Discourse Prominence and Movement Constructions

Ralph L. Rose

Northwestern University

1 Introduction

One of the key requirements in understanding a text is deciding how successive utterances relate to one another. Anaphors help in this respect by picking out entities already existing in the discourse and indicating the referent to which the new information encoded in the utterance should be attached. Sometimes, the interpretation of an anaphor is determined entirely by the morphosyntactic features of the anaphor itself which fully constrain its interpretation (e.g., reflexives). However, at other times, the choice of a referent for an anaphor is free and listeners must rely on other factors to determine its interpretation. Current theories of pronominal resolution (McKoon et al., 1993; Grosz and Sidner, 1986; Grosz et al., 1995; Lappin and Leass, 1994; Kennedy and Boguraev, 1996) hold that in such cases, the pronoun is assigned (if possible) the best-matching most prominent referent in a list of discourse-prominent entities–that is, a list of entities invoked in the current discourse and ranked according to discourse prominence. Should later information prove that this assignment was incorrect, reanalysis may be necessary and certain consequences may result such as degraded discourse coherence. Hence, the process by which discourse entities are ranked is therefore a critical feature for pronominal resolution. In this paper, I examine two previously uninvestigated features—one syntactic, the other semantic—which may influence this ranking process.

All else being equal, entities realized as syntactic subjects are preferred referents for pronominal resolution. This is illustrated by the difference in discourse coherence between (1) and (2).

(1)   a. Nancy$_i$ will certainly beat Susan$_j$ in the 100-yard dash.
        b. She$_i$ will become the state champ again.
(2)   a. Nancy$_i$ will certainly beat Susan$_j$ in the 100-yard dash.
        b. #She$_j$ will no doubt be very frustrated.

Discourse (1) suffers from degraded coherence because *she* refers to the syntactically less prominent object of the preceding utterance. However, in examining the *a* sentences of (1) and (2), we see that, in both cases, *Nancy* is a simple subject: it does not move from another clause to arrive at its surface syntactic position. However, compare (1)-(2) to (3)-(4).

(3)   a. Nancy$_i$ is certain t_i to beat Susan$_j$ in the 100-yard dash.
        b. She$_i$ will become the state champ again.

(4)   a. Nancy$_i$ is certain t_i to beat Susan$_j$ in the 100-yard dash.
      b. #She$_j$ will no doubt be very frustrated.

The subjects in (3)a and (4)a differ from those of (1)a and (2)a because they are derived by movement from an embedded clause. As will be discussed below, information associated with elements which have been moved appears to be more prominent for comprehenders as assessed by cued-recall and probe recognition tasks (Blumenthal, 1967; Bever and McElree, 1988). Consequently, a relevant question to ask is how discourse prominence might be affected by movement. Or, perhaps more concisely, what effect do movement constructions have on the discourse prominence of their syntactic arguments, both those which move and those which do not? This question has so far remained uninvestigated.

In this paper, I present an analysis of this question and results of a psycholinguistic investigation. While the results are in the predicted direction, they do not provide clear evidence of an effect of movement. I offer some explanation for this and suggest methods for further examination of the question.

Preference for resolution to an entity realized as a syntactic subject is a commonly observed phenomenon in psycholinguistic studies (e.g., Mathews and Chodorow, 1988; Hudson-D'Zmura and Tanenhaus, 1997). Yet it appears that none of these studies have controlled for the semantic role of the syntactic subject. In other words, many studies have used active constructions in which syntactic role and semantic role are conflated (i.e., subjects are agents, objects are patients, and so on). It could be the case that what has been observed as a preference for a syntactic subject is, in fact, preference for a particular semantic role (say, AGENT), or perhaps some interaction of both of these preferences. Movement provides a case which can separate the effects of syntactic position and semantic role on discourse prominence. Using *tough*-movement constructions, which crucially partition syntactic and semantic role in its arguments, I examine the influence of semantic role on discourse prominence. Results show that there is an effect of semantic role.

2   Background

2.1   Discourse Model

I begin with a discussion of the discourse model I assume throughout this paper.

As a discourse progresses, entities realized in the discourse are stored in memory for possible later access and information expressed about those entities is linked directly to those entities (cf., file change semantics, Heim (1983); Discourse Reference Theory, Kamp and Reyle (1993). This information includes not only the propositions made about an entity, but also the morphosyntactic and semantic features of the realizations of that entity. When anaphors are encountered in the discourse, coreference relations are determined by reviewing the set of entities and evaluating them as potential antecedents with respect to the relevant morphosyntactic features of the anaphoric element and each possible antecedent. If reference resolution is possible on the basis of this information then the resolution process is completed. Otherwise, semantic and pragmatic features are also taken into account to find a suitable referent.

As described so far, this model does not differ from current models (Grosz and Sidner, 1986; Greene et al., 1992; McKoon et al., 1993; Garrod, 1994; Gernsbacher, 1990; Gordon and Hendrick, 1997; Garrod et al., 1994; Clifton and Ferreira, 1987). However, it is at this point where my model diverges. The process of anaphora resolution depends crucially on the degree of prominence of the various discourse entities. In some discourse models (e.g., Centering Theory: Grosz and Sidner, 1986; Grosz et al., 1995), discourse prominence is a straightforward relative ranking schema: the only relevant question is whether one entity outranks another. The magnitude by which one entity outranks another is not relevant. Consider the olympics: it doesn't matter whether the first-place finisher is one-hundredth of a second or one-hundred seconds ahead of the second-place finisher—either way, whoever finishes first wins the gold medal. In the same way, the highest ranking entity is preferred no matter what happens with the other entities. However, consider the difference between (5)a and (6)a.

(5)   a. Barry$_i$ hit Marcus$_j$.
       b. He$_{i/j}$ was angry.
(6)   b. It was Barry$_i$ who hit Marcus$_j$.
       b. He$_{i/\#j}$ was angry.

In a discrete ranking schema in which SUBJECTs are more prominent than OBJECTs, there is no difference in the prominence hierarchy between (5)a and (6)a. However, this doesn't capture the intuition that (6)a is more about Barry than (5)a: that is, Barry seems to be *closer* to the center of attention in (6)a. Hence, while the interpretation of the pronoun in (5)b is ambiguous, in (6)b, interpretation of the pronoun as Marcus is considerably marked.[1] A simple ranking schema is not robust enough to capture this difference. Hence, the model I assume in this paper assumes a gradient scale of discourse prominence. To be explicit, the degree to which one entity outranks another is relevant. In other words, it is not only important to know which entity is closest to the center of attention, but also *how* close it is.

I propose to relate this model of discourse representation to models of memory access, thereby making available to this model the relatively large body of psycholinguistic literature on activation of entities in memory. I propose that activation of an entity in memory results in an increase in that entity's prominence in the discourse model. As shown by Nicol and Swinney (1989); McKoon et al. (1994), and others, lexical associates of an NP are facilitated in a lexical decision task at a gap site associated with that NP as in such sentences as (7).

(7)   The policeman saw the boy$_i$ that the crowd at the party accused t_i of the crime.

At the *wh*-trace site, facilitation of a lexical associate (e.g., *girl*) of *boy* (the antecedent of the *wh*-trace) over a non-associate (e.g., *check*) was observed. So when an entity is first activated—and therefore entered in the discourse model—to at least some degree, its respective associates are also activated and are therefore more easily accessible. This is, perhaps, an uncontroversial part of my proposal. The more controversial part is that further mention of an entity influences its discourse salience. There is evidence that this is true for explicit references–that is, the more often an entity is mentioned in a discourse, the

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[1]For some, he_j in (5) may be worse than he_i. However, he_j in (6) is still even worse.

more prominent a candidate it is for anaphor resolution. This feature is even encoded as a Frequency index in the pronoun resolution algorithm of Lappin and Leass (1994). However, the novel aspect that I propose is that implicit reference (via certain empty categories) may also influence the discourse prominence of the entity realized as the antecedent. I suggest that manipulating an entity in memory leaves that entity in a more accessible state in memory. The more an entity is manipulated, the more accessible it will be up to whatever the limit of accessibility may be. By way of analogy, there are some "smart" computer systems which keep track of which files a user accesses more often and stores these files in locations on the hard drive or in fast memory which facilitate easier or faster accessibility. In the same way, explicit and implicit mention of an entity results in the (re)activation of that entity in memory and increased prominence in the discourse model.

2.2 Subject-antecedent Preference

In the resolution of a pronoun, surface subjects are known to be preferred antecedents. In a study by Hudson-D'Zmura and Tanenhaus (1997), participants read short discourses containing the following sequences.

(8)   a. $Jack_i$ apologized profusely to $Josh_j$.
       b. He_i had been rude to $Josh_j$ yesterday.
(9)   a. $Jack_i$ apologized profusely to $Josh_j$.
       b. He_j had been offended by $Jack_i$'s comment. (p. 202)

Participants[2] in their study read sentences containing pronouns with subject-antecedents (as in (8)b) more quickly and judged those sentences to be more coherent than those with object-antecedents (as in (9)b). Similar results were obtained by Mathews and Chodorow (1988) using two-clause sentences as in (10): participants read sentences in which the pronoun coreferred with the subject faster, and in a post-sentence task, judged the pronoun to be coreferent with the subject more often (even when it was in contrast with the semantic analysis of the sentence, i.e., as in (10)b).[3]

(10)   After the $bartender_i$ served the $patron_j$,
       a. he_i got a big tip.
       b. he_j left a big tip.

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[2]Because this paper will frequently discuss both syntactic subjects and experimental subjects, in order to reduce ambiguity, I will use *subject* to refer only to syntactic subjects, and *participants* to refer to experimental subjects.

[3]Blumenthal (1967) and Blumenthal and Boakes (1967) gave an early demonstration of the advantage that subjects seem to enjoy in memory. Using a cued-recall task, they found subjects to be better prompts than objects. However, their investigation used a prompted recall task in which participants were trained on a list of sentences over some time and then asked to recall these sentences via their respective prompt words. Results of such a long-term memory task may not be applicable to the maintenance of discourse information in short-term memory. However, the parallel is interesting.

2.2.1 Syntactic Prominence

Typically, these results have been interpreted as evidence of pronominal preference for a syntactically prominent antecedent. This is usually the syntactic subject, or in terms of phrase structure, the NP in the specifier of the IP, the top-most syntactic projection in a simple sentence. Most pronoun resolution algorithms depend crucially on this view. For example, in the algorithm described in Hobbs (1978), when a pronoun is encountered, the algorithm searches the syntax tree for antecedents in a left-to-right, breadth first manner. As such, it prefers SUBJECTs to other arguments. In the Lappin and Leass (1994) algorithm, a salience index is computed from a number of sub-indices including GRAMMATICAL ROLE which gives preference to syntactic SUBJECTs. If this syntactic explanation for subject-antecedent preference is correct, the implication is that syntactic subjects are closer to the center of attention (i.e., more discourse prominent) than syntactic objects. In this paper, I will refer to this as *syntactic prominence* (SYNPROM).

However, there is no study which confirms that syntactic prominence is the cause of the subject-antecedent preference. In fact, there are two alternative analyses which I propose below.

2.2.2 Movement

While syntactic position is an obvious difference between SUBJECTs and OBJECTs, recent studies indicate another key difference. According to the VP-internal subject hypothesis (Koopman and Sportiche, 1991), both SUBJECTs and OBJECTs are argued to be base-generated inside the verb phrase. However, at some later point in the derivation, SUBJECTs move out of VP into the specifier of IP. In the discourse model I am assuming herein, it could be the case that it is simply this additional manipulation of the entity in memory which causes it to become more discourse prominent than the unmanipulated object.

A direct test of the effect of specVP to specIP movement on discourse prominence is difficult because such movement is a near-universal in English and cannot be contrasted. However, an alternative test of the hypothesis that movement is responsible for increasing the discourse prominence of the moved entity is to take advantage of constructions in which the surface subject is generated below the VP and moves up to subject position. If such moved entities are closer to the center of attention as a result of movement, then the discourse model would predict that these entities had been activated and manipulated multiple times: in a movement paradigm, this would result from implicit mentions via such empty categories as *NP*-trace. So, the question is what movement constructions show the clearest effect of antecedent activation at the site of an empty category. Several psycholinguistic investigations point toward an answer.

In a study of filler-gap dependencies, (Bever and McElree, 1988) used a probe recognition technique with stimuli as in (11).

(11)   a. The astute lawyer$_i$ who faced the female judge hoped he$_i$ would speak during the trial. (pronoun)
   b. The astute lawyer$_i$ who faced the female judge strongly hoped PRO$_i$ to argue during the trial. (PRO)
   c. The astute lawyer$_i$ who faced the female judge was certain t_i to argue during the

trial. (NP-raising)

d. The astute lawyer$_i$ was hard for the judge to control t_i during the very long trial. (tough-movement)

e. The astute lawyer$_i$ who faced the female judge hated the long speech during the trial. (non-anaphor)

PROBE: *astute*

Immediately after reading a sentence, the probe word appeared and participants judged whether the probe word had appeared in the preceding sentence. Bever and McElree found that tough-movement, NP-raising, and pronoun constructions yielded faster and more accurate responses than the PRO[4] and non-anaphor constructions, demonstrating that these constructions access their antecedents. The fact that pronoun constructions showed an effect is not surprising given that explicit reference to an entity necessarily activates that entity. However, the difference between tough-movement and NP-raising on the one hand, and PRO and non-anaphor constructions on the other, is puzzling. It is important to note, though, that one feature which distinguishes these constructions is movement: the former two are generally analyzed as involving some sort of movement, while the latter two are not. This is in line with the hypothesis that movement results in greater activation of entities and therefore greater discourse prominence as predicted by the discourse model.[5]

On the basis of the psycholinguistic evidence, NP-raising constructions appear to be a good candidate for use in investigating the influence of movement on discourse prominence. If the hypothesis is correct, then the SUBJECT of (12)a will be more discourse prominent than the SUBJECT of (13)a because the former has udergone movement.

(12)   a. Nancy$_i$ is certain t_i to beat Susan$_j$ in the 100-yard dash.
       b. She$_i$ will become the state champ again.
(13)   a. Nancy$_i$ will certainly beat Susan$_j$ in the 100-yard dash.
       b. She$_i$ will become the state champ again.

Before continuing, I should make my syntactic assumptions explicit. In this paper, I assume a syntactic analysis in which subjects and objects are generated inside the VP, but that only the subject moves at later stages in the derivation. I also assume that for the movement constructions used in this study (i.e., NP-raising and *tough*-movement constructions), the linguistic entity which undergoes movement is generated at the base site and moves to its landing site via a copy-and-delete process. However, should this syntactic analysis be wrong, but there is an effect of "movement", then the effect will still need to be reconciled with whatever account of these constructions proves (more) correct.

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[4]It is curious that PRO constructions and pronoun constructions do not pattern together. On the assumption that PRO is a (phonetically empty) pronominal, I have no explanation for this fact. Yet, on the other hand, perhaps it should not be a surprise because numerous differences between PRO and overt pronominals have been noted: PRO must be bound, it cannot appear in a case position, etc.

[5]Other psycholinguistic studies showing activation of information related to a moved element at a gap site include Nicol (1988), Nicol and Swinney (1989) and Hickock et al. (1992) using cross-modal lexical priming tasks, MacDonald (1989) with a different movement construction (passive), and Bever and Sanz (1997) in a different language (Spanish, using unaccusative versus unergative constructions).

2.3   Semantic Prominence

Yet another potential explanation for the subject-antecedent preference exists. In this section I argue that this preference may be explained as preference for a semantic AGENT. I will refer to this as *semantic prominence* (SEMPROM).

The two studies described above as showing preference for a subject-antecedent (Mathews and Chodorow, 1988; Hudson-D'Zmura and Tanenhaus, 1997) used context sentences as in (8)-(10). These sentences contain verbs in the active voice and for which the SUBJECT is the semantic AGENT. As such, it is difficult to tell whether it is an entity's status as a syntactic SUBJECT or as a semantic AGENT which contributes to its higher discourse prominence because these are conflated. If, in fact, semantic prominence is having an influence, then it would appear from earlier results that the active prominence hierarchy of semantic roles would place the AGENT highest as in (14).

(14)   Semantic Prominence Hierarchy: AGENT > PATIENT > OTHERS

There has been little previous work on the influence of semantic role in pronominal resolution. One study which purports to show an effect is Stevenson et al. (1994) in which participants performed a sentence completion task for sentences as in (15)-(20).

(15)   John kicked Bill. He ...
(16)   Bill was kicked by John. He ...
(17)   John kicked Bill and he ...
(18)   Bill was kicked by John and he ...
(19)   John kicked Bill because/so he ...
(20)   Bill was kicked by John because/so he ...

For AGENT-PATIENT verbs, results consistently showed preference for the PATIENT as the antecedent of the pronoun. However, there are some problems with this study. First, from a methodological point of view, the results do not necessarily capture the on-line intuitions of the participants: the sentence-completion task allows participants to overlook their first intuitions. Because participants may take time to think and reflect before writing a continuation, it is not clear that they are relying on the same discourse strategies they use in a real-time task. In addition, there is less control of prosody in these tasks: participants could have been reading each discourse with focal accent on the pronouns. This is known to change the interpretation of a pronoun (Akmajian and Jackendoff, 1970; Smyth, 1994). A further problem with this study is that in the passive sentences, there is a confound with syntactic prominence and the preference for a PATIENT-antecedent could be exaggerated in cases like (16), (18), and (20). In the absence of clear evidence otherwise, I continue to assume the semantic prominence hierarchy in (14).

There has been no previous study which clearly distinguishes between possible effects of syntactic prominence and possible effects of semantic prominence. No doubt this is because in English, it is nearly impossible to partition these clearly. However, there is one construction in English which does allow such a partition: sentences formed with *tough*-adjectives. Consider the sentences in (21)-(22).

(21)   Mike was tough for John to kick.

(22)   Mary was easy for Laura to find at the party.

Syntactically, Mike and Mary are the most prominent entities in their respective utterances, outranking the embedded subjects John and Laura. However, semantically, John and Laura as AGENTs respectively outrank the PATIENT arguments Mike and Mary.

There is, in fact, some psycholinguistic evidence on these types of constructions. Blumenthal and Boakes (1967) performed a prompted recall task with sentences as in (23)-(24).

(23)   John is eager to please.
(24)   John is easy to please.

Results showed that the subject (the semantic SOURCE), of (23) was a reliably better prompt than the subject (the semantic GOAL) of (24), suggesting that SOURCE is higher on the semantic hierarchy than GOAL.[6] Syntactic prominence cannot account for this difference.

In the experiment outlined in the next section, I use such *tough*-adjective constructions to investigate the effect of semantic prominence on discourse prominence.

2.3.1   Interaction

The phenomenon of Subject-antecedent preference may be explained by one of the three accounts given above: syntactic prominence, movement, or semantic prominence. However, it could be the case the two or all three of these have an influence. In other words, subject-antecedent preference could be caused by the convergence of some combination of syntactic prominence, movement, and semantic prominence. No existing study of discourse prominence has controlled for this possibility. However, by using NP-raising constructions, which partition syntactic prominence and movement, and *tough*-movement constructions, which partition syntactic and semantic prominence, the effects of all three on discourse prominence can be discerned. In the next section, I outline an experimental investigation which examines these effects.

3   Experiment

The experiment is designed to examine the three hypotheses expressed in (25)-(26).

(25)   SYNTACTIC PROMINENCE An utterance-initial pronoun prefers as its antecedent an entity realized as the syntactic subject of the preceding utterance.
(26)   SEMANTIC PROMINENCE An utterance-initial pronoun prefers as its antecedent an entity realized in a high position on the semantic hierarchy, (14).
(27)   MOVEMENT An utterance-initial pronoun prefers as its antecedent an entity which has undergone movement.

Three different experimental variables, SYNPROM, SEMPROM, and MOVEMENT, were manipulated in the experiment with the levels defined as follows.

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[6]Curiously, Stevenson et al. (1994) show contrasting results for source-goal sentences: participants preferred pronominal reference to the GOAL rather than the SOURCE. Their results are consistent if nothing else. Nevertheless, I suggest that their results may be anomalous for the reasons outlined above.

- SYNPROM

  +SYNPROM - pronoun in target sentence coreferred with entity realized as syntactic subject of context sentence

  −SYNPROM - pronoun in target sentence coreferred with entity not realized as syntactic subject of context sentence

- SEMPROM

  +SEMPROM - pronoun in target sentence coreferred with entity realized in a high position on the semantic hierarchy in context sentence

  −SEMPROM - pronoun in target sentence coreferred with entity realized in a non-high position on the semantic hierarchy in context sentence

- MOVEMENT

  CONTROL - predicate in context sentence does not involve movement of arguments

  MOVED - predicate in context sentence involves movement of arguments

These variables were manipulated in the experimental paradigms shown in Table 1-Table 2.

Table 1: NP-Raising Constructions

context	a	[name$_i$] non-NP-raising predicate [name$_j$]	CONTROL
		Nancy$_i$ will certainly beat Susan$_j$ in the 100-yard dash.	
	a'	[name$_i$] NP-raising predicate ... t$_i$ ... [name$_j$]	MOVED
		Nancy$_i$ is certain t$_i$ to beat Susan$_j$ in the 100-yard dash.	
target	b	pronoun$_i$ ...	+SYNPROM, +SEMPROM
		She$_i$ will become the state champ again.	
	b'	pronoun$_j$ ...	−SYNPROM, −SEMPROM
		She$_j$ will no doubt be very disappointed.	

Reading times for the target sentences were recorded. The reader should note that the SYNPROM and SEMPROM variables in this study are not utterly independent variables, but rather different partitionings of the data set. In fact, the data are manipulated in only two dimensions.

The next three sections outline the predictions for each hypothesis in this experimental paradigm.

3.1 Hypothesis 1: Syntactic Prominence

The first hypothesis evaluates whether subject-antecedent preference is due to the antecedent's role as a syntactic subject. Under this hypothesis, the two entities in the context sentence will be more or less discourse prominent as illustrated in Table 3.

When the pronoun in the target sentence is encountered, initial assignment should be made to the syntactic subject because it is more discourse prominent and hence easier to access. However, if reanalysis is necessary to resolve to the syntactic non-subject, then

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Table 2: *Tough*-Movement Constructions

context	a	[name$_i$] non-*tough*-predicate [name$_j$]	CONTROL
		John$_i$ could hardly hit Matt$_j$ in the boxing match.	
target	b	pronoun$_i$ ...	+SYNPROM, +SEMPROM
		He$_i$ was too tired and had no strength left.	
	b'	pronoun$_j$ ...	−SYNPROM, −SEMPROM
		He$_j$ was too quick and had plenty of energy.	
context	a'	[name$_j$] *tough*-predicate ... [name$_i$] ... t$_j$	MOVED
		Matt$_j$ was hard for John$_i$ to hit in the boxing match.	
target	b	pronoun$_i$ ...	−SYNPROM, +SEMPROM
		He$_i$ was too tired and had no strength left.	
	b'	pronoun$_j$ ...	+SYNPROM, −SEMPROM
		He$_j$ was too quick and had plenty of energy.	

Table 3: Prominent Entities (SYNPROM)

			Syntactically Prominent
CONTROL		*name$_i$*	$\checkmark$
		name$_j$	
MOVED	NP-raising	*name$_i$*	$\checkmark$
		name$_j$	
	tough-movement	*name$_j$*	$\checkmark$
		name$_i$	

reading times should increase because it should be difficult to access the lower-ranked entity. In summary, the mean reading times of the target sentences in the +SYNPROM are predicted to be faster than those in the –SYNPROM condition (see (28). Such results would replicate earlier studies Mathews and Chodorow (i.e., 1988); Hudson-D'Zmura and Tanenhaus (i.e., 1997) and form a standard for success of the experimental task.

(28) (+SYNPROM) < (−SYNPROM)

3.2   Hypothesis 2: Semantic Prominence

The second hypothesis evaluates whether subject-antecedent preference is due to the antecedent's position on the semantic hierarchy. Under this hypothesis, the two entities in the context sentence will be more or less discourse prominent as illustrated in Table 4.

When the pronoun is encountered in the target sentence, initial assignment of the referent should be to the semantically prominent entity (the first entity in the context sentence for all CONTROL conditions and the NP-raising MOVED condition, the second entity in the *tough*-movement MOVED condition) because according to the hypothesis, these entities are the most

Table 4: Prominent Entities (SEMPROM)

			Semantically Prominent
CONTROL		$name_i$	√
		$name_j$	
MOVED	NP-raising	$name_i$	√
		$name_j$	
	tough-movement	$name_j$	
		$name_i$	√

discourse prominent. However, in the –SEMPROM condition when reassignment is necessary, mean reading times of the target sentence are expected to be slower (see (29)).

(29)   (+SEMPROM) < (–SEMPROM)

3.3   Hypothesis 3: Movement

The third hypothesis evaluates whether subject-antecedent preference is due to the movement of the antecedent. Under this hypothesis, the two entities in the context sentence will be more or less discourse prominent as illustrated in Table 5. Note that under this hypothesis, the first entity is always predicted to be more prominent–similar to the predictions of syntactic prominence. Hence, it will be useful to view the data under the SYNPROM partition.

Table 5: Prominent Entities (MOVED)

			Movement
CONTROL		$name_i$	√
		$name_j$	
MOVED	NP-raising	$name_i$	√√
		$name_j$	
	tough-movement	$name_j$	√√
		$name_i$	√

Under this hypothesis, the first entity in the CONTROL case is more prominent because it has moved out of the verb phrase. However, in the MOVED conditions, the first entity has undergone an extra movement operation and is predicted to be even more discourse prominent than the first entity in the CONTROL condition. Initial assignment should be made to the first entity, however because of the prominence difference, mean reading times for the target sentence in the (MOVED, +SYNPROM) condition are predicted to be faster than those in the (CONTROL, +SYNPROM) condition. However, given that in this comparison, both entities are more prominent and close to the center of attention, a ceiling effect might

occur. Hence, it may be more advantageous to consider the –SYNPROM condition. Here, reassignment to the lower-ranked entity should be more difficult in the MOVED condition because the first entity is closer to the center of attention. Hence, reading times of the target sentence in the (MOVED, –SYNPROM) condition are predicted to be slower than those in the (CONTROL, –SYNPROM condition. Finally, because the first entity is always more prominent than the second entity, reading times for the target sentences in the (+SYNPROM) condition are predicted to be faster than those in the (–SYNPROM) condition.

(30) (+SYNPROM) < (–SYNPROM)
(31) (MOVED, +SYNPROM) < (CONTROL, +SYNPROM)
      (MOVED, –SYNPROM) > (CONTROL, –SYNPROM)

3.4 Further Predictions: Interactions

As noted earlier, it is entirely possible that subject-antecedent preference is caused by some combination of syntactic prominence, semantic prominence, and movement. There are four possible combinations of two or more of these. In this section I will review these possibilities and the predictions they make. Before doing so, a brief discussion on "combining" is necessary. Because there is no prior research on what contributions syntactic prominence, semantic prominence and movement as distinct features of discourse make to discourse prominence, it is difficult to predict what individual effect each has on discourse prominence. It could be that one is more influential than the others: an entity realized in a syntactically prominent position might be more prominent than one realized in a semantically prominent position (assuming they are different entities), or an entity which has undergone movement and is syntactically prominent might be equal in prominence to an entity which is only semantically prominent. At present, any of these is possible. I will take, though, what I believe to be a conservative starting point, and assume that the contribution of each of these features to an entity's discourse prominence is equally weighted. Thus, if an entity is both syntactically prominent and has undergone movement, then it is twice as prominent as an entity which is only semantically prominent. Similarly, if one entity has undergone movement while another entity is syntactically prominent, then both entities are equally prominent in the discourse. This is undoubtedly an oversimplification, but in the absence of any guiding evidence, it seems a prudent starting place.

3.4.1 Syntactic Prominence and Semantic Prominence

If both Syntactic Prominence and Semantic Prominence are relevant, then the entities in the context sentence will be more or less prominent as illustrated in Table 6. Under this hypothesis, it will be necessary to view the results under both the SYNPROM and SEMPROM partitions.

For NP-raising, because syntactic prominence and semantic prominence coincide, mean reading times for the target sentences in the (+SYNPROM/+SEMPROM) condition are predicted to be faster than those in the (–SYNPROM/–SEMPROM) condition. However, the *tough*-movement data require more explanation. In the context sentence, the first entity is syntactically prominent while the second entity is semantically prominent. As such, when

Table 6: Prominent Entities (SYNPROM, SEMPROM)

			Syntactically Prominent	Semantically Prominent
CONTROL		$name_i$	√	√
		$name_j$		
MOVED	NP-raising	$name_i$	√	√
		$name_j$		
	tough-movement	$name_j$	√	
		$name_i$		√

the pronoun in the target sentence is encountered, initial assignment cannot take place because neither entity is more prominent: they are equidistant from the center of attention in the discourse representation. Both entities must be maintained in memory until later information can disambiguate the resolution of the pronoun. This results in slower mean reading times in *both* the (+SYNPROM) and (−SYNPROM) conditions (similarly for the (±SEMPROM) conditions). However, because the first entity in the CONTROL condition is both syntactically and semantically prominent, it is closer to the center of attention and mean reading times for the target sentences in the (CONTROL, +SYNPROM) condition are therefore predicted to be faster than those in the (MOVED, +SYNPROM) condition.

(32) For NP-raising
      (+SYNPROM) < (−SYNPROM)
(33) For *tough*-movement
      (CONTROL, +SYNPROM) < (MOVED, +SYNPROM)
      (CONTROL, −SEMPROM) < (MOVED, −SEMPROM)

3.4.2 Syntactic Prominence and Movement

If both syntactic prominence and movement are relevant then the two entities in the context sentence will be more or less prominent as illustrated in Table 7.

Table 7: Prominent Entities (SYNPROM, MOVED)

			Syntactically Prominent	Movement
CONTROL		$name_i$	√	√
		$name_j$		
MOVED	NP-raising	$name_i$	√	√√
		$name_j$		
	tough-movement	$name_j$	√	√√
		$name_i$		√

13

The first entity in the context sentence is always the most prominent, so mean reading times for the target sentences in the (+SYNPROM) condition are predicted to be faster than those in the (–SYNPROM) condition. Furthermore, the first entity in the MOVED condition should be even more prominent than in the CONTROL condition. Therefore, mean reading times for the target sentence in the (MOVED, +SYNPROM) condition are predicted to be faster than those of the (CONTROL, –SYNPROM) condition. For NP-raising, when pronoun reassignment is necessary in the (–SYNPROM) condition, it should be more difficult to access the second entity because the first is so prominent. Hence, reading times for the target sentences in the (MOVED, –SYNPROM) condition are predicted to be slower than those in the (CONTROL, –SYNPROM) condition. This difference is not predicted with the *tough*-movement sentences because the second entity in the MOVED condition, as the subject of the embedded clause, is somewhat more prominent due its movement out of the embedded verb phrase.

(34) (+SYNPROM) < (–SYNPROM)
      (MOVED, +SYNPROM) < (CONTROL, +SYNPROM)
(35) For NP-raising
      (MOVED, –SYNPROM) > (CONTROL, –SYNPROM)

3.4.3   Semantic Prominence and Movement

If both semantic prominence and movement are relevant then the two entities in the context sentence will be more or less prominent as illustrated in Table 8. Note that in this case, a view of the data under the SEMPROM partition will be more appropriate.

Table 8: Prominent Entities (SEMPROM, MOVED)

			Semantically Prominent	Movement
CONTROL		$name_i$	√	√
		$name_j$		
MOVED	NP-raising	$name_i$	√	√√
		$name_j$		
	tough-movement	$name_j$		√√
		$name_i$	√	√

For NP-raising, the predictions look exactly the same as in the case above with syntactic prominence and movement. As such, I will not repeat the discussion here. For *tough*-movement, once again there is the situation in which both entities in the MOVED condition have equal prominence as in the case described above with syntactic and semantic prominence. Again, I do not repeat that discussion, but merely present the predictions as follows.

(36) For NP-raising
      (+SYNPROM) < (–SYNPROM)
      (MOVED, +SYNPROM) < (CONTROL, +SYNPROM)
      (MOVED, –SYNPROM) > (CONTROL, –SYNPROM)

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(37) For *tough*-movement
   $(\textsc{control}, +\textsc{semprom}) < (\textsc{moved}, +\textsc{semprom})$

3.4.4 Syntactic Prominence, Semantic Prominence, and Movement

Let us now consider the case when all three are relevant–semantic prominence, syntactic prominence, and movement. The two entities in the context sentence will be more or less prominent as illustrated in Table 9. Note that in this case, a view of the data under both the SYNPROM and SEMPROM partitions will be appropriate.

Table 9: Prominent Entities (SYNPROM, SEMPROM, MOVED)

			Syntactically Prominent	Semantically Prominent	Movement
CONTROL		$name_i$	√	√	√
		$name_j$			
MOVED	NP-raising	$name_i$	√	√	√√
		$name_j$			
	tough-movement	$name_j$	√		√√
		$name_i$		√	√

The first entity in every condition is the most prominent entity and initial assignment should be made to it when the pronoun is encountered. Subsequent reassignment to the second entity should result in slower mean reading times. Therefore, the reading times for the target sentences in the (+SYNPROM) condition should be faster than those in the (–SYNPROM) condition. However, the *tough*-movement cases warrant some discussion. The first entity in both the CONTROL and MOVED conditions are comparably prominent. Therefore, no difference is expected in the SYNPROM partition. However, the second entity in the MOVED condition is both semantically prominent and has had a movement operation applied to it. Hence, it is less prominent than the first entity in the CONTROL condition and more prominent than the second entity. Mean reading times of the target sentence in the (MOVED, –SYNPROM condition are predicted to be faster than those in the (CONTROL, –SYNPROM) condition. Conversely, mean reading times for the target sentences in the (MOVED, +SEMPROM) condition are predicted to be slower than those of the (CONTROL, +SEMPROM) condition.

(38) $(+\textsc{synprom}) < (-\textsc{synprom})$
(39) For NP-raising
   $(\textsc{moved}, +\textsc{synprom}) < (\textsc{control}, +\textsc{synprom})$
   $(\textsc{moved}, -\textsc{synprom}) > (\textsc{control}, -\textsc{synprom})$
(40) For *tough*-movement
   $(\textsc{moved}, -\textsc{synprom}) < (\textsc{control}, -\textsc{synprom})$
   $(\textsc{moved}, +\textsc{semprom}) > (\textsc{control}, +\textsc{semprom})$

3.5 Embeddedness

One possible confounding factor in this study is the issue of embeddedness. A major difference between the CONTROL and MOVED conditions is that the latter has an intervening clause boundary between the names. That is, the second name in context sentence *a'* is contained in an embedded clause, while in *a* it is in the matrix clause. It is conceivable that any effect observed is due to the embeddedness of the second name. One way to flush out this possible confound is to take advantage of the optionality of movement in many movement constructions. Hence, a third movement condition may be added as in Table 10 (shown as the UNMOVED context sentence).

Table 10: Context Sentences - CONTROL, MOVED, UNMOVED

context	a	[name$_i$] non-movement predicate [name$_j$]	CONTROL
	a'	[name$_i$] NP-raising predicate ... t$_i$ ... [name$_j$], or	
		[name$_j$] *tough*-movement predicate ... [name$_i$] ... t$_j$	MOVED
	a"	It$_{expletive}$ movement predicate ... name$_i$ ... name$_j$	UNMOVED

If mean reading times in the UNMOVED condition pattern after those of the CONTROL condition, then we can conclude that embeddedness is not relevant. Conversely, if they pattern after the MOVED condition, then we can conclude that embeddedness is relevant.[7]

3.6 Stimuli

In short, the syntactic prominence hypothesis will be tested primarily with NP-raising constructions, the semantic prominence hypothesis will be tested primarily with *tough*-movement constructions, and the movement hypothesis will be tested by considering both constructions.

The NP-raising and tough-movement constructions were presented in five-sentence vignettes as in Tables 11 and 12.

The first sentence of each discourse introduces two conjoined, gender-unambiguous names of the same gender and a context. The second sentence focuses attention on the context by giving some elaboration without any further mention of the names. This allows the two entities to drift away from the center of attention such that at the beginning of the third sentence, the names are recognizable, but neither is more prominent than the other (cf., Gordon et al., 1999). The third sentence, here the context sentence, then begins with a preposed clause in which the primary noun phrase corefers with (or is inferrable from) a constituent of the second sentence, forming a coherent continuation, not dependent on either of the main characters. The remainder of the utterance varies among the three conditions: CONTROL, MOVED, and UNMOVED. These three variations were controlled to maintain the same semantic entailments and truth conditions. In the tough-movement stimuli, the order

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[7]Of course, there is an implicit third possibility: that the UNMOVED condition will pattern independently of the other two coditions. However, I will not speculate as to what such results might mean because the results of this investigation do not show this pattern.

Table 11: NP-Raising Vignette

	a	Nancy and Susan will take part in a track meet this weekend.	
	b	There will be many kinds of events at the meet.	
context	c	In the 100-yard dash, Nancy will certainly beat Susan.	CONTROL
	c'	In the 100-yard dash, Nancy is certain to beat Susan.	MOVED
	c"	In the 100-yard dash, it is certain that Nancy will beat Susan.	UNMOVED
target	d	She has been working out lately.	+SYNPROM
	d'	She has been feeling sick lately.	−SYNPROM
	e	The winner will receive a 100-dollar savings bond.	

Table 12: Tough-Movement Vignette

	a	John and Matt fought each other in a boxing match.	
	b	It was fifteen rounds long.	
context	c	In the final round, John could hardly hit Matt.	CONTROL
	c'	In the final round, Matt was hard for John to hit.	MOVED
	c"	In the final round, it was tough for John to hit Matt.	UNMOVED
target	d	He was too tired and had no strength left.	+SYNPROM
	d'	He was too quick and had plenty of energy.	−SYNPROM
	e	The match finished with a knockout.	

of the conjoined names in *a* was reversed when necessary in order to match the order of presentation in the third sentence (i.e., *c'*). The fourth sentence, here the target sentence, always began with a third-person singular pronoun matching the gender of the names and continued with two variations: the +SYNPROM and −SYNPROM conditions. Because the participants would be seeing different target sentences in the different conditions, the two versions of the target sentence were balanced for length. The fifth sentence concluded the discourse by reference to the context and/or both entities via the third-person plural pronoun.

Six NP-raising constructions (*certain, likely, seem, appear, predicted, expected*) and six tough-movement constructions (*hard, difficult, fun, tough, easy, a cinch*) were selected based on their acceptability in all three movement conditions and overall acceptability and coherence judgments in a pilot study. Four vignettes were prepared with each movement construction making a total of 48 vignettes (24 for each of the NP-raising and tough-movement constructions). The six variants (according to the six conditions) of each vignette were placed into six different tests of four blocks each according to the following constraints.

- Each test contained a particular vignette exactly once.

- Each block contained exactly one vignette for each of the twelve (6+6) different movement constructions.

- Each block contained exactly two vignettes in the same condition: one, an NP-raising construction; the other, a tough-movement construction.

- In any given test, none of the four different vignettes containing a particular movement construction appeared in the same condition.

In addition, 24 filler vignettes were prepared which did not use any of the movement constructions and minimized ambiguity in the pronoun of the fourth sentence. Half of these constructions used name-pairs of mixed gender. These fillers were divided evenly among the four blocks of each test. Thus, in total, each test contained a total of 72 items in 4 blocks, each block containing 6 NP-raising constructions, 6 tough-movement constructions, and 6 fillers.

After each vignette, participants were given a multiple-choice comprehension question. During a pilot study, these questions were simply a check on the interpretation of the pronoun at the beginning of the target sentence (d/d'). In principle, I am only interested in the results when the participant interpreted the pronoun in the predicted way. However, in the pilot study, there was no significant variation in the mean reading times of the target sentence based on the interpretation of the pronoun. More importantly, though, many pilot participants noted that they developed a strategy in which they read only the first, third, and fourth sentences (i.e., a, $c/c'/c''$, and d/d') conscientiously and skipped the others. So, in order to encourage more careful reading of the entire discourse, in the actual experiment, half of the comprehension questions checked the interpretation of the pronoun in the target sentence, while the other half queried some extraneous details contained in the second sentence (b).

3.7   Procedure

Thirty undergraduate students from the Northwestern University Linguistic Department subject pool participated in the experiment for less than one hour each and received course credit for their participation. The vignettes were presented one sentence at a time on a computer screen using SuperLab Pro (ver. 2.0, by Cedrus Corporation). Participants were instructed to read each sentence as quickly as possible but also for comprehension, and then to press a button to continue reading the next sentence. The time (in milliseconds) between button-presses was recorded. Participants were offered an opportunity between each vignette to take a short break, if desired, but were instructed not to break in the middle of a vignette. Because pilot participants noted that fatigue was a significant factor, a planned forced break was taken between the second and third blocks. During this time, participants completed a short demographic survey.

4   Results

In this section I present the results of the experiment described above. Please note that reading times reported here are of only the target sentences (d/d' in Tables 11 and 12 above).

4.1 SYNPROM Partition

The reading times for the target sentences in the NP-raising construction vignettes show a significant main effect of Syntactic Prominence (by subjects $F(1, 23) = 4.51$, $p < 0.05$; by items $F(1, 23) = 15.05$, $p < 0.005$). However, there is no significant effect of Movement and no significant interaction between Syntactic Prominence and Movement.

Table 13: Mean Reading Times for Target Sentences in NP-Raising Vignettes

	CONTROL	MOVED	UNMOVED	
+SYNPROM	2430	2540	2440	2470
−SYNPROM	2700	2910	2840	2803
	2565	2725	2640	

This is in line with the predictions made by the first hypothesis, (25) above, indicating the relevance of syntactic prominence. However, the NP-raising results do not present any evidence in favor of the third hypothesis: movement appears not to have any effect on the discourse prominence of the entities.

The tough-movement results are less clear. Reading times for the critical sentence in the tough-movement construction vignettes show a significant main effect of Movement (by subjects $F(1, 23) = 7.20$, $p < 0.005$; by items $F(1, 23) = 3.87$, $p < 0.05$). Target sentences in which the pronoun referred to a moved antecedent were read more slowly than those in the UNMOVED and CONTROL conditions. However, there is no significant main effect of Syntactic Prominence and no significant interaction between Movement and Syntactic Prominence.

Table 14: Mean Reading Times for Target Sentences in *Tough*-Movement Vignettes

(SYNPROM partition)

	CONTROL	MOVED	UNMOVED	
+SYNPROM	2200	2930	2240	2456
−SYNPROM	2580	2640	2590	2606
	2390	2785	2416	

The lack of any effect of Syntactic Prominence is surprising because it contrasts strongly with those of the NP-raising results above and with many preceding studies. However, it is consistent with the claim that semantic and syntactic prominence have been conflated in those studies. Furthermore, the movement results, although significant, are not as expected if movement increases discourse prominence. In *both* of the (+SYNPROM) and (−SYNPROM) conditions, the MOVED reading times were longer than the other conditions.

4.2 SEMPROM Partition

Repartitioning the data with respect to semantic prominence yields the following results. For NP-raising data, syntactic and semantic prominence coincide, so the results are exactly as reported above: a significant main effect of Semantic Prominence and no other significant effects. However, for tough-movement data, reading times for the target sentence show a significant main effect of Semantic Prominence (by subjects, $F(1, 23) = 5.37$, $p < 0.05$; by items, $F(1, 23) = 4.13$, $p = 0.54$–just shy of significance at $\alpha = 0.05$). A main effect of Movement remains (as above because data did not change in this dimension), but no significant interaction between Movement and Semantic Prominence.

Table 15: Mean Reading Times for Target Sentences in *Tough*-Movement Vignettes

(SEMPROM partition)

	CONTROL	MOVED	UNMOVED	
+SEMPROM	2200	2640	2240	2360
−SEMPROM	2580	2930	2590	2737
	2390	2785	2415	

This presentation of the results supports the second hypothesis: that semantic prominence has an influence on discourse prominence. Further, the data show that movement also has an effect, in contrast to the NP-raising results. In the next section I will outline the overall trend in the data in order to explain these contrasting results.

As one final note, there was no significant difference between the CONTROL and UNMOVED conditions in any part of the results indicating that there is no effect of embeddedness in the data.

4.3 Summary

The following is a summary of the statistically significant trends observed in the data.

(41) For NP-raising
    (+SYNPROM) < (−SYNPROM)
(42) For *tough*-movement
    (+SEMPROM) < (−SEMPROM)
    (CONTROL, +SYNPROM) < (MOVED, +SYNPROM)
    (CONTROL, −SEMPROM) < (MOVED, −SEMPROM)

These results most closely match the predictions made under the assumption that only syntactic prominence and semantic prominence are relevant (see (32)-(33), above). First, the NP-raising results show a strong effect of syntactic prominence supporting the first hypothesis, and the *tough*-movement results show a strong effect of semantic prominence, with resolution to the semantically prominent (but syntactically non-prominent) antecedent being

read faster than resolution to the semantically non-prominent (but syntactically prominent) antecedent. This supports the second hypothesis. Further, the data also match with predictions of the interaction between the two. Mean reading times for target sentences in both the (MOVED, +SEMPROM) and (MOVED, −SEMPROM) conditions were the longest mean reading times in the experiment indicating that participants had trouble integrating these sentences into the discourse. This is consistent with the predictions made by the discourse model outlined in Section 2.1: in cases where no candidate antecedent is more prominent, no initial assignment of the interpretation of the pronoun is made. Rather, both entities are kept in memory until later disambiguating information is found. Keeping such entities in memory is an additional processing burden requiring more time to resolve.

5   Discussion

Results of this study show that both the syntactic prominence and the semantic prominence of the entities realized in a discourse are relevant features for pronominal resolution. However, the characterization of the *tough*-movement results with respect to syntactic and semantic constraints on pronominal resolution means that the *tough*-movement data provides no evidence of an effect of movement on discourse prominence. While this contradicts the predictions given above it is consistent with the results of the NP-raising results. As such, I conclude that the hypothesis that undergoing movement influences the discourse prominence of potential antecedents for pronominal resolution remains unconfirmed. In the next section, I suggest some possible reasons for this failure.

On the other hand, this study provides strong evidence that semantic prominence is a relevant feature for discourse prominence. This should be of general significance to models of discourse representation and of specific interested to models of pronominal resolution. A good example of the latter is the Lappin and Leass (1994) in which the prominence (salience) of a given candidate is calculated from a number of indices including RECENCY and GRAMMATICAL ROLE. This algorithm could easily be extended to reflect the results of the current study by merely appending another index, say SEMANTIC ROLE which is cued to the semantic hierarchy, and tweaking the heuristic which determines the net prominence of each discourse entity.

One more comment I wish to make about the results is to note that, as I discussed in Section 3.4, I have assumed in this paper that syntactic and semantic prominence have equal influence on discourse prominence. However, there is no *a priori* reason to assume this is true. In fact, the data give some evidence that it is not. For the *tough*-movement data, it was observed that reading times in the (MOVED, +SEMPROM) condition are slightly faster (although not quite significant) than those in the (MOVED, −SEMPROM) condition. In other words, participants in this study were more reluctant to resolve the pronoun to a less semantically prominent entity. This lends tentative support to the the hypothesis that perhaps semantic prominence is actually *more* influential to discourse prominence than syntactic prominence.

5.1 Future work

This study provides some interesting and potentially controversial results. However, one problem with the results is that the target sentences were different across the prominence conditions. While the length of these sentences was controlled, the syntactic structures, tense, and complexity of these sentences were not. It could be that the effects (or lack thereof) observed are due to something other than variations in the context sentence. One method to check this is by looking for a repeated-name penalty (Gordon et al., 1993). In this experimental paradigm, entities in the center of attention of a discoure, if realized in the immediate subsequent utterance, are expected to be realized as pronouns. If they are realized as names, a penalty results, often measured as longer reading times. Hence, continuation (43)b is predicted to take longer to read than (43)b'.

(43) a. Susan went to the store.
      b. Susan bought some apples.
      b'. She bought some apples.

The experimental materials in this study could be revised to look for such a repeated-name penalty by measuring the reading times of the target sentences in the –SEMPROM condtion with full names and also with pronouns. This comparison would provide confirming evidence that semantic prominence is having an influence.

A second criticism of this study is that participants saw only four items in each of the six experimental conditions. While this provides a sufficient number of observations for standard statistical tests, it is perhaps not enough to generate a robust effect. Future examination should either expand the number of stimuli or modify the experimental design to get a more robust design with fewer stimuli.

Lastly, I wish to note that while *tough*-movement does provide an excellent means for partitioning syntactic and semantic prominence because it uniquely reorders arguments, it is exactly this reordering quality that has prevented a coherent syntactic and semantic analysis of it (some competing accounts include Lasnik and Fiengo, 1974; Chomsky, 1977; Pesetsky, 1987; Kim, 1996). As such, baseline study of tough-movement in discourse prominence investigations may be necessary to establish its overall usefulness in further studies of this type. An excellent candidate model for this is Gordon and Chan (1995) which examines the relative syntactic prominence of arguments in passive constructions. Their study looks for a repeated-name penalty in the various argument positions of a passive construction used in the target sentence. A similar procedure could be employed with tough-movement constructions.

6 Conclusion

In this paper, I have presented evidence from an examination of the question of whether subject-antecedent preference is actually an artifact of syntactic prominence, semantic prominence, movement, or some combination of these three. The results do not indicate that movement has any influence on discourse prominence. However, results do point to a reexamination of what we know about discourse prominence. While discourse prominence has

largely been treated as determined by syntactic features, the results of this study suggest that semantic role also plays a part in determining prominence–in fact, it may even be the greater part.

Finally, I have presented a number of proposals for increasing the strength of the conclusions given herein.

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