comp woman
('Jose wants to marry a pilot who's a woman.')

b. *Sa′nä-nña si Carmen ni oru ni
agr.look.good-Compar Carmen Obl gold LN(modR).Comp
alahas kini diamenti.
jewelry than Diamond
('Carmen looks better with gold that's jewelry than diamonds.')

These contrasts reveal that Modify, like Restrict, introduces an asymmetry when it combines contents.

This asymmetry resembles the asymmetry introduced by Restrict in some important ways. Though not truth-conditional in and of itself, it comes close to contributing to truth conditions in opaque contexts; see, for instance, (21a) and (22a) (as well as their English translations). Further, just as we did earlier with Restrict, we can observe here that intuitively, the predicate's relation to the relevant argument is fixed by the content of the head NP, not by the content of the NP modifier. In (21a), what Jose wants is to stand in the marriage relation to a certain sort of woman, not to a certain sort of pilot; in (21b), what looks good on Carmen is jewelry of a certain sort, not gold of a certain sort. Intuitively, that is, the truth or falsity of Jose's marrying a woman-who-is-a-pilot in some world (the world of his desires) can't depend on facts about non-women in that world. Similarly, the truth or falsity of jewelry-that-is-gold being attractive on Carmen can't depend on facts about non-jewelry.

All this suggests that Modify takes the content of the head NP to introduce a domain that is then narrowed by combination with the content of the modifier. Crucially, it is the syntactic relation *head*, not category type or linear order, that determines which property content supplies the initial domain. A comparison of (22b) and (23b) makes this clear. The head-modifier constructions in these examples are formed from two NP constituents, *alahas* 'jewelry' and *oru* 'gold', arranged so that *alahas* precedes *oru*; they differ only in which NP is identified by the linker as the head. The fact that (23b) is grammatical but (22b) is deviant argues that *head* is the relation that signals how Modify, a nonsaturating composition operation, should proceed (for similar observations, see Keenan 1974; Kamp and Partee 1995; Bittner 2001).

In short, Modify is not a commutative operation. This conclusion is strengthened by the fact that contrasts reminiscent of those just discussed can be found in many languages besides Chamorro. Consider, for instance, the English complex DPs below, in which the NP is modified by a relative clause.

(25)a. ?Every woman who's a man will want to beat back this challenge.
b. #Everyone who's a woman and a man will want to beat back this challenge.

(26)a. The Senate impeached a former Governor who was a philanderer.
b. ??The Senate impeached a philanderer who was a former Governor.

Here, as in Chamorro, it evidently makes a difference which property content is supplied by the head NP and which by the relative clause modifier. Thus, (25a) seems to have an acceptable noncontradictory construal, whereas (25b) does not; (26a) is unremarkable, but (26b) is peculiar. A similar point is made by the English translations of the Chamorro examples in (21)–(24). Jim McCloskey (personal communication) observes that the asymmetry can have truth-conditional consequences if the circumstances are right. The sentences

in (27), containing the vague cardinal *many*, express propositions that are not equivalent.

(27)a. There are many governors who are lawyers.
b. There are many lawyers who are governors.

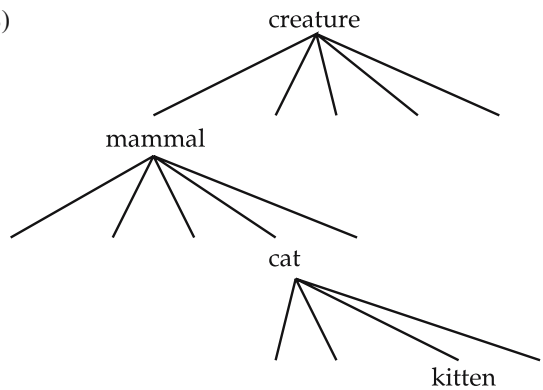
These English contrasts should be investigated more systematically, of course. But even in their current anecdotal state, they lend support to the view that Modify introduces an asymmetry: it cannot be reduced to mere predicate intersection.

4 Domain narrowing and class inclusion effects

Our claim that Restrict and Modify use the property contents they combine to narrow a domain is reinforced by cases in which the contents can be related by class inclusion.

In a discussion of discourse anaphora, Stenning (1978) observed that common nouns can be arranged in a hierarchy according to the class inclusion relations of their denotations. In this multi-branching hierarchy of class inclusion, *cat* is subordinate to *creature*, because "if something falls under the denotation of *cat*, then it falls under the denotation of *creature*" (1978; p. 167); similarly, *kitten* is subordinate to *cat*, *mammal* is subordinate to *creature*, and so on. One branch of the hierarchy is sketched in (28).

(28)



Stenning saw his hierarchy as an ordering of nouns based on their denotations, but it can equally well be viewed as an ordering of informativeness. Whether the ordering is ultimately grounded in knowledge of language or knowledge of the world, we can use it to make a prediction. Suppose that Restrict and Modify do indeed use the contents they compose to narrow a domain. Then these operations should be informative only when they actually succeed in narrowing the domain with which they are presented. But there is a situation in which this cannot happen—namely, when the NP whose content supplies

the initial domain is subordinate (to use Stenning's term) to the NP whose content is intended to narrow it further. In such situations, the narrowing must be vacuous and deviance results.

We show here that this prediction is realized. Section 4.1 presents evidence from multiple applications of Restrict; Sect. 4.2, evidence from Modify.

4.1 Evidence from multiple applications of Restrict

C&L (2004, pp. 119–121) observe that incorporation constructions exhibit a well-known effect that can be characterized in Stenning's terms. The effect is this: in incorporation of the doubling type, the incorporated object cannot be subordinate to the extra object in the hierarchy of class inclusion. (For previous discussions, many of which describe the effect in terms of specificity, see e.g., Woodbury 1975; Mithun 1984; Rosen 1989. A characterization close to C&L's is offered by Anderson 2000.)

Consider, for instance, Chamorro incorporation sentences in which the extra object (italicized) is itself a property-content expression. In such sentences, the incorporated object is not allowed to be subordinate to the extra object, as (29) shows.[10]

(29)a. *Gäi-[kätu] si Jose *ga'ga'*.
agr.have-cat Jose animal
('Jose has a pet as cat (lit. Jose cat-has an animal).')

b. *Gäi-[bistidu] *magagu* i palao'an.
agr.have-dress clothing the woman
('The woman has clothes for a dress (lit. The woman dress-has clothes).')

c. *Kao gäi-[tanduki] hao *chotda?*
Q agr.have-plantain you banana
('Do you have any banana plantains?')

d. *Si Dolores täi-[neni] *patgun*.
Dolores agr.not.have-baby child
('Dolores doesn't have child babies.')

e. *Si Rita täi-[unpesu] *ni hófafa ha' na salappi'*.
Rita agr.not.have-dollar not anything Emp LN money
('Rita doesn't have any dollars in money.')

Notice that the extra objects in (29) range from general terms that would be located relatively high on the hierarchy (e.g., *ga'ga'* 'animal' in (29a)) to specific terms that would be located relatively low (e.g., *chotda* '(unripe) banana' in (29c)). Nonetheless, these examples are all firmly rejected as ungrammatical, because in all of them the incorporated object is subordinate to the extra object.

[10] Notice that the extra object in (29e) is a negative concord DP. In general, negative concord determiners in Chamorro have domain-widening effects similar to those described by Kadmon and Landman (1993) for the negative polarity determiner *any*. Examples like (29e) suggest that these domain-widening effects are not enough to suspend the requirement that the incorporated object cannot be subordinate to the extra object.

Revealingly, when the NPs are reversed so that the illegal subordination relation no longer holds, the defect is remedied. Compare (29) with (30).[11]

(30)a. Gäi-[ga'] si Jose *kätu*.
agr.have-animal Jose cat
'Jose has a cat as pet (lit. Jose animal-has a cat).'

b. Gäi-[magagu] *bistidu* i palao'an.
agr.have-clothing dress the woman
'The woman has a dress for clothes (lit. The woman clothes-has a dress).'

c. Kao gäi-[chotda] hao *tanduki*?
Q agr.have-banana you plantain
'Do you have any plantain bananas?'

d. Si Dolores täi-[patgun] *neni*.
Dolores agr.not.have-child baby
'Dolores doesn't have baby children.'

e. Si Rita täi-[salappi′] *ni hófafa ha′ na unpesu.*
Rita agr.not.have-money not anything Emp LN dollar
'Rita doesn't have any money in dollars.'

This is exactly the pattern we expect if Restrict uses the contents it combines to narrow a domain. Recall that in the composition of sentences like (29)–(30), Restrict applies twice, combining the verb's internal argument first with the property supplied by the incorporated object and then with the property supplied by the extra object (see Sect. 2.2). The first time that Restrict applies, the domain presented by the internal argument is the universe of individuals—a domain that is inevitably narrowed by combination with the content of the incorporated object. But when Restrict applies the second time, the domain presented by the internal argument is now defined by the incorporated object's content, and matters are different. This new domain can be narrowed by the content of the extra object only under certain circumstances—only when the inclusion relations between the contents of the two NPs are right. If the incorporated object is subordinate to the extra object, narrowing will fail and Restrict will be uninformative. This, we claim, is why the sentences in (29) are deviant.[12]

[11] In the examples in (30), the extra object's content happens to be properly included in the incorporated object's content. Notice that proper inclusion is by no means required. There are well-formed incorporation structures in which the two contents overlap but neither is properly included in the other (see Sect. 2.2). Some speakers also find it possible for the two contents to be identical. Consider

(i) Gäi-[guma'] yu' guma'.
agr.have-house I house
'I have a house (as a house).'

For a little more discussion of this last possibility, see C&L (2004, pp. 120–121).

[12] When the contents of the incorporated object and the extra object are identical (see footnote 11), the result seems to be that this content is focused. We have not investigated examples of this type in any detail.

The contrast between (29) and (30), then, confirms that Restrict serves to narrow a domain. At the same time, it adds to the evidence that this operation cannot be reduced to mere predicate intersection, but rather introduces an asymmetry.

4.2 Evidence from Modify

Head-modifier constructions exhibit an effect similar to that just documented for incorporation, although this is not often noticed. The effect can be described in Stenning's terms as follows: a head NP cannot be subordinate to its intersective modifier in the hierarchy of class inclusion.

To see the effect in action, consider the Chamorro examples of intersective modification in (31), in which a head NP has a modifier that is itself an NP. As is perhaps self-evident by now, the realizations of the linker in these examples reveal that the modifier (italicized) precedes the head in (31a), but follows the head in (31b) and (31c).[13]

(31)a. *Kao guäha tiningo'-mu *doktu*
Q *agr.exist* *WH[obj].know-agr* *doctor*
na ä'amti chetnut kidney?
LN(modL) *healer* *disease* *kidney*
('Do you know any treaters of kidney disease who are doctors?')

b. *Kao guäha tiningo'-mu ä'amti chetnut
Q *agr.exist* *WH[obj].know-agr* *healer* *disease*
kidney ni *doktu*?
kidney *LN(modR).Comp* *doctor*
('Do you know any treaters of kidney disease who are doctors?')

c. *Kao guäha katsunes-mu *magagu*?
Q *agr.exist* *pants-agr.LN(modR)* *clothing*
('Are there pants of yours that are clothes?')

The point is that these examples are ungrammatical, because all of them contain a head NP that is subordinate to its modifier. But when the two NPs are reversed so that the illegal subordination relation no longer holds, the ungrammaticality disappears. Compare (31) with (32).

(32)a. Kao guäha tiningo'-mu *ä'amti* *chetnut* *kidney*
Q *agr.exist* *WH[obj].know-agr* *healer* *disease* *kidney*
na doktu?
LN(modL) *doctor*
'Do you know any doctors who treat (lit. are healers of) kidney disease?'

[13] Notice that speakers judge examples of this type to be deviant only if they do indeed interpret the head NP as subordinate to the modifier in the hierarchy of class inclusion. For instance, one speaker who we interviewed accepted (31b), but then commented, "Of course, traditional healers treat kidney disease too—and they're not doctors." For this speaker, 'treater of kidney disease' would not be subordinate to 'doctor' in the hierarchy. A number of the examples that we tested were less susceptible to this sort of alternative interpretation, and speakers' reactions to them were uniform; see, for instance, (31c) and (34).

b. Kao guäha tiningo'-mu doktu ni *ä'amti*
Q agr.exist WH[obj].know-agr doctor LN(modR) healer
chetnut kidney?
disease kidney
'Do you know any doctors who treat (lit. are healers of) kidney disease?'

c. Kao guäha magagu-mu *katsunis*?
Q agr.exist clothing-agr.LN(modR) pants
'Are there clothes of yours that are pants?'

Similar contrasts can be constructed from English complex DPs containing relative clauses, as (33) shows.

(33)a. ??Did you notice any cats that were creatures?
b. Did you notice any creatures that were cats?

These contrasts are predicted, of course, if Modify is an operation that serves to narrow a domain. More precisely, they are what we expect if Modify takes the content of the head NP to supply a domain that is then narrowed by combination with the content of the modifier. What goes wrong in (31) and (33a) is that the domain supplied by the head NP's content cannot be meaningfully narrowed by the modifier's content, because the head NP's content is properly included in the modifier's content. Narrowing then fails (i.e. Modify is uninformative), and the outcome is deviant. The story is essentially the same as the story we told a moment ago concerning Restrict.

The contrasts in (31)–(32) are significant for a further reason: they demonstrate that this particular class inclusion effect cannot be attributed to linear precedence in discourse. If the effect in (31) were a linear precedence effect, it would be hard to explain why (31a) is deviant but (32b) is well-formed, since the relative order of the two NPs *doktu* 'doctor' and *ä'amti chetnut kidney* 'healer of kidney disease' is identical in these examples. The same holds true for (31b) and (32a). What differentiates the ungrammatical examples in these pairs from their grammatical counterparts is not linear order, but rather the way in which the inclusion relations of the two NPs align with the head-modifier relation. Thus, in (31a, b), the linker's shape singles out the less inclusive (i.e., subordinate) NP *ä'amti chetnut kidney* 'healer of kidney disease' as the head, and the more inclusive NP *doktu* 'doctor' as its modifier. This configuration is not permitted. In (32a, b), however, the linker's shape singles out the more inclusive NP as the head and the less inclusive NP as its modifier—a configuration that is well-formed.

The situation is entirely parallel when the modifier is a relative clause, as can be seen from the following. In the sentences in (34), the head NP is subordinate to its relative clause modifier, and the results are ungrammatical. Notice that this is so whether the modifier precedes or follows the head NP.

(34)a. *Man-manggi ädyu siha na *kantót* na
agr.is where? that Pl LN singer LN(modL)
man-géfmaolik mang-anta?
WH[nom].agr-very.good WH[nom].agr-sing
('Where are those who sing really well who are singers?')

b. *Amanu na man-gaigi ädyu siha i
where? Comp agr-be.at that Pl the
man-géfmaolik mang-anta ni *kantót*?
WH[nom].agr-very.good WH[nom].agr-sing LN(modR).Comp singer
('Where are those who sing really well who are singers?')

But in (35), the content of the two constituents has been reversed so that the illegal subordination relation no longer holds, and there is no problem.

(35)a. Amanu na man-gaigi ädyu siha i
where? Comp agr-be.at that Pl the
man-géfmaolik mang-anta na kantót?
WH[nom].agr-very.good WH[nom].agr-sing LN(modL) singer
'Where are the singers who sing really well?'

b. Man-manggi ädyu siha na kantót ni
agr-is.where? that Pl LN singer LN(modR).Comp
man-géfmaolik mang-anta?
WH[nom].agr-very.good WH[nom].agr-sing
'Where are the singers who sing really well?'

These examples confirm that it is not linear precedence, but rather the head-modifier relation, that must reflect class inclusion relations in the right way in (31)–(32).

We note that, although linear precedence plays no role in the effect illustrated in (31) and (34), there are more complicated circumstances in which class inclusion relations do align with precedence relations in Chamorro. When an overt head NP has more than one modifier, the modifiers are typically arranged so that more inclusive modifiers precede less inclusive ones. This is the order of modifiers seen in (36), for example.

(36)a. Kao un-tungu' maseha hayi na taotao ni
Q agr-know any.at.all person LN(modR).Comp
peskadót ni *pumépeska* *katchu'?*
fisherman LN(modR).Comp WH[nom].agr.fish.Prog tuna
'Do you know anyone who's a fisherman who fishes for tuna?'

b. Taya' *man-yommuk* na famalao'an
agr.not.exist WH[nom].agr-fat LN(modL) women
ni *in-ipus* *kuatru* *sientus*
LN*(modR).Comp agr.Pass-exceed four hundred*
libra-ñiha.
weight-agr
'There are no fat women whose weight exceeds 400 pounds.'

When the modifiers are shuffled so that less inclusive (i.e., subordinate) modifiers precede more inclusive ones, speakers judge the results to be awkward, choppy, or questionable—the sort of Chamorro that would be produced by a child or by someone who was not a full speaker of the language. Consider (37a, b):

(37)a. ??Kao un-tungu' maseha hayi *pumépeska* *katchu'*
Q *agr-know any.at.all* *WH[nom].agr.fish.Prog tuna*
na taotao ni *peskadót*?
LN(modL) person LN(modR).Comp fisherman
('Do you know anyone who fishes for tuna who's a fisherman?')

b. ??Taya' *in-ipus* *kuatru* *sientus* *libra-nñiha*
agr.not.exist agr.Pass-exceed four hundred pound-their
na famalao'an ni *man-yommuk.*
LN(modL) women LN(modR).Comp WH[nom].agr-fat
('There are no women whose weight exceeds 400 pounds who are fat.')

We do not know what is responsible for the questionable status of examples like (37).[14] But whatever the explanation, the phenomenon is both different from, and considerably weaker than, the effect seen in (31) and (34), which is the focus of interest here.

To return to the main point, the effect in (31) and (34) is just as we described it initially: a head NP cannot be subordinate to its modifier in the hierarchy of class inclusion. This effect, which cannot be attributed to linear precedence, is neatly accounted for by our claim that Modify, like Restrict, serves to narrow a domain.

5 Representing the asymmetry

So far we have used evidence from Chamorro (and English) to defend a particular view of the composition operations we call Restrict and Modify. These operations, we claim, incorporate an asymmetry: they compose the contents of A and B by taking the content of A to supply a domain that is narrowed further by combination with the content of B. The hypothesis that these operations serve to narrow a domain explains why the property contents they compose cannot be switched in incorporation constructions in which Restrict applies twice, or in head-modifier constructions composed by Modify.

[14] One possibility worth considering runs as follows. Suppose that when a head NP is surrounded by modifiers, there is a preference for the NP to form a syntactic constituent first with the modifier on the left, and only then with the modifier on the right. Assuming that semantic composition tracks syntactic structure, the questionable status of (37) could then be attributed to a class inclusion effect. The effect would be weaker than those described in the text, because the syntactic constituency just described is merely a preference, not an absolute requirement.

It also explains why the contents must align with the syntax in the right way when one content happens to be more inclusive than the other.

Our view of Restrict and Modify has consequences for the trade-off between the theory of semantic contents and the theory of composition operations, as we observed earlier. Because each of these operations is a nonsaturating operation that manipulates property contents, inspection of the contents alone does not reveal which content supplies the initial domain and which serves to narrow it further. As a matter of fact, both options are systematically available: the same contents can be composed with distinct results, as we demonstrated several times in Sects. 2–4. We showed then that the syntax determines which content supplies the initial domain: the incorporated object's content does so in incorporation constructions, and the head NP's content does so in head-modifier constructions. But for this information to emerge in the semantics, it is necessary to take into account not just the contents composed but also how the composition operation manipulates them. In other words, the structure of the composition operation is crucial.

The next step, clearly, is to develop a formal theory of Restrict and Modify that makes explicit their domain-narrowing character. Although we will not be able to undertake that project here, we can offer some preliminary remarks on the territory that will have to be covered before a theory is arrived at.

Recall that we take an expression's mode of composition to contribute to its meaning, as is expected if compositionality is understood to be 'a function of the meaning of the parts and the way they are put together'. One might take this as an invitation to see the domain-narrowing character of Restrict and Modify as a species of 'intensionality'. But it is different from the intensionality that Montague attempted to capture by distinguishing between extensions and intensions. In our account, we assume that Restrict and Modify apply to properties, and as (23)–(24) show, they introduce a compositional asymmetry in intensional as well as extensional contexts. The difference in meaning that concerns us here is more similar to the kind of intensionality for which structured meanings have been proposed (see e.g., Cresswell 1985).

Alternatively, one might be tempted to see the domain-narrowing character of Restrict and Modify as involving 'presuppositionality'. But it is not the sort of global presupposition associated with the discourse common ground. This emerges clearly from examples like (11a) and (12a), which presuppose equally little—that is, nothing at all—about the existence of children or doctors. Nonetheless, a more distant connection to presuppositionality can perhaps be glimpsed if one takes the representation of functions to include domain conditions, as suggested by Heim and Kratzer (1998). In our account, the first time that Restrict targets the relatum of a predicate, the domain that it narrows is the initial domain from which the value of the targeted variable is chosen—a domain specified by a domain condition. Now, certain presuppositions can also be expressed by way of domain conditions (see e.g., Heim and Kratzer 1998, p. 163); this may be what sparks the question of whether Restrict introduces a presupposition. But in our view, not all domain

conditions express presuppositions, so Restrict can narrow the domain of the targeted variable without having presuppositional effects.

Looking beyond familiar concepts, we can pinpoint two design specifications that any successful theory of Restrict and Modify will have to incorporate. First, the domains introduced by Restrict and Modify must be accessible to later stages of semantic composition. It is, we claim, precisely because these domains can be accessed by later composition that there is a felt difference between 'woman who is a physicist' and 'physicist who is a woman' in the examples in (38) below. Notice that there is nothing inherently strange about the head-modifier relation presented by the second of these expressions. When the context is right, the appropriateness of the two expressions can be reversed, as (39) reveals.

(38)a. Joe wants to marry a woman who is a physicist.
b. ??Joe wants to marry a physicist who is a woman.

(39)a. For affirmative action reasons, the Physics Department badly needs to hire a physicist who is a woman.
b. ??For affirmative action reasons, the Physics Department badly needs to hire a woman who is a physicist.

Second, when Restrict targets the same relatum of a predicate twice, the output of its first application must supply the domain used by its second application. The operation is therefore fundamentally dynamic.

The dynamicity of Restrict raises the question of whether the larger architecture of a dynamic semantics could supply some or all of what is needed to represent the asymmetries documented in Sects. 2–4. We have been maintaining that these asymmetries arise from the structure of the composition operation. But might it be possible to derive them more efficiently in a dynamic approach to interpretation? We suspect that the answer is ultimately no, for the following reasons.

First of all, despite the broad conceptual parallel with context change (see e.g., Groenendijk and Stokhof 1991), the compositional asymmetry introduced by Restrict and Modify is not easily packaged in terms of dynamic $\wedge$, a logical constant which relates information states and which is crucially sensitive to the linear (temporal) structure of discourse. What is needed instead is a dynamic approach more along the lines of Bittner (2001)—one which operates at the subclausal level and can detect structural differences not necessarily reflected in linear order, such as the difference between heads and non-heads.

Some headway can be made by pursuing this path. For instance, in the spirit of Bittner (2001), one could propose that an NP introduces the denotation of its head into the discourse as a local context. Modify would then serve to narrow that local context further, so that, for instance, the *tall pilots* would be just the *tall entities* in a local context that happened to be limited to pilots. A dynamic approach of this sort could successfully derive a contrast between *pilots who are women* and *women who are pilots*, depending on how the

accessibility relations for the resulting state descriptions are defined: the subclausal discourses corresponding to these NPs would end up in different states, thanks to the different local contexts introduced by their respective heads. However, it would also run the risk of introducing ''too many'' local contexts. In Chamorro, both the incorporated object and the extra object in incorporation structures are NPs (not just Ns), and it is possible for both the head and the modifier in modification structures to be NPs. The mystery for a dynamic approach would be why the local contexts introduced by incorporated objects and by heads of modification structures are systematically accessible to later stages of composition, but the local contexts introduced by extra objects and modifiers are systematically inaccessible.

Also to be determined is how such an approach would handle the class inclusion effects of Sect. 4. If the head *blouses* introduces a local context in which all the entities happen to be blouses, it is hard to see what the (local) informational difference would be between *blouses that are clothes* and *blouses that are blouses*: in both cases, the modifier would pick out every entity in the local context. But for some speakers there is a clear, felt difference between the two; see footnote 11.

More generally, the challenge for a dynamic approach to these asymmetries will be to correctly identify the domains that are accessible to later stages of composition, and to characterize the sense in which Restrict and Modify must narrow these domains. It is an open question whether this challenge can be met. We strongly suspect that if it can, the outcome will be very close to our approach, in that it will in effect attribute the asymmetries not just to the dynamics of composition, but to the structure of the composition itself.

We leave matters here, with a final remark. In our terms, Restrict and Modify are alike in that both serve to introduce and then narrow a domain. But the two operations differ from each another as well. Most obviously, Modify has a focal dimension—it introduces a partition; Restrict does not. (This can be seen from the fact that the constructions in which Modify operates are explicitly or implicitly contrastive, whereas some of the constructions in which Restrict operates, such as object incorporation, do not allow for the possibility of contrast.) These differences present an apparent barrier to any attempt to reduce Restrict to Modify, or vice versa. At the same time, they provide a third design specification that any theory of these operations, and their domain-narrowing character, will have to incorporate.

6 A further thought on domains

The discussion so far raises an expectation. If Restrict and Modify do indeed involve the narrowing of a domain, then we might expect further sorts of semantic phenomena to be sensitive to the domains set up by these operations. Here we briefly discuss some facts concerning gradable adjectives in English that promise to bear out this expectation.

Gradable adjectives, such as *small*, *dirty*, *generous*, and *beautiful*, establish relations between individuals and measures of the degree to which they possess some property, relative to some standard of comparison (see e.g., Kennedy 1999, 2003). For adjectives in predicate position, the standard and its associated comparison class are typically contextually determined. For English adjectives that are prenominal modifiers of NP (henceforth, attributive adjectives), the intuition is strong that the standard must be related to the property content of the head NP.[15] Compare the following:

(40)a. Kim is small.
b. Kim is a small lizard.
c. Kim is a small giraffe.

Here are two pieces of support for our claim that the standard of comparison for attributive adjectives must be related to the property content of the head NP. First, as Bresnan (1973, p. 318) originally noticed, there is a clear contrast in naturalness between examples like the following.

(41)a. Joe is taller than my mother.
b. #Joe is a taller man than my mother.

In both (41a) and (41b) the standard of comparison is explicitly identified as *my mother*. The reason why (41b) is peculiar is that my mother does not fit naturally into the domain defined by the property content of the head NP *man*. For us, this is evidence that the standard for attributive adjectives must be related to the domain set up by Modify.

Second, as Vendler (1967) and others have noticed, attributive adjectives in expressions such as *beautiful dancer* permit more than one interpretation. So (42) can mean that the female in question is a dancer who is a beautiful individual, or else that she is a dancer who dances beautifully.

(42) She is a beautiful dancer.

Similarly, (43) can mean that Ned is a composer who is a difficult individual, or else that he is a composer whose compositions are difficult (to e.g. understand or perform).

(43) Ned is a difficult composer.

Some other examples like (43) are cited below.

[15] Notice that we are claiming that the standard must be related in some way to the property content of the head NP, not that it must be determined exclusively by that property content. For relevant discussion, see Kamp and Partee (1995, pp. 142–143) and Kennedy (2003).

(44)a. Sylvia is a wonderful poet.
b. I consider him a rather boring novelist.
c. Neil is a repetitive playwright.

Larson (1998) has proposed an account of examples like (42) in which certain nouns include an event argument of which adjectives can be predicated. While such an analysis has merit, it seems to us not to generalize straightforwardly to (43)–(44). (44a), for example, can be interpreted to mean either that Sylvia is a wonderful individual or that the poems she writes are wonderful; it does not mean that the event of her writing poems is wonderful. We prefer to take these examples to suggest that there can be more than one way to map individuals onto a given scale. Typically, the mapping of individuals onto the scale of beauty (or difficulty or wonderfulness, etc.) attends to their inherent personal qualities. What (42)–(44) show is that, in addition, there are special mappings of individuals onto this scale that attend to their performances or creations (for related discussion, see Pustejovsky 1995 on selective binding, and Kennedy and McNally 2005).

Notice now that the standard of comparison in such quality-of-performance interpretations cannot be recovered more broadly from the discourse context; it must be supplied by the property content of the head NP. This can be seen from the following.

(45)a. Olga, who was astonishingly ugly, pirouetted across the stage.
#She was beautiful.
b. Olga, who was astonishingly ugly, pirouetted across the stage.
She was a beautiful dancer.

As Potts (2003) shows, the content of supplementary relatives, such as *who was astonishingly ugly*, is not deniable. This is evidently what has gone wrong in (45a): the continuation *she was beautiful* denies the content of the supplementary relative, and in fact can only be interpreted that way. No comparable problem arises in (45b), because *astonishingly ugly* is interpreted relative to the inherent-personal-qualities standard, whereas *beautiful* can be interpreted relative to the quality-of-performance standard supplied by the content of *dancer*.

Generally speaking, scalar accounts of gradable adjectives enable these adjectives to be classified as intersective. If adjectives such as *beautiful* and *difficult* in their quality-of-performance interpretations are intersective as well (a point on which we are not completely clear; see Kamp and Partee 1995, p. 143 for related discussion), then (45) offers a further indication that the standard for attributive adjectives must be related to the domain set up by Modify.

7 Conclusion

We would like to conclude by placing our results in perspective, and then suggesting some more speculative directions in which they could be taken.

There are important precedents in the literature for our claim that the interpretation of intersective modifiers of NP introduces an asymmetry that involves the narrowing of a domain. Keenan (1974) claims that the logical structure of certain natural language expressions is constrained by his Functional Principle, which states that functions may vary according to the choice of argument, but the interpretation of an argument expression must be determined independently of the function applied to it. In clauses, the subject serves as the argument and the predicate as the function; in possessive constructions, the possessor serves as the argument and the possessed as the function; and—relevant to us—in restrictive relative clauses, the head NP serves as the argument and the restricting clause as the function. Keenan claims that this function-argument asymmetry lies behind the patterns of anaphora, scope, and agreement exhibited by all three constructions across languages.

More recently, in a discussion of the effects of context on the interpretation of vague terms, Kamp and Partee (1995, pp. 159–161) observe that the sentences *Sam is a giant midget* and *Sam is a midget giant* do not express equivalent propositions. They continue, "*giant* and *midget* are normally construed as mutually exclusive categories . . . [but] the modifier-head construction seems virtually to force one to construe them as compatible if at all possible, apparently by adjusting the interpretation of the modifier in light of the local context created by the head noun (see Keenan 1974)." These observations lead them to posit the Head Primacy Principle, which states that a modifier is interpreted relative to the local context created by the interpretation of the head (1995, p. 161). Bittner (2001), in her dynamic theory of clause-internal composition, posits bridging mechanisms to capture roughly the same generalization.

We hope to have contributed to this line of inquiry in two ways. First, we have demonstrated that the asymmetries just reviewed are not specific to head-modifier constructions, but rather more broadly characteristic of semantic composition that does not eliminate any functional incompleteness. Chamorro happens to be an unusually rich source of evidence bearing on this point. Second, we have hypothesized that these asymmetries are derived directly from the structure of the composition operations. Such a hypothesis can be contemplated, we believe, only once one is willing to venture outside the PTQ box and explore the possibility that it can make a difference how semantic contents are composed.

A much harder question now arises. How far do these systematic asymmetries of composition extend? Are they limited to nonsaturating composition operations, such as Restrict and Modify, or do they arise in all clause-internal composition operations, whether saturating or not?

One reason why this question is difficult to address is that when a composition operation eliminates functional incompleteness (i.e., is saturating), it often eliminates whatever evidence there might have been for compositional asymmetry. Witness the fact that in Chamorro, no evidence for the domain-narrowing character of Restrict can be uncovered when the targeted relatum

is later saturated by Function Application (see Sect. 2.2). Nonetheless, if compositional asymmetry is an intrinsic property of predicate-argument composition, one would expect indications of this to show up in constructions standardly viewed as interpreted via Function Application. We suspect that clues of just this sort are provided by certain contrasts involving restricted quantification. Specifically:

Kratzer (1986) argues that indicative conditionals are interpreted not in terms of material implication, but rather in terms of restricted quantification, where the *if*-clause supplies the restriction. Observing that "two *if*-clauses in a row . . . may successively restrict the domain of one and the same quantifier like two adjectives or two relative clauses might successively restrict the extension of one and the same noun" (1986, p. 10), she then suggests that (46a) (= her (35)) has the logical form sketched roughly in (46b) (= her (36)).

(46)a. If you are back before eight, then if the roast is ready, we will have dinner together.
b. [Must: you are back before eight and the roast is ready] we will have dinner together.

(47) ?If the roast is ready, then if you are back before eight, we will have dinner together.

Significantly, there seems to us to be a slight but noticeable difference in naturalness between (46a) and (47), in which the two *if*-clauses have been reversed. The difference is reminiscent of the contrasts in Chamorro incorporation discussed earlier in Sect. 2.2. If this difference can be shown to be systematic, it might well provide support for the idea that when restricted quantification is interpreted, an asymmetry is introduced.[16]

In his discussion of interrogatives, Higginbotham (1993) notices that questions involving unrestricted quantification have different (partial) answers from their counterparts involving restricted quantification. Consider, for example, the questions below (which correspond to his (10) and (8)):

(48)a. Which things are such that John saw them and they are persons?
b. Who did John see?

Higginbotham (1993, p. 200) observes that *Fido is not a person* constitutes a partial answer to the question in (48a), but in response to (48b) is "simply an irrelevant remark." In other words, the answer to (48b) does not depend on facts about non-persons. He then goes on to say (1993, p. 200),

[16] Christine Bartels (personal communication) suggests that an analysis of the contrast between (46a) and (47) could be given in terms of the status of the different clauses of the conditional as claims vs. concessions. Such an analysis, she points out, might well be compatible with our observations here.

[The distinction] is also seen, rather more vividly, in pairs like (12)–(13).

(12) Which men are bachelors?

(13) Which bachelors are men?

The unrestricted question corresponding to both of these examples is (14).

(14) Which things are both bachelors and men?

But of course (12) and (13) are very different.

The contrast between Higginbotham's (12)–(13) recalls some of the class inclusion effects we discussed for Chamorro in Sect. 3. More generally, his remarks suggest a further way of investigating the idea that the operation that interprets restricted quantification introduces an asymmetry.

An analogy between asymmetry in modification and restrictive quantification raises an interesting connection to the relation between determiners and their arguments. Keenan (2002) claims that intersective determiners are sortally reducible, meaning that e.g., *Det A's are B*'s "says the same" as *Det individuals are both A's and B's*. Higginbotham's discussion suggests either that the determiner *which* is not intersective, or else that sortal reducibility must be understood in such a way that his examples (12)–(13) do not provide counterexamples to Keenan's claim. Of course, Keenan's notion of "says the same" is a truth-conditional one. But Higginbotham's discussion must look to intuitions about what constitutes a partial answer to a question to reveal the difference.

Venturing even farther, we can speculate that evidence for the asymmetric character of predicate-argument composition can be found in Keenan and Stavi's (1986, p. 260) Conservativity Universal.

(49) *Keenan and Stavi's Conservativity Universal:*
Extensional determiners in all languages are always interpreted by *conservative* functions.
Where a function f is conservative iff for all properties p and q,
$q \in f(p)$
iff $(q \wedge p) \in f(p)$ (see Keenan and Stavi 1986, p. 275).

Intuitively, what the Conservativity Universal says is that the truth of *All musicians are poets* can't depend on facts about non-musicians. As Keenan and Stavi say (1986, p. 324, note 6), "our conservativity intuition for one place functions says that to know if q is in $f(p)$ we only need to know about the p's who are q's." (In language more in keeping with the current investigation, we need only to know about facts about the p's; no facts about non-p's are relevant.)

Is the Conservativity Universal an empirical discovery about categories of type <<e,t>,<<e,t>,t>> (i.e. determiners)? Or is it a necessary fact, given the asymmetric character of predicate-argument composition? If the latter, conservativity will provide dramatic support for the claim that all composition operations within the clause serve to introduce asymmetry. We will then have

arrived at a view of clause-internal composition that resonates interestingly with Bittner's (2001) claim that composition at this level is fundamentally dynamic. But in our view, the progressive restriction of domains will arise not from the context-change potentials or bridging mechanisms of discourse, but rather from the structure of more familiar composition operations when these are properly understood (see especially Keenan 1974, for a precedent). It remains to be seen how far, and with what results, the project of fleshing out these speculations can be pursued.

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