

TOUGH SUBJECTS ARE THEMATIC*

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1. Introduction: Background

Analyzing *tough* constructions, such as in (1), has been a challenge throughout the history of generative linguistic research (Rosenbaum 1967, Postal 1971, Postal and Ross 1971, Chomsky 1972/1977, 1977, 1981, 1993, Lasnik and Fiengo 1974, Browning 1987, Tellier 1991, Kawai 1992, among others).

- (1) a. The exam was hard/easy/a breeze/difficult/impossible to pass.
 b. The ballet was boring/amusing/great/a marvel/a pleasure to watch
 c. The job was impossible/painful/tiresome/depressing/exhausting to do.
 d. The person is annoying/terrible/important/nice to deal with.
- (2) a. The exam was hard/easy/a breeze/difficult/impossible.¹
 b. The ballet was boring/amusing/great/a marvel/a pleasure.
 c. The job was impossible/painful/tiresome/depressing/exhausting.
 d. The person is annoying/terrible/important/nice.

Of the many questions that the constructions pose, this study deals with whether the matrix subject (*tough*-subject, henceforth) is thematic.² This paper argues for the 2-hood of *tough*-subjects, with Lasnik and Fiengo 1974, Chomsky 1977, Tellier 1991, Kawai 1992, and Hornstein 2001 (to be referred to as the 2-subject

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¹We will not consider a possibility where the infinitival complement deletes after the surface matrix subject raises.

²In this study, I will adhere to the standard GB-/Minimalist view of 2-roles/reasons (Chomsky 1981, 1986, 1995, Chomsky and Lasnik 1992), although, as Jacobson (1992) puts it, “the notion of “assigning a 2-role” is notoriously difficult to pin down.”

approach (of *tough* constructions)). Such data as in (2) appear to be decisive for this position; the matrix subjects in both (1) and (2) bear THEME role of the *tough* predicates.³

Yet, standardly, the subject of a *tough* construction is assumed as non-thematic (non-2 subject approach (of *tough* constructions)) (Chomsky 1981, 1982, 1993, Browning 1987, Cinque 1991, and references cited there), mainly due to the following observations:

- (3) a. Each *tough*-sentence has an *it*-extraposition counterpart.
- b. The *tough* class predicates with an infinitival complement are distinct from their respective complementless counterparts.

- (4) a. It was hard/easy/a breeze/difficult/impossible to pass the exam.
- b. It was boring/amusing/great/a marvel/a pleasure to watch the ballet
- c. It was impossible/painful/depressing/exhausting to do the job.
- d. It was annoying/terrible/important/nice to deal with the person.

- (5) a. To pass the exam was hard/easy/a breeze/difficult/impossible.
- b. To watch the ballet was boring/amusing/great/a marvel/a pleasure
- c. To do the job was impossible/painful/depressing/exhausting
- d. To deal with the person was annoying/terrible/important/nice.

First, we will consider (3a), as illustrated in (4), a familiar phenomenon described in terms of *IT*-replacement transformation by Rosenbaum (1968).⁴ Assuming that the respective examples of (1a-d) and (4a-b) involve an identical 2-structure, the presence of expletive *it* in (4) is generally taken as evidence for the non-2-hood of *tough* subjects.⁵ Under this approach, THEME of a *tough* predicate can be

³Naturally, a question arises as to what kind of 2-role is given to the infinitive in (1), if the matrix subject assumes THEME-role. Elsewhere (1992) I argued that the infinitives in (1) are an adjunct modifier of their respective matrix predicates, much like infinitival relatives; in this study, I maintain the essence of this position.

⁴This cannot be the core property of the constructions, since the *pretty* class predicates (i) and degree constructions (ii), with their 2-subjects, successfully host missing objects (Lasnik and Fiengo 1974).

⁵Given that the matrix subjects in (1) are interpreted as the embedded objects, a *tough*-subject is standardly assumed to “originate” in the embedded object, although the exact mode of displacement remains unsettled: e.g., via A-movement (Postal and Ross 1971, among others), and via lexical insertion in-situ (Chomsky 1980, 1981). Supporting arguments, as in (i), for the non- θ -subject approach depend upon two rather dubious assumptions: (a) the *tough* subject and the missing object establishes an A-chain; and, (b) an A-chain may have one and only one θ -role/position (Chomsky 1986, 1993).

assigned to the matrix subject, as in (2) and (5), or to the “extraposed” infinitival complement via expletive in the matrix subject position, as in (1); in the latter case, the matrix subjects bear the relevant 2-role assigned by the embedded predicates. For convenience, we will refer to the *tough* predicates in (4)/(5) as *IT-tough*, to those in (1) as *Missing Object (MO)-tough*, and those in (2) as *2-tough*. In other words, the crucial difference between the 2-subject approach and the non-2 subject approach is that the latter posits two distinct lexical entries for *IT-/MO-tough* and *2-tough*, whereas the former posits a single lexical entry.

However, (3a) is far from decisive. As Postal and Pullum (1988) show, expletive *it* can occur in strictly subcategorized positions, as shown in (6).

- (6) a. I dislike it that he is so cruel.
 b. I didn't suspect it for a moment that you would fail.
-

- (i) a. Idiomatic interpretation is available.
 b. Tabs are easy to keep on linguists.
 c. Advantage would be easy to take on Mary.
 d. Accusation against himself would be harder for the president to discuss.

Note that (ia) may support the ‘derived’ status of *tough*-subject, if idioms form a chunk at LF via A-reconstruction, a process whose existence remains in dispute (cf. Chomsky 1993, Lasnik 1999), and if multiple- θ -assignment to an argument is prohibited. Conceptual, as well as empirical, advantages of a theory that allows multiple θ -assignment to an argument are discussed in Bošković 1994, Lasnik 1995, Hornstein 1999, the position I subscribe to in this study. If A-movement can target a θ -position, then (i) has little to say about the θ -hood of the matrix subject.

I believe that a *tough* subject is base-generated in-situ (or, more precisely, in the predicate (AP/DP) internal subject position (Tellier 1991, Kawai 1992, among others)), not moved from the embedded clause (e.g., Hornstein 2001), since a *tough* subject and its gap do not form an A-chain. Predicate raising is not allowed with raising constructions involving an A-chain (iia), but permissible with *tough* constructions (iib) (Kawai 1992, Harley 2000).

- (ii) a. * [How likely to win] is John?
 b. [How difficult to avoid] was the problem?
 (iii) Documents about themselves are easy for the inspectors to shred.
 (iv) Documents about themselves would be too important for the inspectors to shred.

Consequently, I assume that the connectivity effects, as in (iii), involve anaphor licensing by a non-c-commanding antecedent, and that anaphor interpretation involve LF (A'-) reconstruction parallel to reconstruction under topicalization (Kawai 1992). This is on the right track, I believe, since connectivity effects can also be observed in missing object constructions with a thematic matrix subject, as in degree constructions (iv).

- c. I resent it greatly that you didn't call me.
 - d. It will cost me \$2,000 to acquire this hockey card.
- (7)
- a. I dislike his cruelty.
 - b. I didn't suspect your success for a moment.
 - c. I resent your indifference greatly.
 - d. This hockey card will cost me \$2,000.

Following the standard assumption that strictly subcategorized positions are 2-positions, the respective pairs in (4) and (5) plausibly share an identical 2-structure. The presence of expletive *it* is insufficient to establish the non-2-hood of *tough* subjects. In short, (3a) says little about the (non-) 2-hood of the matrix subject in a *tough* construction.

Now, consider (3b): namely, the *tough* class predicates with an infinitival complement appear to be distinct from their respective complementless counterparts. This claim is based upon the observation that the interpretation of the *tough* class predicates is distinct with and without the infinitival complement, as illustrated in (8a-c).

- (8)
- a. John is tough (to convince him to fight).
 - b. The meat is tough (to hold up the desk with because it's too soft).
 - c. Mary is easy (to invite for a church meeting).
 - d. The exam is difficult (to do well on).

However, what we are witnessing in (8a-c) is idiomatic vs. non-idiomatic use of *tough/easy*, which arises due to the open-endedness of the interpretation of some *tough*-class predicates (cf. Jones 1985, Kawai 1992). Such predicates as *difficult*, on the other hand, do not show the same effects; or, at least, the effect is much smaller in comparison (8d).

Even still, the relevance of the predicates, such as *difficult* and *hard*, are dismissed, since it has been noted that (9b) does not entail (8a), nor (9), (9a).

- (9)
- a. The exam was hard.
 - b. The exam was hard to fail. (= it is easy).
 - c. Freedom of Speech is illegal.
 - d. Freedom of Speech is illegal to restrict. (= it is not illegal).

The subjects in (9b/d) do not appear to be selected by their respective predicate, unlike those in (9a/c). This shift in interpretation in 2- and *MO-tough* class predicates is taken, by the proponents of the non-2 subject approach, as crucial

evidence for dual lexical entries of *tough*-class predicates: one with a subject 2-role and without an infinitival complement (*2-tough*) and one without a subject 2-role and with an infinitival complement (*MO-tough*).

If this explanation is indeed correct, then (2) has no bearing on the paradigm in (1)/(4)/(5), since the former involves a distinct type of predicate. As far as I know, this is perhaps the only unanswered counter argument against the data in (2), to the best of my knowledge; and, thus, it would constitute significant evidence against the 2-subject approach of *tough* constructions. We will refer to the phenomenon in (9) *entailment problem*. In the next section, I will argue that a single lexical entry of *tough* suffices for both *2-* and *MO-tough* predicates, thereby nullifying the relevance of the entailment problem.

2. Predictability of Interpretation Shift in Entailment Problem

In this section, we will argue that the entailment problem illustrated in (9) does not justify dual lexical entry of *tough*-class predicates because the shift is predictable. The interpretive shift as in (9) is rather common; it is found with scalar adjectives (10) (Keenan and Faltz 1985), *grow* (11), and *cost* (12), among others.⁶

- (10) a. John is short.
 b. John is short for the adult norm.
 c. John is short for a basketball player.
- (11) a. The kingdom grew.
 b. The kingdom grew large/strong/...
 c. The kingdom grew weak.
- (12) a. The book cost me \$50 dollars.
 b. The book cost me \$50 dollars to buy/own/write/...
 c. The book cost me \$50 dollars to discard/get rid of/give away...

In (10)-(12), the b-examples, but not the c-examples, entail the respective a-examples, typical entailment problems. In spite of this fact, we do not need two

⁶*Cost*-class predicates behave similar to *tough*-class predicates (Jones 1985). They host an expletive subject (ia) and an MO-infinitive (ib); and it also exhibits connectivity effects (ic):

- (i) a. It costs me \$50.00 to rent this movie.
 b. This movie costs me \$50.00 to rent.
 c. Pictures of themselves naked would cost the politicians their political careers.

lexical entries for the predicates in the a- and b-examples, since the shift is predictable.

Observe that the interpretation of the modifiers, such as *for a basketball player* in (10), *weak/strong/...* in (11), and infinitives in (12), are integral parts of the interpretation of those predicates; thus, the interpretation of the modifiers, when covert, is still present; in such cases, the interpretation of the covert modifier is predictable.⁷ For example, without an overt modifier, *is short* is measured against the normative height in the discourse; in (11) *grow* bigger, longer, etc., but not shorter or smaller; and (12) *cost* is concerned with a canonical transaction — such as buying, owning, but not shredding or destroying. We will refer to this sort of interpretation as *default interpretation*.

While default interpretations for the predicates in (10)-(12) seem to be under-defined, they are robust enough to exclude those that are listed in the c-examples of (10)-(12). From this, we describe the interpretive shift as in (13).

(13) Interpretive shift

The interpretive shift of the entailment problem is observed, when the interpretation of the overt modifier of the relevant predicates is markedly distinct from the default interpretation.

Naturally, a question remains as to how a default interpretation arises, which is beyond the scope of this paper; I suspect that the question will have to be settled outside of the domain of Narrow Syntax (NS), but somewhere in the C-I system, or, some other domain(s) of cognition.

At the same time, it is important to acknowledge the fact that grammar (and the C-I system) interacts with such knowledge relevant to “conceptual knowledge.” For example, denominal verbs seem to demand a notion of “canonical use”: namely, “if an action is named after a thing, it involves a canonical use of the things” (Kiparsky 1997: p. 482):

to tape means “to apply or use” tape in any way whatever that is consistent with ... [a canonical (conventional, generic) use of the noun], for example, to

⁷Some predicates accept contextually defined interpretations of the modifier, as in (i). Null Complement Anaphora (NCA) requires a linguistic antecedent; a discourse antecedent is not sufficient for NCA licensing (Hankamer and Sag 1976). Below, we will ignore cases of NCA.

- (i) a. Mary is short for a basketball player, and Bill is, too.
- b. That old car cost me \$50 to get rid of, and that piano cost me even more.

fasten, tie, bind, cover, support, record, or measure with tape; but it cannot refer to ad hoc uses of tape: e.g. using a roll of tape as a paperweight is not “taping” the paper, using a piece of tape to strangle someone is not “taping” that person, etc.

Whether Kiparsky's observation on denominal verbs is directly related to the entailment problem discussed here is immaterial; for our purposes, it suffices to acknowledge the existence of default (or canonical) interpretation.

For concreteness, I will use the following meaning postulates to express the interpretation of the predicates in our interest; for ease of presentation, I will use short-hand notations expressing only the relevant information.⁸

- (14) a. **short'** [**x, for-y**] : lower height comparative to the normative value y
 default(y): normative height (for a group that x belongs to).
- b. **grow'** [**x, direction-y**]: change its state in direction y
 default(y): positive (y)/upward(y)/increasing(y)/...
- c. **cost'** [**x, y, purpose-z**]: resource(s) y required for z
 a. default(y): resources (y)/currency(y)/effort(y)/life(y)/...
 b. default(z): to own(z)/accomplish(z)/use(z)/...

In (14a), *short'* stands for a relation in which an individual entity x has smaller value for its height than the value assigned to y , either overtly specified or set as default: namely, normative height for the group to which x belongs, or the

⁸See Wheeler 1972, 1978, Keenan and Faltz 1985, and Kawai 1989 for more detailed formulations of scalar adjectives. Concretely, (ia) is expressed by Wheeler as (ib), and by Kawai as (ic) (The formulas simplified somewhat).

- (i) a. John is much taller than Fred.
 b. Tall (John, (\hat{y})(Tall (y , (\hat{w})(w =Fred)))) & John ε (\hat{y})(Tall (y , (\hat{w})(w =Fred)))
 c. Taller (John, **Norm**({ s | Taller (s , Fred) })

(ia) states that *John* is tall for someone who is taller than *Fred*, and (ib), that *John* is taller than the norm of the people taller than *Fred*. Keenan and Faltz are reluctant to view scalar adjectives as inherently comparative, as done by Kawai (1989). This is because of their strict adherence to compositionality; consequently, *tall* and *tall for* are two distinct lexical entries, a highly redundant — and, thus, undesirable — solution. I very much doubt that *tall* can be defined without comparison, due to its scalar nature.

normative height of the relevant context. Observe that a single lexical entry for each predicate (14) is sufficient for describing the interpretative shifts observed in (9). Granted that one could posit two distinct lexical entries for each predicate, such an approach misses an important generalization: namely, the predictability and systematicity of the interpretation shifts.

The central claim of this study is that the interpretive shift observed in *tough*-class predicates is of the same phenomenon, and that, thus, the same explanation extends to the cases with *tough*-constructions. The format in (14) readily extends to *tough*-class predicates, as in (15), where y is an experiencer, and R , a relation.

- (15) a. $\lambda R \lambda y \lambda x$ [**impossible'** (x) (y) (R)]
 b. **easy'** [x , **for- y** , R]: small degree of challenge for y in relation R :
 default(y): human(y); default(R): accomplish.
 c. **difficult'** [x , **for- y** , R]: high degree of challenge for y in relation R :
 default(y): human(y); default(R): accomplish.
 d. **depressing'** [x , **for- y** , R]: cause distress for y in relation R :
 default(y): human; default(R): activity
- (16) a. The exam is difficult to fail.
 b. This rock is impossible for me to move, and that one also is impossible.
 c. The exam is difficult.

(15a) states that there is no possible world in which y stands in the R relation to x (Jacobson 1992).⁹ As was in the case of (14), in the absence of an overt infinitive or null complement anaphora, (16a) and (16b), respectively, the default interpretation — i.e., *to do well on, pass*, among others — provides R with an appropriate interpretation (16c).

With (15), we can derive the desired interpretations with and without the overt infinitive, thereby rendering unnecessary dual lexical entries for *tough*-predicates. In other words, the entailment problem does not motivate the dual lexical

⁹The notations in (15) do not express two crucial properties of the constructions: namely, the experiencer y obligatorily controls the agent in R ; and x must be in a lexically governed position (Kawai 1992). I believe that those two properties follow from the properties of the computational system, thus are unnecessary to be listed in lexicon.

representation of *tough* class predicates. Consequently, (2) must be taken as evidence against the non-2 subject approach to *tough* subject.

If the conclusion that we have reached above is essentially correct, then the alleged lack of selection relation between the subjects and *tough* class predicates, discussed in Section 1, demands an explanation. If the matrix subject of a *tough* construction is indeed selected by the matrix predicate, some evidence for it must be available. In what remains, I will briefly argue that contrary to the standard belief, there is in fact a 2-relation established between them. Consider (17).

- (17) a. * Cars are illegal to park here.
- b. * Bill is possible to talk to only at breakfast.
- (18) a. Performance-enhancing drugs are illegal to take before games.
- b. Cheap accommodations are possible for the organizers to arrange.
- (19) a. We prevented it from being obvious that things were out of control.
- b. * It₁ was tough to prevent *t*₁ from becoming obvious that things were out of control.
- c. The animal₁ was now quite large, and it₁ was tough to prevent *t*₁ from escaping.

In the past, it has been argued that such predicates as *illegal* and *possible* do not host a *MO*-infinitive (17) (e.g., Flickinger and Nerbonne 1992). However, they do host an *MO*-construction, as shown in (18), insofar as the *tough*-subject satisfies the selection restriction: *drugs* are illegal, but *cars* are not; *Bill* is not possible, but *cheap accommodations* are. This fact is predicted by the 2-subject approach, but left unaccounted for by the non-2-subject approach. Further, Postal and Pullum (1988) report that expletive *it* cannot be the subject of a *tough* construction (19b), even though it can appear in the embedded complement position (19a), and the referential *it* can licitly be in the matrix subject position (19c). If the matrix subject has no selection relation with a *tough*-class predicate, then the observed contrast in (19) is not expected.

To sum up, we saw, in this section, that the shift of the interpretation with and without an overt infinitive — the entailment problem — does not justify the dual lexical entries. If *2-tough* and *MO-tough* are thematically identical (i.e. a single lexical entry with an optional infinitival modifier), then the existence of the former straightforwardly supports the 2-subject approach. The following picture emerges: viz., the modifier (whether over or covert) is an integral part of the thematic property of the predicates; and in the absence of an overt infinitive, an appropriate interpretation is provided either at LF (or SEM) or in the C-I system.

3. Implications

This study argued for a single lexical entry for *2-tough-*, *MO-tough-*, and *IT-tough-* type predicates, contrary to the standard assumption, thus supporting the 2-subject approach to *tough* constructions. The result of this study has a wide range of implications. Due to space limitation, I will single out the question regarding the status of 2-role licensing within Minimalism (cf. Chomsky 1995, 2000, 2001, Lasnik 1999, among others).

Given the result of this study, Chomsky's (1993) argument against the all-at-once licensing of 2-roles (Satisfy) at D-Structure is weakened. Chomsky's main argument for the LF licensing of 2-roles crucially relies upon the non-2-hood of the subject of *tough* predicates. He states that

[a *tough* subject] occupies a non-2-position and hence cannot appear at D-structure. Satisfy is therefore violated ... More recent work has brought forth other cases of expressions interpretable at LF but not in their D-structure positions... along with other reasons to suspect that there are generalized transformations ... If so, the special assumptions underlying the postulation of D-Structure lose credibility.

As a result, "we are led to dispense with the level of D-Structure and the "all-at-once" property of Satisfy, relying in its place on a theory of generalized transformations for lexical access." If the result of this study is correct, however, a *tough* subject does not violate Satisfy, being Merged at the predicate internal thematic subject position.

Granted, the "all-at-once" property of Satisfy cannot be maintained, once we accept the strictly derivational approach to phrase structure building and the elimination of D-Structure as an interface level. This does not automatically support the LF-licensing of 2-roles, however; we can recreate the effect of D-structure by applying Satisfy derivationally, i.e., in a "step-by-step" fashion. That is, each 2-role may be licensed (checked) at the point of Merger (Lasnik 1999, Hornstein 2001, Kawai 2001, among others).

It is worth noting that the standard minimalist treatment (Chomsky 1993, 1995, 2000) of the 2-theory cannot handle *tough* constructions, independent of the 2-hood of the matrix predicate. Consider what Chomsky (2000) calls "the 2-theoretic principle (6)," as in (20).

(20) Pure Merge in a 2-position is required of (and restricted to) arguments.¹⁰

Observe that (20) does not rule out Pure Merged of a *tough* subject in situ (a non-2 position), since it is not concerned with non-2 positions. Yet, it fails to explain why the *tough* subject must be merged into the matrix subject position; it predicts that the subject is merged into the embedded object position, instead.

Suppose, instead, that the embedded object is A-moved to the matrix subject (*tough*-movement). Pure Merge of the embedded object is required by (20); yet, *tough*-movement (A-movement) of the embedded object will result in a 2-violation. This is so, because under Chomsky's (1995) analysis, 2-roles are licensed only under a relevant configuration; chains are not a 2-configuration; hence, A-traces are left unlicensed at LF, a problem recognized by Lasnik (1999). In short, assuming the non-2 subject approach, *tough* constructions cannot be generated under Chomsky's (1993, 1995) treatment of 2-roles.

A solution to this problem, I believe, comes in two parts: namely, the 2-subject approach of *tough* constructions advocated here and Lasnik's (1999) 2-checking approach, where a 2-role is checked *at the time of Merger* under a relevant configuration. (The latter approach is entertained, but rejected, by Chomsky (2001)). Given the result of this study, Merger of the *tough* subject *in-situ* is motivated by the need of 2-checking either by pure Merge in-situ, assuming that multiple 2-role checking by a single argument is allowed (*contra* Chomsky 1995, and *pro* Bošković 1994, Lasnik 1995, Hornstein 1999).¹¹

Under Chomsky's (2001) theoretical architecture, an entirely different picture emerges; namely, the result of this study has virtually no relevance at all, at least with respect to Narrow Syntax (NS). Chomsky explicitly denies the relevance of 2-theory in NS, stating that

¹⁰To the best of my knowledge, (20) has not been derived from independent principles of grammar. This is so, because it is unclear as to why pure Merge, a strictly derivational operation, is sensitive to the 2-role-argument relations, which are not vindicated until LF (Hale and Keyser's (1993) configurational approach to 2-theory). Alternatively, (20) may be taken as a descriptive generalization, rather than a principle. Suppose that A-movement into a 2-position and lowering operation is prohibited, then any failure of Merging an argument in its 2-position will result in a 2-violation at LF. See Kawai 2001 for further discussions.

¹¹Alternatively, the matrix subject may be A-moved from the embedded. The evidence presented in the current study does not choose the base-generation vs. A-movement. The decision will demand further empirical investigation on the constructions. I take the base-generation analysis *pro* Lasnik and Fiengo 1974, Kawai 1986, 1992, and *contra* Hornstein 2001.

... [θ]-theoretic failures at the interface do not cause the derivation to crash; such structures yield “deviant” interpretations of a great many kinds (Chomsky 2001, p. 10).

If so, 2-theory has no role in NS; and, thus, NS does not care about the 2-hood of the matrix subject of a *tough* construction.¹² This is not to say that the conclusion of this study is without any relevance to linguistics. The burden remains on us to answer the thematic status of the subject of *tough*-class predicates within Lexicon.

Finally, this study crucially utilizes the notion of “default (canonical)” interpretation of modifiers. The notion remains as an observation, far from being a theory. Further study of lexico-conceptual structure (Bierwisch and Schreuder 1992, Wunderlich 1997, Kiparsky 1997, among others) is in order, be it a part of NS, the C-I system, or some other cognitive system.

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¹²This is not to say that the question of the 2-hood of the *tough* subject is irrelevant to our concern; it is an empirical question concerning properties of natural language. If 2-theory is a theory about a sub-component of the C-I system but not NS, as alluded by Chomsky (2001), then the result of this study is concerned with the properties of the C-I system. Generalization regarding the C-I system is presumably just as relevant for generative linguistics as those regarding NS, as was the case for *a rule of interpretation* RI (Chomsky 1973/1977), the disjoint reference rule (Lasnik 1976, 1981), among numerous others.

Obviously, under the featural approach of 2-roles (Bošković 1994, Lasnik 1995, Hornstein 1999, 2001, Kawai 2001, among others), 2-roles plays an integral role in NS.

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