# Semantic Case Theory

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1987

Semantic Case Theory initiates an axiomatic treatment of the ways natural languages constrain the interpretation of simple main clause sentences. It provides (1) an explanation of the existence of quantifier scope ambiguities, (2) a variety of universal generalizations concerning the distribution and interpretation of anaphors, (3) an explanation for a surprising asymmetry in the distribution of Passives and Reflexives, and (4), for the limited class of structures considered, an empirically non-circular way of construing universal generalizations using notions like 'subject' and 'direct object'.

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**FINAL VERSION** Please discount an earlier version which received some circulation.

[redacted] in Proc. of the Sixth Amsterdam Colloquium, J. Groenendijk & & M. Stokhof (eds.) Univ. of Amsterdam

Also in Semantics and Contextual Expression
R. Bartsch et al (eds)
? Foris, Dordrecht Holland
? year?

I introduce here the notion of semantic case as a way of extending the interpretation of NPs in simple contexts to more complex ones. The idea is developed from the treatment of scope in van Benthem (1986) and contrasts in interesting ways with the treatment of the same phenomena in Montague (1973) and Keenan & Faltz (1985).

## 1. Notation and Limitations of the Present Study

I limit myself here to nuclear sentences (Ss)--ones formed from simple one and two place first order predicates ($P_1$s and $P_2$s). Given a universe E of objects, $P_1$s (and common nouns, like student) denote subsets of E, called properties. $P_2$s denote subsets of $E^2$, called binary relations. So for n = 1 or 2, a nuclear n-ary S consists of n independent NP occurrences, a simple $P_n$, and no optional material. (An NP occurrence is independent if it is not a proper subconstituent of another NP occurrence).

The class of NPs considered is extensive, properly including those denoting generalized quantifiers. An NP is called initial if it combines with a simple $P_1$ to form a nuclear (unary) S. The initial NPs in a language are partitioned into basic NPs and deictic NPs.

Basic NPs are ones which may be adequately interpreted by functions from the set P of properties of the model into {0,1}, the set of truth values. Such functions are also called basic. I use basic S to mean a nuclear S whose independent NP occurrences are occurrences of basic NPs. Some examples of basic NPs are:

(1) every student, some teacher, every boy but not every girl, no boy's cat, all but two boys, every boy but Tom, more male than female students, Bob's friends, most of the students, fewer boys than girls, John

For example, every boy denotes that function EVERY BOY from properties into {0,1} which sends q to 1 (true) iff the property BOY is a subset of q. More generally, EVERY denotes that function from properties into basic functions given in (2). (For other definitions in this format see Barwise & Cooper (1981) and Keenan & Stavi (1986)).

(2) a. $EVERY(p)(q) = 1$ iff $p \subseteq q$

b. $SOME(p)(q) = 1$ iff $|p \cap q| \geq 1$

Proper nouns (e.g. John) denote individuals, where for each $b \in E$, $I_b$ or the individual generated by b, is that basic function sending a property q to 1 iff $b \in q$.

Deictic NPs are initial NPs which are not basic. To interpret nuclear unary Ss containing them we must know not only the property denoted by the $P_1$ but also additional information provided by the context (of utterance). Up to isomorphism then we may represent deictic NPs as denoting functions from contexts into basic functions. (I.e. in context you might denote the same as Fred). Such functions are called deictic, and initial functions are ones which are either basic or deictic. Some examples of deictic NPs:

(3) I, you, every friend of yours, the same student, he, most of the papers he wrote, a different boy, this cat

## 2. Semantic Cases

A basic unary S differs in a crucial way from a basic transitive (= binary) one: its interpretation is uniquely determined by the denotation of its basic NP and its $P_1$--it is just the value of the former at the latter.

But interpretations for basic transitive Ss (henceforth batSs) are underdetermined in two ways merely given the basic functions denoted by the two basic NPs and the binary relation denoted by the $P_2$. We must state in addition which NP is "logical subject" and which "logical object", and given this, we must state their relative semantic scopes. I provide here a way of specifying these two properties without committment as to how any particular language syntactically presents its batSs. So e.g. "scope" is independent of syntactic relations like C-command.

Consider the two readings of (4):

(4) Every student kissed some teacher

On the "object narrow scope" reading (4) is true iff the basic function EVERY STUDENT holds of the property expressed by kissed some teacher. To build this property from the binary relation KISS and the basic function SOME TEACHER we shall extend the domain of the latter so that it sends binary relations to properties (in addition to sending properties to truth values). Specifically this extended function must send KISS to the set of objects b which are such that the basic function SOME TEACHER holds of the set of things b bears the KISS relation to. More generally:

(5) a. For F basic, $F_{acc}$ or the accusative case extension of F is that extension of F which sends each binary relation R to $\{b:F(R_b) = 1\}$. ($R_b =_{df} \{a: (b,a) \in R\}$

b. ACC is that function sending each basic F to $F_{acc}$

In this notation then, the object narrow scope reading of (4) is given by (EVERY STUDENT)[(SOME TEACHER)$_{acc}$(KISS)].

To get the object wide scope reading of (4) we want to say that some teacher has the property that every student kissed him. To build this property from EVERY STUDENT and KISS we extend the domain of the former so that it takes KISS to the set of objects b which are such that the basic function EVERY STUDENT holds of the set of objects which bear the KISS relation to b. Generalizing:

(6) a. For F basic, $F_{nom}$ or the nominative case extension of F is that extension of F which sends each binary relation R to $\{b: F(R^b) = 1\}$. ($R^b =_{df} \{a: (a,b) \in R\}$)

b. NOM is that function sending each basic F to $F_{nom}$.

The object wide scope reading of (4) then is given by (SOME TEACHER)[(EVERY STUDENT)$_{nom}$(KISS)].

NOM and ACC are called semantic cases.

Informally, note that the nom. ext. of David sends KISS to the set of objects which David kissed. Formally,

(7) $(I_d)_{nom}(KISS) = \{b: I_d(KISS^b) = 1\} = \{b: (d,b) \in KISS\}$

Similarly the accusative extension of David sends KISS to the set of objects which kissed David.

We see then that given two basic NPs and a simple $P_2$, denoting say F,G, and R respectively, there are four[1] ways we may build a sentence interpretation, illustrated in (8).

(8) $F(G_{acc}(R))$ "G is logical object & has narrow scope"

$G(F_{nom}(R))$ "G is logical object & has wide scope"

$G(F_{acc}(R))$ "G is logical subject & has wide scope"

$F(G_{nom}(R))$ "G is logical subject & has narrow scope"

Thus given two basic NPs and a simple $P_2$, argument structure (which is logical subject/object) is expressed in terms of which case extensions are used to interpret the NPs, and "scope" is determined by which of these extensions takes the binary relation as argument--that one having narrow scope. Note that these purely semantic notions are expressed in purely semantic terms.

Finally note that the semantic cases extend in the obvious way to deictic NPs. E.g. NOM(THIS CAT) sends a context c to NOM[(THIS CAT)(c)]. Thus we may in general refer to case extensions of initial functions.

## 3. Semantic Case Theory

From (8) we have seen that given an arbitrary batS in an arbitrary L there are at least four ways it might be semantically interpreted. Usually however batSs in a language are not four ways ambiguous (or vague). (9a) from English has only two truth conditionally distinct readings and (9b) has only one.

(9) a. Every student kissed some teacher
    b. John kissed David

Neither of these Ss is <u>argument ambiguous</u>. E.g. (9b) is not ambiguous (or vague) according as $(b,d) \in$ KISS or $(d,b) \in$ KISS. Clearly then English constrains the acceptable interpretations of its batSs over and above what is logically possible. One statement of these constraints is given by:

(10) <u>English Case Constraint</u> (ECC)

> In a batS of the form [$NP_1$ [V $NP_2$]], interpret $NP_2$ accusatively and $NP_1$ nominatively

The ECC is a claim about English and thus naturally refers to structural properties of English Ss, such as linear order and constituency with the verb. But the ECC also instantiates several quite general properties concerning the ways in which languages constrain the interpretations of simple Ss. Three such constraints are given below. I take them as the axioms of Semantic Case Theory in the sense that all natural languages are held to satisfy them.

(11) <u>Case Existence</u> (CE)

> The independent NPs in a batS are interpreted by case extensions of the basic functions they denote

The motivation for this axiom is given by the <u>Argument Structure Theorem</u> in section 5. In essence the theorem says that NOM and ACC are the only ways a basic function may be extended to binary relations so that basic NPs in transitive contexts preserve, in a uniformly retreivable way, the meaning they have in intransitive contexts. If CE failed generally we would not be able to determine the truth conditions of batSs (up to scope and subject/object ambiguities) given the denotations of the basic NPs and the $P_2$. So CE rules out e.g. that <u>every student</u> might mean <u>not a single student</u> when in collocation with a transitive verb. Ultimately then the motivation for CE is that we interpret familiar items in complex contexts in the same way as in simple ones, the only differences being induced by the complex context itself i.e. does the NP function as logical subject or object, does it have wide or narrow scope. These are questions which cannot arise in intransitive contexts.

(12) <u>Case Distinctness</u> (CS)

> The independent NPs in a batS are interpreted by distinct case extensions

The reader may compute that if both NPs in a batS like <u>John kissed David</u> were interpreted nominatively (or both accusatively) the S would be argument ambiguous (depending on which NP had narrow scope (= took KISS as argument).

Note that CE and CD jointly claim than an interpretation of a batS determines a bijection from the independent NPs into the set {NOM,ACC} of semantic cases. They do not preclude however that a given batS have two such interpretations. So the axioms so far eliminate some but not all possibilities of argument ambiguities.

It is easily seen that the ECC satisfies CD and CE (with respect to the batSs it quantifies over).

A third general property possessed by the ECC is that case interpretations of the NPs in a batS are determined as a function of the structure of the S. Thus we want an axiom which guarantees that Ss with the same structure (regardless of what it is) have their corresponding NPs assigned the same case.

(13) Case Structure (CS)

> Let T and T' be nuclear transitive Ss such that T is derived from ($NP_1$, $NP_2$, V) in the same way that T' is derived from ($NP_1$', $NP_2$', V'). Then,
>
> if an interpretation f interprets $NP_i$ and $NP_i$' by case extensions of initial functions then these case extensions are identical (i.e. both nom or both acc)

E.g. given that (14a) is derived from (John, David, Kiss) in the same way that (14b) is derived from (David, John, Kiss), CS tells us that there is no interpretation f of English which interprets these Ss with the case extensions indicated.

(14) a. John kissed David — John: nom, David: acc
b. David kissed John — David: acc, John: nom

(Clearly the ECC guarantees this by blocking (14b)). Note that if there were such an interpretation f then these two Ss would have a reading on which they were logically equivalent, which is empirically false.

In the statement of CS, we quantify over nuclear Ss, not just basic ones, whence the NP variables range over NPs in general, not just basic (or even deictic ones, see section 4.3) ones. The *if* clause in CS is needed since some non-basic NPs are interpreted by functions which are not case extensions of any initial function. CS may be further refined by requiring that the corresponding NPs match in syntactic and semantic subclass.

To appreciate how our axioms constrain the possible Case Constraints (CCs) languages may present, consider that CS rules out ECC* below as a possible English Case Constraint.

(15) ECC* In batSs of the form [$NP_1$ [V $NP_2$]] interpret $NP_2$ accusatively unless it begins with a vowel, in which case interpret it nominatively

Given that Mary kissed Ellen is derived from (Mary, Ellen, Kiss) in the same way that Ellen kissed Mary is derived from (Ellen, Mary, Kiss) we infer from CS that the second NPs in these Ss must have the same semantic case, contradicting ECC*.

The empirical nature and generality of the three axioms in constraining how natural languages may interpret batSs may be further elucidated by contrasting the ECC with the Japanese CC below. Note that in general, having adopted the axioms, we may avail ourselves of them in stating CCs. For example, the ECC can be given by: "In a batS containing a VP of the form [V NP] interpret that NP accusatively". That the other NP, however presented, is interpreted nominatively follows from this statement plus CE and CD.

(16) Japanese Case Constraint (JCC)[2]

In a batS, interpret an independent NP suffixed -o accusatively if there is one; otherwise interpret some -ga suffixed NP accusatively

The JCC entails, correctly, both that (17a) is not argument ambiguous and that (17b) is.

(17) a. Taroo-ga Hanako-o nagutte
Taroo Hanako hit
"Taroo hit Hanako" *"Hanako hit Taroo"

b. Taroo-ga Hanako-ga suki
Taroo Hanako likes
"Taroo likes Hanako" or "Hanako likes Taroo"

(I am indebted to George Bedell for these examples and much relevant discussion, cf footnote 2).

The JCC differs in several respects from the ECC. First it does not refer to linear order or VP constituency[3] but rather to the system of NP morphological markings. Second, in distinction to the ECC, the JCC permits argument ambiguities in the class of batSs it quantifies over. The reader may compute that the ECC does not allow two interpretations for a batS of the form [$NP_1$ [V $NP_2$]] one of which interprets $NP_1$ nominatively and $NP_2$ accusatively and the other of which does just the opposite.

Third, the existence of Case Constraints for two languages presents an empirical consequence not derivable from the CC for any given L. It says that a structurally identified NP in one L is interpreted by the same case extension as that of some differently identified NP in the other L. And this has empirical consequences in terms of translation equivalences. Thus in a situation in which the Japanese expressions in (17a) have the same denotations as their English glosses and in which the equivalently denoting NPs are interpreted in the same case extensions, it follows that the Japanese S and the English Taroo hit Hanako have the same truth value. That is, the one is judged a translation of the other.

In the actual practice of linguists, in my judgment, it is to a significant extent these translation equivalences on which we rely in determing which NP is "subject" and which "object" in a language we are studying. It is then an advantage of the approach taken here that it entails translation equivalences.

Note in this regard that on the basis of English alone it is quite arbitrary that we assigned $NP_2$ nominative case and $NP_1$ accusative. The opposite assignment would have satisfied the axioms just as well. Comparable remarks obtain for Japanese. But once the CC for one of these Ls is given that for the other ceases to be arbitrary in this respect. Had we chosen to interpret -o marked NPs nominatively... in Japanese then the translation of (17a) would be judged to be Hanako hit Taroo. But it isn't.

Finally we observe that the use of morphological markings on NPs to code semantic case interpretation is very widespread among the world's languages. In one way or another it is used in Ls as diverse as Latin, Warlpiri (Australia), and Tagalog (Philippines). As is well known, batSs in Warlpiri present all six relative orders of the two NPs and $P_2$ with about equal freedom. (18) is a Warlpiri S and (19) gives the WCC.

(18) Ngarrka-ngku karli-∅ jarntu-run
man boomerang trim -past
"The man trimmed the boomerang"

(19) Warlpiri Case Constraint (WCC)

In batSs, interpret a -ngku marked NP nominatively if there is one, otherwise interpret a -∅ marked one nominatively

The WCC is stated with sufficient generality to (correctly) interpret batSs formed from $P_2$s translating "wait for", "accompany", in which one NP is marked -∅ and the other -ku (called "dative" in Warlpiri grammars). Thus both Warlpiri and Japanese show that there is no one to one relation between morphological markings and semantic case assignment. In general in such Ls markings on both NPs must be checked to determine semantic case.

We have so far illustrated VP constituency and NP morphology as indicators of semantic case. Linear order of elements will be crucially referred to in "VSO" languages like Maori (Polynesian), Nandi (Nilo-Saharan), Welsh (Celtic), and Jacaltec (Mayan). There batSs have the form [V $NP_1$ $NP_2$] with $NP_1$ interpreted nominatively and $NP_2$ accusatively. By contrast [V $NP_1$ $NP_2$] Ls like Tzeltal (Mayan), Malagasy and Fijian (Malayo-Polynesian) interpret $NP_1$ accusatively and $NP_2$ nominatively.

Less widely realized perhaps, though discussed in Keenan (1979), is that verbal morphology is also an indicator of semantic case. Schachter (1984) provides an important example for our later discussion from Toba Batak (Malayo-Polynesian; Sumatra).

(20) a. Mang-ida si Ria si Torus
see art Ria art Torus
"Torus sees Ria" *"Ria sees Torus"

b. Di-ida si Torus si Ria
see art Torus art Ria
"Torus saw Ria" *"Ria saw Torus"

$P_2$s in Toba are presented with one of two prefixes (see Schachter for many details), an M- prefix and a D- one. Main clause Ss with M- verbs are interpreted "imperfectively", e.g. the action is presented as continuous or habitual. Main clause Ss with D- verbs are by contrast interpreted "perfectively"--the action is presented as a single undivided whole. So for example speakers tend to reject main clause M- forms where the verb is inherently perfective, such as pukkul 'hit' (though such forms occur in subordinate structures).

I note further that both verb forms above are transitive in requiring two independent NPs. Moreover Schachter argues in convincing detail that regardless of the verbal prefix, the immediately postverbal NP forms a syntactic constituent with the verb. Thus the Toba CC can be given:

(21) Toba Batak Case Constraint (TBCC)

In batS including a constituent of the form [x-V NP] interpret NP accusatively if x = M- and nominatively if x = D-

Thus, in contrast to English, Toba presents one type of batS (D- ones) in which the NP which forms a constituent with the transitive verb is interpreted nominatively rather than accusatively. Crucial here in establishing case assignment is that if the immediate postverbal NP in D- Ss were accusative then (20b) would be translated as "Ria saw Torus", which is in fact incorrect.

We see then that CCs may refer to VP constituency, linear order, and both verbal and nominal morphology. In addition they may also refer to verb agreement paradigms and NP subclass (e.g. definiteness, animacy, etc.).

## 4. Consequences of the Theory

### 4.1 Subjects and Objects

Consider commonplace linguistic generalizations like:

(22) a. Turkish is an SOV language; Hixkaryana is OVS

b. In batSs in English, the subject is the AGENT and the object is the PATIENT or THEME

Aside from a certain looseness in formulation, these generalizations suffer a methodological drawback. Namely, what prevents us from identifying NP occurrences ad hocly as "subject" and "object" so as to make the generalizations true? Clearly to be empirically significant we need some language general definition of these notions.

Within SCT as so far developed a solution to this methodological problem is at hand. Simply replace 'subject' and 'object' in (22) by 'nominatively interpreted' and 'accusatively interpreted' respectively. This move does not resolve all the problems associated with (22) but it does remove the empirical circularity one. It enables us to say e.g. that Toba Batak is neither a VOS language nor a VSO one. Some batSs (M- ones) have a VOS order and others (D- ones) have a VSO order.

The generalization in (22b) is given to emphasize that semantic cases as used here are independent of "theta roles" (AGENT, PATIENT, etc.). It is logically possible that batSs formed from certain verbs associate the nominatively interpreted NP with AGENT and their accusatively interpreted one with PATIENT whereas batSs formed from other $P_2$s would exhibit the opposite association. While I do not know of such cases in English we do find verb pairs such as <u>like</u> and <u>please</u> which (approximately) interchange their theta roles. Viz. the nominatively interpreted NP in <u>John likes this book</u> is associated with the theta role of <u>experiencer</u> whereas in <u>This book pleases John</u> it is the accusatively interpreted NP which is assigned this role. (I am indebted to Aryeh Faltz for discussion of these points).

4.2 <u>Quantifier Scope Ambiguities</u> (QSAs)

I claim here that SCT provides an explanatory account of the existence of QSAs. Observe first that our axioms have been largely concerned with argument structure and not with (semantic) scope. This is because natural languages commonly tolerate scope ambiguities (in distinction to argument ambiguities). Ls could perfectly well mark scope syntactically. Imagine English enriched with a suffix <u>blik</u> which attached to an independent NP in a nuclear transitive S just in case that NP was interpreted as taking the binary relation as argument, that is, just in case it had narrow scope. But generally speaking Ls do not present such scope markers in simple Ss. Why not? I claim this is due to the joint effect of (Q.1) and (Q.2) below:

(Q.1) In nuclear transitive Ss in which at least one of the independent NPs is individual denoting there is no communicative advantage in marking scope since the two scope analyses have the same truth conditions

(Q.2) Scope ambiguities arise as an artifact of presenting Quantified NPs (QNPs, = ones that do not always denote individuals) in the same syntactic format as individual denoting NPs

In support of (Q.1) note that, like batSs in general, elementary batSs such as John kissed David have two scope analyses. On the "David wide scope" analysis it says (paraphrasing the formal statement) that David has the property that John kissed him. On the "David narrow scope" analysis it says that John has the property that he kissed David. These statements are obviously truth conditionally identical. Moreover the lack of truth conditional ambiguity remains (Thm-1) when either NP is replaced by any basic NP or any deictically interpreted NP. E.g. the "noone wide scope" reading of John kissed noone says that noone has the property that John kissed him. The narrow scope reading says that John has the property that he kissed noone.

(23) Thm-1 For all basic F and all individuals I,

a. $I_{nom}(F_{acc}(R)) = F_{acc}(I_{nom}(R))$ and

b. $F_{nom}(I_{acc}(R)) = I_{acc}(F_{nom}(R))$

Thus for what we may take to be the most widespread and earliest learned batSs--those with at most one QNP--there is no reason to mark scope. Scope ambiguities arise only when both NPs in a batS are quantified (and not always then). Thus QSAs are expected in a language in which QNPs may be presented in the same format as individual denoting ones.

I note in further support of the above claim that psycholinguistic research, such as Lee (1986) and Donaldson & Lloyd (1974), strongly supports that Ss with at most one QNP are understood much earlier than those with two. The detailed work by Lee showed both for Mandarin and English that simple singly quantified Ss like "All the pandas are asleep" were understood with adult competence by age 4 (but not age 3). But even by age 8 the child's performance lagged behind that of the adults for Ss with two QNPs.

Compare the view of QSAs presented here with others in the literature. In Montague's work multiply quantified Ss are instances structural homonymity: Syntactically they are derived in more than one way, the distinct derivations being compositionally associated with distinct truth conditions. Montague's analysis then is explanatory in the sense used here, but the explanation is different. The Ss are ambiguous because they are really two (or more) different syntactic structures with the same phonological interpretation. They are thus on a par with classical cases of structural homonymity like Flying planes can be dangerous and The chickens are ready to eat.

Despite the forceful presentation in Partee (1975), however, syntacticians have not in general found it fruitful to assign distinct syntactic analyses to Ss like (9a) Every student kissed some teacher. In partial support for the syntacticians' intuitions here I note that QSAs seem to lack the accidental character of the ambiguities in the classical cases of structural homonymity and they seem to elicit rather different sorts of reactions from native speakers. In the classical examples speakers seem antecedently clear about the two meanings but are surprised to have pointed out to them that the given phonological (or orthographic) string can be analyzed in such a way as to signify either of those meanings. In Ss presenting QSAs however we rather seem to have to teach even sophisticated speakers what the two meanings are.

To the extent then that the structural homonymity approach to QSAs is not independently supported we may say that Montague's explanation is not the correct one.

On more usual treatments within Linguistics, such as May (1977) and Higginbotham & May (1981), multiply quantified Ss like (9a) are not syntactically generated in two or more different ways, but they are assigned two "logical forms" structurally reminiscent of the distinct syntactic representations on Montague's treatment. On this view then scope ambiguities are surprising. The Ss are not syntactically ambiguous but they are semantically ambiguous as though they were. On our view of course these ambiguities are not surprising. They result from the fact that quantified NPs are treated in the same syntactic format as individual denoting ones and the language doesn't mark scope there.

## 4.3 Passives and Reflexives

The Ss in (24) illustrate respectively a reflexive and a passive construction in (Standard) English.

(24) a. Every student shot himself
     b. Every student was shot

The reflexive pronoun himself in (24a) may be interpreted by the function SELF from binary relations to properties given in (25).

(25) $\text{SELF}(R) = \{b: (b,b) \in R\}$

The correct interpretation for (24a) then is given by applying the nominative extension of EVERY STUDENT to SELF(SHOOT).

In (24b) the passive predicate was shot is (a complex) intransitive. It may be derived from the transitive shoot by a (broadly) morphological function from $P_2$s to $P_1$s interpreted by the function PASS from binary relations to properties given below.

(26) $\text{PASS}(R) = \{b: \text{for some } a, (a,b) \in R\} = \text{Ran}R$

The correct interpretation of (24b) then is given by applying the EVERY $STUDENT_{nom}$ to PASS(SHOOT).

We observe that both across and within Ls Passive and Reflexive have very much in common. Morphologically they are both commonly expressed in the verbal morphology. Indeed in many Ls, such as Quechua, Hixkaryana and Russian the same morphology is sometimes interpreted as passive, sometimes as reflexive. Semantically as well they are similar. SELF(R) $\subseteq$ PASS(R) and thus John shot himself entails John was shot. And syntactically, like NPs in general, both Passive and Reflexive combine with $P_2$s to form $P_1$s. But there are a few striking differences in the way Passives and Reflexives are expressed in languages:

(27) Passive in distinction to Reflexive is never expressed by a structurally accusative NP

(An independent NP occurrence is said to be structurally accusative (nominative) if its replacement by a basic NP may be interpreted accusatively (nominatively).)

Thus (27) says that there is no language which is like St.Eng. except that it presents an NP blik with the property that Ss like (28a) are logically equivalent to those in (28b).

(28) a. NP kissed blik    b. NP was kissed

For supporting data on the forms Passives may take see the survey in Keenan (1985). Now the issue is this: Is (27) simply an artifact of our data or is the gap in the expression of Passive principled? The answer is the latter. In fact, unexpectedly, (27) follows from our axioms given how Passive is interpreted. Thus,

(29) Thm-2
 a. There is no basic function F such that $F_{acc}(R)$ = PASS(R), all R
 b. There is a basic function G such that $G_{nom}(R)$ = PASS(R), all R. Namely, G(p) = 1 iff $p \neq \emptyset$, all properties p.

The G given in (27b) is naively just the denotation of some individual or perhaps more exactly someone or something. Now by (29b) Passive is interpreted as a case extension of a basic function, hence the Case Structure axiom applies, whence the structurally accusative blik in (28a) must be interpreted by an accusative case extension of an initial function. But this contradicts (29a). Thus no language with Passive interpreted as indicated can present Passive as a structurally accusative NP.

Theorem 3 below shows that the same argument does not apply to Reflexive.

(30) Thm-3: It is not the case that there is a basic function F and a case extension k such that $F_k(R)$ = SELF(R), all binary relations R.

Thus the CS axiom does not apply and Reflexive is free to be expressed as an NP. Of course one might still wonder why something not interpreted as an extension of an initial NP should be expressible by an NP. This question among others is answered in the next section. Note that in St.Eng. (and in many other Ls, such as Hindi, Korean, and Malagasy) the reflexive pronoun himself is an NP. It occurs in an NP position, it takes the morphological markings of NPs (himself, *heself), and coordinates with basic NPs, as in John criticized both himself and Paul.

4.4 Anaphora

The farthest reaching consequences of SCT and its extensions (below) concern the domain of anaphora. We have already observed that St.Eng. himself in (24a) is interpreted by a function from binary relations to properties which does not extend any basic function. The same is true of the structurally accusative NPs in (31):

(31) a. John criticized himself and noone else, only himself and Paul, noone but himself, everyone but himself, neither himself nor the other students who came late

b. Each student tackled a problem that ___
was chosen by someone other than himself
noone but himself could solve
only himself and the teacher could solve

To account for why these expressions are syntactically NPs we should like to find some non-trivial property they have in common with basic NPs when accusatively interpreted. The property in question is given by the accusative anaphor condition (32b) below. Informally, it will say that an accusative anaphor X satisfies e.g. the condition: "If John hugged the same objects he kissed then John hugged X iff John kissed X". Formally, we define:

(32) For H a function from binary relations to properties,

a. H is a nominative anaphor iff for all R,S and all $b \in E$ if $R^b = S^b$ then $b \in H(R)$ iff $b \in H(S)$

b. H is an accusative anaphor iff for all R,S, b as above if $R_b = S_b$ then $b \in H(R)$ iff $b \in H(S)$

c. H is a proper anaphor iff H satisfies (39a) or (39b) and H is not a case extension of an initial function (restricted to R, the set of binary relations)

d. A NP X is an <u>anaphor</u> iff some independent occurrence of X in a nuclear S is interpreted as a proper anaphor. An anaphor is called <u>essential</u> if all independent occurrences are interpreted as proper anaphors; otherwise it is <u>non-essential</u>

The definitions in (32) have several properties of interest. First it is easily seen that accusative extensions of basic functions satisfy the accusative anaphor condition in (32b). It is just a special case of (33b) below which characterizes which functions from R into P (the set of properties of the model) are expressible by basic NPs.

(33) <u>Case Extensions Theorem</u> (CET)

Let H be a function from R into P. Then,

a. there is a basic function F such that for all R, $H(R) = F_{nom}(R)$ iff for all binary relations R,S and all entities a,b if $R^a = S^b$ then $a \in H(R)$ iff $b \in H(S)$

b. there is a basic F such that for all R, $H(R) = F_{acc}(R)$ iff for all R,S and all entities a,b if $R_a = S_b$ then $a \in H(R)$ iff $b \in H(S)$

As it is easily seen that there are functions from R into P which fail to satisfy (32b) we have found a non-trivial condition which anaphors in St.Eng. have in common with basic NPs and in this sense accounted for why it is reasonable that anaphors are presented as NPs. See also Szabolsci (this volume) for a related perspective here. Note in this regard that what we are calling the nominative extension can be expressed in categorial terms by composing the $P_2$ with the "subject".

A more important feature of the definition of anaphor given in (32) (for the limited range of nuclear Ss considered) is that the definitions in (32a,b,c) are purely semantic. It thus makes non-circular sense to ask of an NP in some L whether it is an anaphor or not. For example, it is easily seen from (31) that St.Eng. presents denumerably many essential anaphors.

Note that most linguistic approaches to anaphor assume that the anaphors (essential or not) can simply be listed. But the above observation tells us that it is not even obvious that the essential anaphors in a L can be syntactically defined. As is well known, even in very tractable formal languages semantically defined subsets of the expressions may not admit of a syntactic characterization. E.g. the set of formulas in ordinary (second order) arithmetic is a recursive set, but the set of logically true formulas is not even recursively enumerable, much less recursive.

Given (32) then we may expect to make empirically non-circular generalizations concerning anaphors. For example:

(34) Anaphor Universal (AU)

All natural languages present NP anaphors

AU puts a certain lower bound on the expressive power of natural languages. As I indicate below however AU cannot be strengthened by replacing anaphor with essential anaphor.

Two further generalizations, which follow from SCT, are:

(35) Basic NPs are not anaphors

This follows immediately from Case Existence. A basic NP occurring independently in a nuclear transitive S must be interpreted by a case extension of the basic function it denotes and thus cannot be interpreted as a proper anaphor. Thus we rule out Ls which would be like English except that John was interpreted as himself when structurally accusative. More deeply,

(36) Anaphor Deixis Link (ADL)

For V a simple $P_1$ and A an anaphor, either [A V] is ungrammatical or A is interpreted deictically

If A is an anaphor then from (35) it is not basic, whence either it is not initial (so [A V] is ungrammatical) or else it is deictic. Given that reflexives like himself in St.Eng. lack a deictic interpretation then we infer from ADL that:

(37) *[Himself V]

Note that GB (Government Binding) theory also predicts (37), and without the assumption that himself lacks a deictic interpretation. GB needs only Principle A of the Binding Theory (BT) and that himself is in their English anaphor list. (37) then follows since himself is not coindexed with a C-commanding NP, there being none. SCT differs here from the BT in that it predicts that there could exist Ls which would be like St.Eng. except that the anaphor himself occurred with intransitive verbs and was interpreted deictically. SCT makes the correct prediction here as there are several such languages.

First, consider the Irish dialect of English. There an office worker might say to another who arrives late "Careful. Himself is in a foul mood today" meaning "The boss is in a foul mood". Thus in addition to its anaphoric interpretation Irish himself may be deictically interpreted to mean "the ranking individual in context".

Lest the Irish example appear "weird" consider the comparable cases in Japanese. There the standard reflexive anaphor jibun may also be interpreted deictically to mean "the individual from whose point of view the utterance is given". That individual will normally be the Speaker if the utterance is declarative, and the Addressee if the utterance is interrogative or imperative. (38) below from Sakaguchi (1985) is illustrative.

(38) a. Hanako-ga jibun-o utagatte-iru
Hanako doubts
"Hanako doubts herself" or "Hanako doubts Speaker"

b. Jibun-ga Hanako-o utagatte-iru
Hanako doubts
"Speaker doubts Hanako" *"Hanako doubts herself"

I may note here that recent work in generative grammar has been much interested in anaphora and little interested in deixis, and in consequence the deictic interpretations of himself in Irish and jibun in Japanese are regarded with modest hostility. I shall take a moment then to emphasize the very widespread facts from several areas of grammar which show that a given expression may have both deictic and anaphoric uses.

Consider first what on the basis of St.Eng. we might be inclined to regard as "essential deictics", i.e. expressions which only have deictic rather than anaphoric interpretations. Prime candidates here would be first and second person pronouns like I and you. But in subordinate clauses many languages may use these terms anaphorically, as in (39) below from Kannada (Dravidian; Bhat (1978)).

(39) Nanage bahuma:na bandideyendu ra:ju tilisidda:ne
me to prize come has thus Raju informed has
"Raju informed (me) that I have won a prize" or
"Raju informed (me) that he (Raju) has won a prize"

Anderson & Keenan (1985) provide a brief survey of deictic expressions used anaphorically, citing examples comparable to (39) from Persian and Aghem (Bantu).

Similarly recall the "sequence of tense" phenomena from traditional grammar. In main clauses tense marking is interpreted deictically in terms of the time of utterance. But in subordinate clauses tense interpretation may be relativized to that in the main clause--that is, it is anaphoric. C. Lee (1985) discusses this phenomenon extensively for Korean. For example, the simple present tense in (40a) is interpreted deictically relative to speaking time, as in its English translation. But the same present tense in the subordinate clause in (40b) is interpreted as co-temporal, i.e. anaphorically, with the main clause time.

(40) a. Mary-ka ca -ɨn -ta
Mary sleep-Pres-Dec
"Mary is sleeping"

b. John-ɨn [$_S$ Mary-ka ca -ɨn -ta ] malha-jəs -ta
John Mary sleep-Pres-Dec say- Past-Dec
"John said that Mary was sleeping"

Anderson & Keenan cite comparable examples from Hebrew.
Returning now to the interpretation of main clause anaphors in Ss like (38), the data present a clear pattern (which holds for Irish as well). When the anaphor is structurally accusative it may be interpreted either anaphorically or deictically. But when it is structurally nominative or the only independent NP in collocation with a $P_1$ it may only be interpreted deictically. Observe that English presents denumerably many anaphors in this pattern. Thus the structurally nominative NP in (41a) has only a deictic interpertation while its occurrence in (41b) has both deictic and anaphoric interpretations.

(41) a. Most of the papers he wrote were excellent
b. Each professor likes most of the papers he wrote

St.Eng. appears to differ then from Irish and Japanese in that it presents lexical items like himself which are essential anaphors. But this lexical property of St.Eng. is very far from universal. Keenan (1976) cites N. Frisian (Fering dialect), Middle English(!) and Gilbertese as Ls lacking essential (reflexive) anaphors. Further examples are lai (Melanesian), Tahitian and Fijian (shown below):

(42) a. a mokuti koya o ira kece
past hit 3sg pl all
"Everyone hit himself" or "Everyone hit him"

b. a mokuti jone o koya
past hit John 3sg
"He hit John" *"John hit himself"

In one respect here however the Binding Theory might appear to make a better prediction than SCT. Note that while SCT predicts (43a) it does not predict (43b) even given that St.Eng. himself is a non-deictic anaphor.

(43) a. *Himself walks
b. *Himself kissed every student

But this lack of prediction is as it should be. (43a) should follow from general principles given the non-deictic nature of St.Eng. himself. There is nothing in (43a) for it to be anaphoric to. But this is not the case in (43b). As (32a) makes clear, it is logically sensible to have nominative anaphors. Indeed the interpretative mechanisms independently needed for St.Eng. permit (43b) to be interpreted with the same meaning as Every student kissed himself. Simply interpret (43b) by first applying SELF to KISS, which we may do as himself is structurally nominative and such NPs may apply to binary relations on "subject narrow scope" readings, and then apply the accusative extension of EVERY STUDENT to the result. We obtain <u>true</u> just in case the students are a subset of those objects bearing the KISS relation to themselves.

Thus (43b) is logically sensible on an anaphoric interpretation of <u>himself</u> and more should be needed to block it than in the case of (43a). Moreover the fact that St. Eng. does not allow (43b) is non-circularly seen to be significant, as logically it could.

To capture the fact in (43b) we might consider enriching the axioms of SCT. A plausible candidate here is:

(44) <u>Nominative Reference Condition</u> (NRC)

> In nuclear transitive Ss structurally nominative NPs are always interpreted as nominative case extensions of initial functions

Basically the NRC says that the referential possibilities of the only NP in nuclear unary Ss are extended to the structurally nominative ones in nuclear binary Ss. The NRC then has the effect of blocking nominative anaphors. I know of no unequivocal counterexamples to the NRC. Moreover the NRC countenances certain cases of anaphora which are not reasonably handled within the Binding Theory. Recall in this regard the D- Ss in Toba Batak in which the structurally accusative NP is higher in the syntactic tree than the structurally nominative one. SCT enriched by NRC predicts the correct distribution of anaphors in this case:

(45) a. [[Di- ida si Torus] dirina]
perf-see art Torus self
"Torus saw himself"

b. *[[Di- ida dirina] si Torus]
perf-see self art Torus

Despite the apparent empirical adequacy of NRC however I am reluctant to adopt it as an axiom of SCT, at least in our current state of knowledge. The main reason for hesitation here is that there seems to me no strong positive reason why it <u>should</u> be true. To be sure, generalizing the referential autonomy of intransitive NPs to a fixed NP in a transitive S has the advantage of providing a uniform "anchor" for anaphors. But generalizing to the structurally accusative NP would have the same advantage. Recall in this regard the ergative-absolutive case marking systems in Ls like Warlpiri (Georgian, Tongan, etc.). In these Ls the structurally accusative NP in a batS is marked in the same way as the only NP in an intransitive S, and the structurally nominative NP has a special marker (the "ergative"). So these Ls have generalized the NP markings from intransitives not to the nominative NP in transitives, as is done in Ls like Latin and Russian, but rather to the structurally accusative NP. Why could there not exist referentially ergative languages just as there are morphologically ergative languages? Perhaps more research will reveal that there are. And if not, more thought is needed to reveal why not.

I conclude here with a proper statement and motivation for the Case Existence axiom. The discussion has some independent interest as it provides a direct characterization of individuals rather than the one given earlier which defines them in terms of entities.

## 5. The Argument Structure Theorem (AST)

The idea behind the Case Existence axiom and, in effect, the notions of "subject" and "object" it induces, is that there are only two ways in which the interpretations of basic NPs in intransitive contexts can be uniformly extended to account for their interpretations in transitive contexts in such a way that their meanings are preserved.

To build up to a formalization of this idea let h be a function which sends each basic function F to an extension h(F) of F which takes binary relations to properties. We investigate what conditions h should meet. Note that even in a tiny universe with just two elements there are four properties and 16 binary relations and thus $4^{16}$ = 131,072 functions from binary relations into properties. So there are that many ways any given basic function F can be extended and thus the number of functions h which simultaneously extend all the basic functions lies in the millions. But some of these ways would tell us, for example, that the basic function EVERY BOY would send KISS to the set of objects which didn't kiss a single boy. These functions then do not, intuitively, preserve the meaning of EVERY BOY.

Clearly a first condition that an acceptable extending function h must meet is that it preserve the logical relations among the basic functions. E.g. since NOT EVERY BOY is the boolean complement of EVERY BOY we want that h(NOT EVERY BOY) be the boolean complement of h(EVERY BOY). Thus we want h to be a (complete) homomorphism (c-hom). [Note here that [R --> P], the set of functions from binary relations into properties, is a (complete, atomic) boolean algebra with the operations defined in the obvious pointwise way].

But merely preserving the logical relations in this way is not sufficient. From Keenan & Faltz (1985) we know that any way of mapping the individuals into [R --> P] extends to a c-hom. We must then place requirements on how h behaves at the individuals.

The most obvious requirement is that h must treat all individuals in the same way. E.g. it could not both send John to a function which sent KISS to the set of objects which kissed John and also send David to a function taking KISS to the set of objects which David kissed or to the set of objects which kissed themselves. Thus h cannot really tell what individual it is looking at, and this amounts to saying that h is *automorphism invariant* (AI). A general definition of this notion is given in Keenan & Moss (1984). For present purposes it amounts to the following: Let n be an automorphism of the universe E (i.e. a one to one function from E onto E). Then n extends to an automorphism on all the denotation sets in an obvious way. In particular it sends a property p to $\{n(b):b \in p\}$, an individual $I_b$ to $I_{n(b)}$, and a binary relation R to $\{(n(b),n(d)): (b,d) \in R\}$. Then to say that h is AIis to say that $h(n(I))(R) = n[h(I)(R)]$, all individuals I, all binary relations R, all automorphisms n of E.

In effect this algebraic sounding condition guarantees that e.g. John doesn't suddenly take on the denotation of Fred in a transitive context.

But being an AI c-hom is still not a sufficient condition on h. It would allow for example that h(John) sends KISS to the set of objects that didn't kiss John. So we want to require that h preserve substantive properties of the individuals, not merely respect their distinctness (which is what is imposed by the AI condition).

What are these "substantive" properties? The most obvious is given by the logical equivalence below:

(46) a. John walks but doesn't talk
  b. John walks and it is not the case that John talks

That is, individuals, in distinction to other basic functions, respect the logical structure of their predicates. Thus we want the value of h at an individual I to be a (complete) homomorphism. This will guarantee for example that (*to*) *neither hug nor kiss John* will be interpreted as the same property as (*to*) *not hug John and not kiss John*.

Interestingly however this last condition is still not quite sufficient. Observe that the property of being a c-hom from P into {0,1} *characterizes* the set of basic functions which are individuals. That is, a basic function is provably an individual iff it is a c-hom. But this characterization fails for functions from R into P. Specifically there are many c-homs from R into P which are not, intuitively, proper extensions of individuals. For example the function SELF defined in the text is a c-hom: e.g. *to hug and kiss oneself* expresses the same property as *to hug oneself and kiss oneself*. (In fact SELF is an AI c-hom and uniquely characterized by that property). But clearly extending an individual so that it was interpreted as SELF in transitive contexts would not preserve the meaning of that individual. Thus a further condition on h is required.

In the present context there are several equivalent ways of giving this further condition. The one I prefer both for its intuitive nature and for purposes of extensions of the current treatment is the following: Observe that the set of individuals *individuates* P, the set of properties. That is, whenever p and q are distinct properties then there exists an individual I such that $I(p) \neq I(q)$. In general where K is a set of functions from A into B we shall say that K _individuates_ A iff whenever a and a' are distinct elements of A then there is a function k in K such that $k(a) \neq k(a')$. And we shall require that the set of extensions of individuals individuates **R**, the set of binary relations. Writing 2 for {0,1} we now define:

(47) _Def_: A function h from [P --> 2] into [R --> P] is a _logically faithful embedding_ iff

(a) h is a complete homomorphism and
(b) h is automorphism invariant and
(c) h preserves the _logical character_ of the inds, i.e.

(i) {h(I):I an individual} individuates **R** and
(ii) for each individual I, h(I) is a c-hom

(48) _The Embedding Lemma_

A function h from [P --> 2] into [R --> P] is a logically faithful embedding iff either

a. for all basic F, $h(F)(R) = \{b:F(R^b) = 1\}$ or

b. for all basic F, $h(F)(R) = \{b:F(R_b) = 1\}$

Let us (here) write TYPE-1 for the set of functions which take properties to truth values and binary relations to properties. (So the domain of a type-1 function is $P \cup R$ and its range is included in $\{0,1\} \cup P$). Then,

(49) _Def_: A function K from [P --> 2] into TYPE-1 is a _logically uniform extension_ iff

a. K(F) extends F, all basic F and

b. the function K* from [P --> 2] into [R -->P] given by $K^*(F) = K(F) \upharpoonright R$ is a logically faithful embedding

(50) a. NOM is that function from [P --> 2] into TYPE-1 defined by: $NOM(F)(R) = \{b:F(R^b) = 1\}$ and

b. ACC is that function from [P --> 2] into TYPE-1 defined by: $ACC(F)(R) = \{b:F(R_b) = 1\}$

(51) _The Argument Structure Theorem_ (AST)

NOM and ACC are the only logically uniform extensions from the set [P --> 2] of basic functions into TYPE-1

_Remarks_ The Embedding Lemma extends in the obvious way to the case where h takes basic functions into $[R_{n+1} \text{ --> } R_n]$, there being n+1 logically faithful embeddings in this case. The extensions of the semantic cases NOM and ACC however are not so trivial once even three place relations are considered. The general constraint here is that all scope ambiguities must in principle be allowed without inducing argument ambiguities, and this turns out to impose some additional structure on the class of semantic cases.

## Footnotes

1. These are the only two possibilities when the two NPs act independently with the $P_2$. Another option arises however by interpreting the pair of basic functions as a single operator sending binary relations directly to truth values. Under this rubric for example will fall branching quantifier analyses. This option is ignored here but discussed in detail in Keenan (1987b).

2. I simplify here in two respects which do not materially affect the later discussion. First in certain cases -mo is used instead of -ga. Second, normally in main clauses one of the NPs will be topicalized, i.e. fronted with its -ga or -o replaced by -wa. Crucially for our examples the result of topicalizing either NP in double -ga Ss preserves the argument ambiguity. The two Ss only differ with regard to which NP is "topic".

3. Hinds (1973) argues that no NP in transitive Ss in Japanese forms a syntactic constituent with the verb to the exclusion of the other.

## References


1. Anderson, S.R. & E.L. Keenan (1985) "Deixis" in Language Typology and Syntactic Description. T. Shopen (ed) CUP

2. Barwise, J. & R. Cooper (1981) "Generalized Quantifiers and Natural Language" in Linguistics and Philosophy 4, 159-219

3. van Benthem, J. (1986) Essays in Logical Semantics Reidel

4. Bhat, D.N.S. (1978) Pronominalization. Poona, India Deccan College

5. Donaldson, M. and L. Lloyd (1974) "Sentences and Situations: children's judgments of match and mismatch" in Current problems in Psycholinguistics F. Bresson (ed) Paris. CNRS

6. Higginbotham, J. & R. May (1981) "Questions, Quantifiers and Crossing" in The Linguistic Review 1. 41-79

7. Hinds, J. (1973) "On the Status of the VP Node in Japanese" in Language Research 9.2 44-57

8. Keenan, E.L. (1976) "The Logical Diversity of Natural Languages" reprinted in Keenan (1987a)

9. --- (1979) "On Surface Form and Logical Form" reprinted in Keenan (1987a)

10. ---(1985) "Passive in the World's Languages" in Language Typology and Syntactic Description T. Shopen (ed) CUP

11. ---(1987a) Universal Grammar: 15 Essays Croom Helm

12. ---(1987b) "Unreducible n-ary Quantification in Natural Language" in Generalized Quantifiers: Linguistic and Logical Approaches Reidel 109-150.

13. Keenan, E.L. & L. Faltz (1985) Boolean Semantics for Natural Language Reidel

14. Keenan, E.L. & L. Moss (1984) "Determiners and the Logical Expressive Power of Natural Language" in WCCFL III M. Wescoat et al (eds) Stanford Linguistics Association, Stanford University

15. Keenan, E.L. & J. Stavi (1986) "A Semantic Characterization of Natural Language Determiners" in Linguistics and Philosophy 9 253-326

16. Lee, C. (1985) "Temporal Expressions in Korean" to appear in the Proc. of the Pragmatics Conference, Viareggio, Italy

17. Lee, T. (1986) Studies on Quantification in Chinese PhD Diss. UCLA

18. May, R. (1977) The Grammar of Quantification PhD Diss. MIT

19. Montague, R. (1973) "The Proper Treatment of Quantification in Ordinary English" in J. Hintikka et al (eds) Approaches to Natural Language Reidel

20. Partee, B. (1975) "Montague Grammar and Transformational Grammar" in Linguistic Inquiry 6. 203-300

21. Sakaguchi, M. (1985) "Coreference Relations in Japanese" MA Thesis. Dept. of Linguistics, UCLA

22. Schachter, P. (1984) "Semantic Role Based Syntax in Toba Batak" in P. Schachter (ed) UCLA Occasional Papers in Linguistics No. 5. Dept. of Linguistics, UCLA

23. Szabolsci, A. this volume