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This paper explores the nature of the underlying representation of a sentence, that representation forumulated to make explicit the semantic structure of a sentence as a description of an event. It argues that the typical conception an underlying representation as a predicate-argument representation, exemplifie- in systems of case and thematic relations, must be modified. An underlying representation must include semantic relations between noun phrases as well as the predicate-argument relations of noun phrases to a verb. An examination of instrumental with will be used to motivate and justify this

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Instrumental With and the Control Relation in English

Beth C. Levin

Abstract: This paper explores the nature of the underlying representation of a sentence, that representation formulated to make explicit the semantic structure of a sentence as a description of an event. It argues that the typical conception of an underlying representation as a predicate-argument representation, exemplified in systems of case and thematic relations, must be modified. An underlying representation must include semantic relations between noun phrases as well as the predicate-argument relations of noun phrases to a verb. An examination of instrumental *with* will be used to motivate and justify this revision. In particular, an account of instrumental *with* requires the introduction of the control relation, a relation between two noun phrases.

The approach taken to instrumental *with* in work on case and thematic relations is inadequate because it ignores the existence of locative phrases with an instrumental function. Although an explanation of the behavior of locative and *with* phrases seems to make conflicting demands on a predicate-argument representation, an explanation follows if the locative and *with* phrases are treated, respectively, as indicators of unmarked and marked instances of the Instrumental role, a predicate-argument relation. This solution is only justified if certain aspects of the observed behavior of the phrases can be attributed to the marked/unmarked distinction. The control relation is introduced expressly to characterize the distinction: a marked occurrence of the Instrumental role indicates that the noun phrase which fills that role participates in the relation as a controlled object. Furthermore, the introduction of the control relation is supported by its ability to account for the distribution of acceptable occurrences of instrumental *with*. The need for the control relation provides evidence for including relations between noun phrases in the underlying representation.

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Appendix I. Grammatical Relations 86

1. Introduction

A central part of any description of an event is the identification of the participants in the event and the roles they play in its accomplishment. A sentence, since it provides a description of an event, must convey this information. Clearly, the verb in a sentence denotes the event and the noun phrases denote the participants, but how is a sentence able to express the roles of the participants in the event? The grammatical relations[1] in a sentence seem to be used for this purpose; the problem, then, is to relate the syntactic form and semantic interpretation of a sentence, what will be called the Alignment Problem.[2]

Consider as an example the notion of instrument, one of the common functions of a participant in an event. Typically in English, the notion of instrument is indicated by the preposition *with*, as in (1-1), but I will demonstrate that other prepositions also occur with an instrumental function, as in (1-2).

(1-1) Snow White was poisoned with a magic apple.
(1-2) Sleeping Beauty pricked her finger on the spindle.

Rather than approaching the Alignment Problem directly, the question that will be addressed here is: when is the instrumental use of *with* possible? An examination of this question, as part of the Alignment Problem, will provide insight into the solution of the larger problem.

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1. The grammatical relations I will be concerned with are the relations of subject and direct object together with the relations indicated by prepositions, prepositional phrases. For the syntactic form of a sentence, I will use a description of a sentence in terms of the verb and the grammatical relations of the noun phrases in the sentence. (See Appendix I for details.)

2. This name for the problem was first suggested in a class of Ken Hale's (fall 1977).

1.1 The Underlying Representation

Assume that the choice of grammatical relations in a sentence reflects aspects of its semantic structure; in particular, those aspects related to the sentence as a description of an event and its participants. A solution to the Alignment Problem will require formulating a representation of the sentence, which will be referred to as its underlying representation, that makes explicit the semantic structure[3] implicit in the grammatical relations. The choice of representation must take into account that the level of underlying representation should provide a level of semantic abstraction that captures appropriate generalizations.

The conception of underlying representation found in most work is based on the assumption that the underlying representation can be equated with a predicate-argument representation such as a system of case or thematic relations.[4] This choice of representation is based on the ease with which a predicate-argument representation allows a representation of a sentence as a description of an event and its participants. In a predicate-argument representation of a sentence, the verb (denoting the event) can be considered a predicate, with the noun phrases bearing grammatical relations to the verb (the participants in the event) as its arguments. The predicate-argument representation provides a verb-centered representation of a sentence. A sentence can then be described as a set of predicate-argument relations (also called roles); each predicate-argument

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3. I will restrict myself to these aspects of the semantic structure of a sentence only. The underlying representation of a sentence is not intended as a semantic representation of a sentence. Such a representation would have to include information about anaphora, quantification, topic-comment, etc. The syntactic structure of a sentence also affects their interpretation.

4. The original proposal for a system of case relations is Fillmore [1968]; see also Fillmore [1967, 1971a, 1971b, 1977]. Thematic relations are proposed in Gruber [1965]; this proposal is extended in Jackendoff [1972, 1976].

relation is a possible relation of an argument to a predicate corresponding to the semantic role of a noun phrase in the sentence. Support for a predicate-argument representation derives from the existence of a small set of canonical relations which allow the predicate-argument representation to capture semantic generalizations.

I want to argue for a richer conception of the level of underlying representation than has been suggested: that the underlying representation of a sentence must include certain semantic relations between noun phrases as well as its predicate-argument representation. To demonstrate this, I will identify a phenomenon, the occurrence of instrumental *with*, which cannot be explained by a predicate-argument representation alone. An account of the observed behavior of *with* will require a semantic relation, the control relation.[5]

The properties of the underlying representation should be determined by the needs of the data, by the type of generalizations that must be expressed in a level of semantic abstraction. Therefore, until these properties are recognized, it is important to begin without any commitment to a specific representation. A representation should be selected by its ability to capture those semantic generalizations that will allow the level of underlying representation to provide a level of semantic abstraction. A specific proposal for the underlying representation may introduce certain additional assumptions resulting from properties of the generalizations it is

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5. The use of the term *control* in the phrase *control relation* should not be confused with Chomsky's use of the term in the context of sentential complements to verbs [Chomsky and Lasnik 1977]. The verbs of obligatory control, which include *promise* and *persuade*, require that their complement's subject never be a lexical noun phrase. The complement subject is an empty noun phrase which receives an interpretation by being bound to another noun phrase in the matrix sentence.

supposed to capture.[6] Any limitations of the proposed representation which stem from these assumptions should be recognized since they will serve as motivation for enriching the underlying representation.

Assume that a predicate-argument representation of a sentence should be part of its underlying representation. This will allow the level of underlying representation to achieve, in part, a level of semantic abstraction by means of the generalizations that the predicate-argument representation captures. The verb-centered nature of the predicate-argument representation keeps it from being adequate as a underlying representation. A predicate-argument representation can be used to capture a generalization concerning some phenomenon, just when the phenomenon can be described with a purely verb-centered representation. A predicate-argument representation cannot suffice to account for the distribution of instrumental *with* because any explanation of the observed behavior of instrumental *with* requires a relation between noun phrases. Due to this limitation of the predicate-argument representation, the control relation must be introduced.

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6. The properties attributed to the underlying representation independently of the choice of specific representation should not be confused with those properties which follow from the implicit assumptions adopted along with a specific proposal for the representation. The failure to keep the two distinct can have serious consequences: the limitations of the proposed representation may be perceived as limitations of the underlying representation, becoming a source of restrictions on the generalizations that can be expressed. For example, once a predicate-argument representation is chosen as the underlying representation of a sentence, the solution to the Alignment Problem is forced to take a certain form, whether or not this is appropriate.

1.2 The Instrumental Problem and the Control Relation

The control relation will be introduced to account for the acceptable occurrences of instrumental *with* in English,[7] those uses of *with* which indicate that its object functions semantically as an instrument.[8] Sentences (1-3)-(1-6) illustrate several uses of instrumental *with*.

(1-3) John broke the window with a rock.
(1-4) John opened the door with a key.
(1-5) John wrote the letter with a pen.
(1-6) John chopped the nuts with a knife.

There are also many locative phrases which seem to have an instrumental function, as in (1-7)-(1-10).

(1-7) John came in the car.
(1-8) John cooked the stew on the stove.
(1-9) John saw the stars through the telescope.
(1-10) John tore his sleeve on the fence.

Sometimes both the instrumental use of *with* and the locative prepositions

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7. The instrumental use of *with* can occur optionally with some English verbs. Chafe [1970] and Dik [1978] suggest that these verbs form a semantic class. For the purpose of the discussion here the identity of this class of verbs is not relevant. The question is what factors govern the acceptable use of *with*, given that the verb allows an instrumental phrase.

8. Not all uses of the preposition *with* are instrumental in function. The other frequent uses of *with* include the possessive, proximity, manner, comitative, and patient uses, illustrated by i-v below. Although these uses will not be examined further, they are presented in order that they can be distinguished from the instrumental use. (See [Nilsen 1973] for a thorough discussion of the uses of *with*.)

i. (possessive) I saw the man with the blue hat.
ii. (proximity) The pens are with the paper.
iii. (manner) John opened the gifts with enthusiasm.
iv. (comitative) John came with Mary.
v. (patient) John smeared the wall with paint.

In many of the examples considered the *with* phrase can have either an instrumental or comitative reading. Only the instrumental reading will be of interest. Since, in some sentences, the acceptability varies according to the reading, all acceptability judgements will be with respect to the instrumental reading.

are acceptable to indicate that an entity is being used as an instrument, while in other situations only one is possible, as illustrated in (1-11)-(1-12).

(1-11).a # John cooked the cake with the oven.[9]
(1-11).b John cooked the cake in the oven.

(1-12).a John cut his foot with a piece of glass.
(1-12).b John cut his foot on a piece of glass.

The problem of determining the factors that govern the acceptable use of locative and *with* phrases with an instrumental function and of characterizing the appropriate conditions for the use of each will be referred to as the Instrumental Problem. The Instrumental Problem, therefore, subsumes the problem of explaining the acceptable occurrences of *with*.

Compare the two sentences in (1-12). Although the noun phrase *a piece of glass* appears to have an instrumental function in both sentences, there is a subtle semantic difference between the two. In (1-12).a, John could have used the piece of glass to hurt himself, but in (1-12).b, this could not be the case. If John stepped on some broken glass on the beach, only sentence (1-12).b, and not (1-12).a, is appropriate.

The control relation will be introduced to capture the difference between the locative and *with* phrases having an instrumental function. It is a relation between two participants, the controller and the controlled object, which holds if the controller controls the controlled object. The instrumental use of the preposition *with* in a sentence indicates an occurrence of the control relation in which the object of *with* is the controlled object. The difference found between (1-11)-(1-12) would be predicted by the notion of control: *with* indicates a controlled use of the instrument, so the expected reading of (1-11) should suggest that John in some way manipulated the piece of glass.

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9. The symbol # will be used to mark sentences which are allegedly unacceptable for semantic reasons.

The concept of control was initially suggested by Nilsen's study of the instrumental case [Nilsen 1973].[10] Nilsen attempts to define cases in terms of a set of features, and he uses the notion of control to motivate two of these features, *Controller* and *Controlled*. The agent case will include the features [+Controller], [-Controlled] while the instrumental case includes the feature [+Controlled] and is unspecified as to Controller. Although what I mean by the notion of control is similar to what Nilsen means, I will show that any feature motivated by the notion of control will not be sufficient to explain the observed behavior of instrumental *with*; it must be used to define a relation.

1.3 A Sketch of the Argument

An account of the distribution of instrumental *with* within the framework presented here will necessitate including the control relation in the underlying representation of some sentences as well as a predicate-argument representation. The argument for introducing the control relation consists of two parts: (1) proposing the form that an account of the acceptable occurrences of *with* might take and (2) showing that the proposed solution is viable if the control relation is introduced. As a starting point I will take the approach to instrumental *with* found in work on case and thematic relations.

The definition of the Instrumental role found in most work on case and thematic relations is supposed to characterize the semantic function of noun phrases which occur as the object of the preposition *with*, the

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10. The term control as used in Dik [1978] is more general than the use here. Dik introduces the notion of control as one of the parameters in a typology of states of affairs: "a state of affairs is controlled if one of the entities involved in it, the controller, has the power to determine whether or not the state of affairs will obtain" (Dik, p. 33).

preposition taken as the default marker of the Instrumental role in agentive sentences. This approach is inadequate due to the existence of noun phrases whose semantic function in a sentence satisfies the definition of the Instrumental role although the noun phrase appears as the object of a locative preposition. The applicability of the definition of instrument to both *with* and locative phrases[11] suggests that the problem of accounting for the distribution of instrumental *with* should be solved by addressing a larger problem, the Instrumental Problem.

The question now is: what form should a solution to the Instrumental Problem take? There is evidence both for and against considering that the *with* and locative phrases indicate occurrences of the same role; neither alternative alone will suffice, and the two together would seem to be mutually exclusive. The benefits of both options can be retained by treating the locative phrases and *with*, respectively, as indicators of unmarked and marked instances of the Instrumental role in the underlying representation. This solution is consistent with the observed behavior. Any similarities in behavior and semantic function will follow from the fact that both indicate the occurrence of the same role, while differences can be attributed to the marked/unmarked distinction. However, the proposed solution is only justified if the observed differences follow from the distinction and do not have to be stipulated.

The control relation will be introduced expressly to provide this characterization of the marked/unmarked distinction: a marked occurrence of the Instrumental role indicates that the noun phrase which fills the Instrumental role participates in the control relation as a Controlled Object. Since the control relation will allow a uniform account of the differences,

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11. By locative phrase I will mean a locative phrase with instrumental function. Locative phrases which express location will be referred to as true locatives.

this in turn is evidence for retaining the proposed solution to the Instrumental Problem. An underlying representation with the control relation succeeds in accounting for the distribution of acceptable occurrences of *with* where a predicate-argument representation fails. This supports the addition of the control relation to the underlying representation and demonstrates the insufficiency of a purely verb-centered representation of a sentence.

1.4 Overview

Section 2 sets out the framework for the argument for the control relation by examining the properties of the level of underlying representation. Sections 3 and 4 together form the argument itself. First, the approach to instrumental *with* taken in work on case and thematic relations is rejected as inadequate in Section 3, leading to a redefinition of the problem as the Instrumental Problem. Section 3 proposes that a solution to the Instrumental Problem will follow if occurrences of the locative and *with* phrases are treated as unmarked and marked instances of the Instrumental role, respectively. The control relation is introduced in Section 4 to account for the marked/unmarked distinction, showing that this suggested solution to the Instrumental Problem is viable.

2. The Level of Underlying Representation

The choice of representation must take into account that the level of underlying representation should provide a level of semantic abstraction that captures appropriate semantic generalizations which are not evident from the structure of the sentence itself. Therefore, before making a commitment to a specific representation, it is important to identify the type of generalizations that allow the level of underlying representation to provide a level of semantic abstraction. The form that the generalizations take suggests that a predicate-argument representation of a sentence should be included in its underlying representation. Another necessary assumption is that the semantic acceptability of a sentence be determined at the level of underlying representation.

2.1 Properties of the Level of Underlying Representation

The purpose of the level of underlying representation is to make explicit the semantic information encoded in the choice of grammatical relations in a sentence. The interaction of the grammatical relations and the verb in a sentence reveals those aspects of its semantic structure related to the sentence as a description of an event. Intuitively, sentences describe events (actions, states, processes) which are denoted by the verb in the sentence with the noun phrases that bear grammatical relations to the verb denoting the participants that brought about its accomplishment. The solution to the Alignment Problem, which will determine the form that the underlying representation will take, will require making explicit the correspondence between the noun phrases which bear grammatical relations to a verb and the participants in an action in such a way that semantic similarities between different descriptions of the same action or between different actions are brought out. What will this entail?

Sentences (2-1) and (2-2) provide a trivial illustration of the claim that the grammatical relations are involved in relating the noun phrases in a sentence to the participants in an action.

(2-1) John saw Mary.
(2-2) Mary saw John.

In both sentences, the subject is the person who sees and the direct object the one who is seen. If the grammatical relations did not influence the semantic interpretation of the sentences, the two sentences should be synonymous since they contain the same noun phrases.

Yet, the grammatical relations obscure certain regularities. Sentences (2-3) and (2-4) both describe a state change, but the grammatical relation of the noun phrase which denotes the object that undergoes the state change varies: it is subject in (2-3) and direct object in (2-4).

(2-3) John broke the window.
(2-4) The window broke.

Even if the same grammatical relation does not consistently indicate the same participant, the set of grammatical relations found in a sentence as a whole provide enough information to allow the grammatical relations and participants to be matched. The grammatical relation of the noun phrase *the window* depends on whether it occurs with a transitive or intransitive use of the verb *break*. The relation between (2-3)-(2-4) is distinct from the relation between (2-5)-(2-6).

(2-5) John ate the chocolate.
(2-6) John ate.

The subject, in both sentences, is the one who does the eating. The difference between the *break* and *eat* sentences shows that the verb governs the correspondence expected between sentences with the same verb. The two patterns just illustrated are each common to a large class of verbs and provide a basis of verb classification; verbs like *break* form the class of causative verbs.

Not only are there regularities between different uses of the same verb, but there are similarities among different verbs. The subjects of *break* and *eat* in the transitive use of the verbs denotes the animate entity that brought the action about. The verbs *buy* and *sell* provide the most common example of a similarity between verbs that is not obvious from the grammatical relations. These verbs belong to the same semantic class, the verbs of transfer, and describe the same basic action. Both (2-7) and (2-8) describe the transfer of an object, *the book*, using the same source and goal, but the grammatical relations of the source and goal differ in the two sentences.

(2-7) John bought the book from Bill.
(2-8) Bill sold the book to John.

The use of the same preposition with different verbs also seems to correlate systematically with the same semantic concept. For example, *from* indicates a source and *to* a goal, as in (2-7)-(2-8) above, or *with* indicates an instrument and *for* a benefactive as in (2-9) and (2-10), respectively.

(2-9).a John broke the window with the hammer.
(2-9).b John mended the torn book with tape.

(2-10).a John baked a cake for Bill.
(2-10).b John swept the floor for Sam.

The examples show the existence of regularities concerning the semantic organization of a sentence. Although the grammatical relations in a sentence, together with the verb in the sentence, point to the semantic structure of the sentence, the regularities between the sentences are not obvious at the level of grammatical relations. The level of underlying representation is motivated as an alternative to the level of grammatical relations whose structure should be chosen in such a way that the semantic regularities are evident.

All these regularities take the same form: each one results from the existence of noun phrases in different sentences which have the same semantic function. Once the correspondences in semantic function are brought out, they can be used to define verb classes according to the semantic function of the set of noun phrases that can occur with the verb. The underlying representation should be chosen to bring out correspondences; to do this it can assign the same representation to noun phrases with a similar semantic function. It is in this sense that the level of underlying representation provides a level of semantic abstraction. The level of grammatical relation cannot be used as the level of underlying representation since noun phrases which have a common semantic function across sentences do not consistently have the same grammatical relations. Instead, associated with the level of underlying representation there will have to be a set of realization rules that establishes the relation between the level of underlying representation and the level of grammatical relations.

Are there any criteria for determining what aspects of the semantic interpretation of a sentence belong in its underlying representation? Semantic differences between sentences due to differences in the grammatical relations should be reflected at the level of underlying representation since this level is supposed to make explicit the semantic information encoded in the grammatical relations. For example, the two sentences with *smear*, (2-11) and (2-12), show a subtle semantic difference although the way the noun phrases participate in the action is the same.

(2-11) John smeared the wall with paint.
(2-12) John smeared paint on the wall.

(The difference is concerned with whether the sentence has a holistic or partitive interpretation [Anderson 1971].) Since the interpretation depends on the grammatical relations in a sentence, this distinction should be represented in the underlying representation, although how remains an open

question.[1]

A second guideline to follow is to avoid confusing semantic differences due to intrinsic semantic properties of a noun phrase with those attributable to the grammatical relation of a noun phrase. This problem has been a source of confusion in case grammar.[2] As an example, consider (2-13)-(2-14).

(2-13) The rock broke the window.
(2-14) John broke the window.
(2-15) The wind broke the branch.

Should the semantic difference between these sentences be represented in their underlying representation? Most work on case relations accepts that the subjects of these sentences have different semantic functions and represents the difference at the level of underlying representation.[3] This decision is not made on the basis of these sentences alone. There are other grammatical relations that appear to convey the same semantic notions as the subjects of (2-14) and (2-15) as illustrated by (2-16) and (2-17).

(2-16) John broke the window with a rock.

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1. This example is here for illustrative purposes. I will not propose a solution to it. For more discussion see Anderson [1971], Celce-Murcia [1972], Chomsky [1972], Fillmore [1968], Stockwell, Schachter, and Partee [1973]. The most important question this example raises is whether the two sentences have the same predicate-argument representation with the difference made explicit in some other manner, or whether the distinction is explicit in the choice of predicate-argument representation. The second solution may seem preferable if the underlying representation is equated with a predicate-argument representation. The situation is further complicated by pairs of sentences such as (i)-(ii) and (iii)-(iv) which show the a similar difference in meaning.

i. John read the book.
ii. John read from the book.
iii. John drained the tub of water.
iv. John drained water from the tub.

2. See Huddleston [1970] for a discussion of some problems found in work on case relations which follow from this confusion.
3. This is achieved by assigning the subjects to different cases.

(2-17) The branch broke from the wind.

As a further example consider (2-18) and (2-19).[4]

(2-18) The rock rolled down the hill.
(2-19) John rolled down the hill

Both sentences describe the motion of the entity denoted by the subject. The sentences differ in that the sentence with an animate subject, (2-19), is ambiguous, while (2-18) is not. Sentence (2-19) can have a reading corresponding to the reading of (2-18) in which there is an external cause of the movement. Sentence (2-19) can also mean that John moved himself intentionally. The question once again is whether the difference should be represented in the underlying representation? In a system of case or thematic relations, this difference is made explicit (see Section 2.2).

How should ambiguities such as that in (2-20) be handled?

(2-20) He rented the house next door yesterday.

In (2-20), the subject of *rent*, a verb of transfer, could be either the landlord or tenant, but the sentence alone is not sufficient to allow the decision to be made. When put in the appropriate context, (2-20) can be disambiguated.[5] If (2-20) is preceded by (2-21), the subject is understood as the landlord, while if (2-20) follows (2-22), the subject is the tenant.

(2-21) John put an ad in the paper two days ago.
(2-22) John is moving to this neighborhood.

Since sentence (2-20) is ambiguous when presented without any context, its disambiguation in the context of (2-21) or (2-22) cannot be attributed to the sentence itself. Therefore, the ambiguity should be reflected in the underlying representation of the sentence; the underlying representation

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4. Gruber first discusses the problem presented by examples such as these.
5. Additional information also allows the sentence to be disambiguated, as in (i)-(ii).

i. He rented the house from Bill.
ii. He rented the house to Bill.

should not specify whether the subject is tenant or landlord.

The *rent* example illustrates a property that the level of underlying representation should maintain: context-independence; that is, the underlying representation of a sentence should make explicit only semantic information reflected in the grammatical relations that can be determined independent of the context the sentence is found in. This property is necessary to determine how to treat ambiguities which can only be resolved by additional context. By preserving context-independence, the level of underlying representation will not be forced to make a commitment to an incorrect representation.

The level of underlying representation is supposed to make explicit semantic information encoded in the grammatical relations which conveys the *semantic structure of a sentence* as a description of an event and its participants. There are other possible sources of semantic information that contribute to this aspect of the semantic interpretation of a sentence; two mentioned above were the context that a sentence is found in and the intrinsic semantic properties of the noun phrases in a sentence. The underlying representation should not make explicit information derived from these sources. Once recognized, they provide guidelines for determining whether some aspect of the semantic interpretation of a sentence belongs in the underlying representation.

2.2 The Predicate-Argument Representation

Having considered some general properties of the underlying representation, the question to ask is: what is the structure of such a representation? Suppose there were a specific representation scheme which would allow certain generalizations of the type discussed in the previous section to be captured if it were incorporated within the underlying

representation. This representation would be a necessary part of the underlying representation, but it could not automatically be equated with the underlying representation. A candidate for such a representation is a predicate-argument representation because of the treatment of generalizations it allows.[6]

The purpose of formulating a level of underlying representation is to make explicit semantic properties of a sentence, which, although not always apparent at the level of grammatical relations, are encoded in the choice of grammatical relations in a sentence. These properties are primarily related to the sentence as a description of an action and the participants involved in it. A predicate-argument representation[7] can provide a representation of this aspect of the semantic organization of the sentence. In this approach, the verb, which denotes the action described in the sentence, is viewed as a predicate, and the noun phrases bearing grammatical relations to the verb, each of them a participant in the action, are considered to be in argument relations.

The evidence in favor of a particular predicate-argument representation depends on its ability to provide a level of abstraction through

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6. Lexical rules can be used to express some of the same generalizations as a predicate-argument representation. These rules have been used to relate noun phrases in different subcategorization frames of a verb that have the same semantic restrictions. Predicate-argument relations are introduced, in part, for this reason. Both provide a level of abstraction for making certain semantic well-formedness judgements. See Wasow [1977] for a discussion of the properties of lexical rules. In a later paper [Wasow 1978], following a suggestion in Anderson [1977], Wasow remarks that his class of lexical rules are rules that should be formulated in terms of thematic relations as opposed to transformations which should be formulated in terms of grammatical relations.

7. Aspects of the predicate-argument representation that are not relevant to the argument here will be ignored in this presentation.

the appropriate choice of a small fixed set of predicate-argument relations.[8] The predicate-argument relations are a set of abstract relations used to identify the semantic function of the noun phrases in a sentence.[9] The similarity between sentences with noun phrases that have the same semantic function is made explicit by assigning the noun phrases to the same predicate-argument relation. The intuitive semantic roles of the noun phrases in a sentence are used to provide a definition associated with each predicate-argument relation which can be used to determine whether a noun phrase in a sentence fills that relation. Each of these relations is typically expressed by certain grammatical relations. The grammatical relations themselves are not used as predicate-argument relations since they are unable to adequately capture semantic generalizations.

As well as a set of predicate-argument relations, there is a second component to a level of predicate-argument representation: a set of predicate-argument structures,[10] one for each verb. The predicate-argument structure of a verb is an abstract characterization of the set of possible predicate-argument relations that occur with a verb including a specification of whether each is optional or obligatory. By describing the predicate-argument structures of different verbs in terms of a canonical set of relations certain semantic similarities between verbs can be made evident.

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8. If a noun phrase is in an argument relation to a verb, then it fills a predicate-argument relation. It is important not to confuse the predicate-argument relation, the noun phrase that fills the relation, and the object denoted by that noun phrase. The distinction between the predicate-argument relation and the other two will be expecially important. I will refer to the predicate-argument relations by capitalizing their names. When referring to the noun phrase that fills a relation or the object it denotes by their semantic function, I will not capitalize the name of the relation. (I will ignore the distinction between these two.)

9. The predicate-argument relations correspond to cases in Fillmore [1968] or thematic relations in Gruber [1965].

10. These would correspond to case frames in Fillmore [1968].

Besides these two components, a method of relating the level of predicate-argument representation and the level of grammatical relations, will be needed. Finally, there are semantic restrictions imposed by the verb on each role which must be met for the sentence to be acceptable; these will be discussed in Section 2.3.

The set of predicate-argument relations and analyses of predicate-argument structures of verbs that I will adopt here is derived from the work done in case and thematic relations. Many proposals for predicate-argument representations have been formulated with these sets of relations; they have differed in the purpose for which they were proposed as well as in their approach to the problem of describing role[11] structure. But over a large set of verbs, including those relevant to the Instrumental Problem, the generalizations identified and the analyses proposed have many common elements.

The set of roles[12] I will use are Agent, Patient, Goal, Source, Locative, and Instrument. They will not be defined except by example but will be used in a way that is consistent with other work in case and thematic relations. Although this is not intended to be a comprehensive set of roles for English, it provides a standard set which is sufficient to describe the data presented here. This data will consist mainly of simple transitive and intransitive sentences. The prepositions used will be limited to *with*, the use of *from* to indicate a force, and locative prepositions, as well as the

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11. The terms "role" and "predicate-argument relation" will be used interchangeably, as will "role structure" and "predicate-argument structure".

12. There has been much disagreement as to what makes up a standard set of roles. The justification for choosing a set of roles is their ability to capture generalizations. A discussion of the criteria used to identify whether noun phrases bearing different grammatical relations to the same verbs have the same role will be left to Section 3.2 where this problem will be considered in relation to the Instrumental role.

prepositions *to* and *from* used to indicate the goal and source of transfer verbs respectively.

One of the most common examples cited in favor of a predicate-argument representation is shown in (2-23)-(2-24).

(2-23) John broke the window.
(2-24) The window broke.

Although the similarity in the role of the window in the action is not evident from the grammatical relations, the similarity can be captured by assigning the noun phrase *the window* to the same predicate-argument relation in the predicate-argument representation of both sentences, the Patient role. The subject of (2-23), the noun phrase denoting the person who brings the action about, will be the Agent.

The support for including a predicate-argument representation of a sentence as part of its underlying representation is its ability to provide a level of abstraction for stating semantic generalizations such as those pointed out in the analysis of the verb *break* above. This analysis and the analyses of the verbs *buy*, *sell*, *rent*, and *move* that follow illustrate some of the most significant generalizations found in work on case and thematic relations; these are also the most widely agreed upon. The examples have been chosen since their predicate-argument structure will be necesary for the discussion of the Instrumental Problem.

The example with *break* demonstrates that a predicate-argument representation can capture the similarities between different uses of the same verbs; it can also be used to bring out the semantic similarity between uses of different verbs. *Buy* and *sell* are both verbs of transfer;[13] they describe the transfer of an object, the Patient, from a source to a goal.

(2-25) John bought the book from Bill.

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13. This analysis of verbs of transfer is the one given by Gruber [1965].

(2-26) Bill sold the book to John.

The grammatical relations do not make obvious that both transactions involve a source, goal, and transferred object. A predicate-argument representation can assign the noun phrase *John* to Goal, *Bill* to Source, and *the book* to Patient in each of the sentences. The sentences differ in that the agent of *buy* is also the goal of the transfer while the agent of *sell* is the source of the transfer. The subject of each of these verbs has two roles in the predicate-argument structure, Agent and either Source or Goal depending on the verb. In this way the similarities and differences in the role structure of sentences such as (2-25)-(2-26) will be captured. The presence of shared roles in the predicate-argument structure of the two verbs will reflect their semantic similarities.

The analysis of *buy* and *sell* raises a question about the predicate-argument representation: can two roles be filled by the same noun phrase in the underlying representation? Although this was not permitted in early work on case relations [Fillmore 1968], it is necessary for bringing out the semantic similarities and differences between the pair of sentences (2-25)-(2-26): the sentences both have the same Source and Goal, but the Agent differs. Assigning the subject of either sentence only to the Agent role would not make explicit the role of the subject noun phrase in the transaction, so the similarity between the two would not be obvious. Assigning the subject to the Source role or the Goal role only would not bring out the difference.

The assignment of predicate-argument relations to the verb *buy* and *sell* also describes the roles associated with the verb *rent*, another verb of transfer. The landlord is the source and the tenant the goal of the renting transaction. The choice of agent depends on the sentence; it will be the source in (2-27) and the goal in (2-28).

(2-27) John rented the house to Bill.

(2-28) Bill rented the house to John.

This choice of predicate-argument relations will also handle the ambiguity in (2-29).

(2-29) John rented the house.

If this sentence is considered to describe an act of renting a house with *John* as agent and *the house* as patient, then the predicate-argument representation of this sentence reflects the ambiguity. As a verb of transfer, *rent*'s predicate-argument structure includes a Source and Goal, but the assignment of predicate-argument relations to (2-29), by leaving the Goal and Source unspecified, indicates that nothing else about the transaction is known.

The existence of the ambiguity found with some uses of intransitive verbs of motion can be made explicit in a predicate-argument representation. Occurrences of intransitive verbs of motion with animate subjects show an ambiguity that is not present when the same verbs are used with inanimate subjects, as illustrated by the verb *move* in (2-30)-(2-31).

(2-30) John moved.
(2-31) The rock moved.

To indicate that both subjects move, they are assigned to the Patient role. The possibility of intention present in (2-31), which results in the ambiguity, can be attributed to the fact that an animate entity is capable of agency. This can be made explicit by assigning animate subjects to the Agent role as well as the Patient role. The presence of ambiguity would be associated with the fact that an animate subjects of *move* would be both Patient and Agent.

If the predicate-argument representation is adopted as part of the underlying representation, there is a certain restriction on what can be represented with it which must be recognized since it will limit the range

of phenomena which a predicate-argument representation can describe. The predicate-argument representation was originally proposed to deal with a certain set of problems, and it was able to do so because the problems all had the same form. The applicability of a predicate-argument representation to other phenomena depends on their having the appropriate form.

A predicate-argument representation of a sentence gives a verb-centered view of the semantics of the sentence: it can describe the role of each participant in an action in relation to the action but not in relation to another participant. The semantic properties reflected in the choice of grammatical relations appear to be those related to the sentence as a description of an action and its participants; the most important part of such a description is the role of each participant in the action. Therefore, it seems plausible that the underlying representation should include a verb-centered view of a sentence. A predicate-argument representation of some phenomenon will be possible if it requires only a verb-centered description; this will turn out to be a problem for the Instrumental role. This limitation on predicate-argument representation has consequences for the problem of determining semantic well-formedness which will be discussed in Section 2.3.

In most work on case relations, many prepositions are simply regarded as case markers; that is, they are considered to be indicators of the occurrence of one or more cases devoid of any semantic content. This view is in part a result of the verb-centered nature of the predicate-argument representation. Generally each case has a default preposition associated with it; any exceptions will be lexically marked (see Fillmore [1968], Stockwell, Schachter, and Partee [1973]). This approach to prepositions will turn out

to be insufficient and miss generalizations.[14]

A level of underlying representation which includes the predicate-argument representation set out in this section will be used as the initial framework for the discussion of the Instrumental Problem. A predicate-argument representation has been proposed as part of the level of underlying representation because it provides a level of abstraction for stating semantic properties of sentences concerned with the role of participants in an action. A predicate-argument representation is a necessary part of the underlying representation but is not sufficient as the underlying representation: it will never be able to capture certain generalizations because of its inherently verb-centered nature. But any limitations, once recognized, will reveal more about the structure of the underlying representation.

2.3 Semantic Acceptability

The notion of semantic acceptability will play an important part in the discussion of the Instrumental Problem. A solution to this problem requires an understanding of the factors which determine whether or not a use of *with* is semantically acceptable. The attempt to account for data concerning the semantically acceptable uses of *with* will lead to the identification of the control relation. This section will introduce several assumptions relevant to the question of determining semantic acceptability. First, I will assume that semantic acceptability will be determined at the level of underlying representation: that is, a semantically acceptable sentence is one whose underlying representation is semantically well-formed. This assumption follows in part from the requirement that the level of

14. Jackendoff [1977] discusses some problems with considering prepositions as case-markers.

underlying representation provide a level of semantic abstraction. I will also assume that the semantic well-formedness of a sentence's underlying representation is determined with respect to a world model.[15]

The unacceptability of certain sentences can only be attributed to semantic factors since they have acceptable counterparts with the same verb and syntactic structure which differ from them only in one of the noun phrases bearing a grammatical relation to the verb. Sentences (2-32) and (2-33) are such a pair. The unacceptability of (2-33) can only be due to the noun phrase in direct object position.

(2-32) John broke the window.
(2-33) # John broke the sand.[16]

The existence of such pairs suggests that there are certain semantic restrictions on the noun phrases bearing grammatical relations which must be met to guarantee acceptability. In order to decide whether a sentence is semantically acceptable, it will be necessary to have some way of determining whether these conditions are met. But this raises another question: at what level is semantic acceptability determined, at the level of grammatical relations or at the level of underlying representation? I will assume that semantic acceptability judgements are made at the level of

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15. This assumption in not quite right. The acceptability of certain sentences depends on knowledge of the language as well as knowledge of the world, but it can be very hard to draw the line between them.

16. I am assuming that acceptability judgements are made with respect to an ordinary context. Given an unusual context, any of the sentences marked as unacceptable could receive an acceptable reading; for example compare (i) and (ii).

i. John knocked over the trees as he walked.
ii. The giant knocked over the trees as he walked.

In (2-32)-(2-33), an entity must have a rigid form to be breakable, so if there were a rigid form of sand, (2-33) would be acceptable. This restriction on the direct object of *break* is brought out by the contrast between the type of ice cream referred to in *break the ice cream* and *mop up the ice cream*.

underlying representation rather than at the level of grammatical relations.

This assumption is supported by evidence that it is preferable to state semantic restrictions on noun phrases with respect to a predicate-argument representation, as illustrated in sentences (2-34)-(2-36).

(2-34).a The boy opened the box with a key.
(2-34).b # The boy opened the ball with a key.

(2-35).a The key opened the box.
(2-35).b # The key opened the ball.

(2-36).a The box opened.
(2-36).b # The ball opened.

The contrast in acceptability between the (a) and (b) sentences can only be accounted for by the change in noun phrase. Although the grammatical relation of the noun phrase that changes differs from sentence to sentence, its role in all the sentences is the same: the Patient role. The same semantic restriction[17] is applicable to all occurrences of the same role despite the variation in grammatical relations. Associating the restrictions with the roles rather than the grammatical relation avoids redundancy.

The semantic restrictions on each role are imposed by the verb on the possible noun phrases that can fill the role. As an example consider (2-37) and (2-38).

(2-37) John broke the ice cream.
(2-38) John mopped up the ice cream.

The noun phrase *ice cream* fills the Patient role in both sentences, but the conception of ice cream differs according to the choice of verb. In (2-37)

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17. The definitions of roles found in work on case and thematic relations are merely a variant of semantic restrictions. The definitions attempt to identify the noun phrases which can fill a role by characterizing the semantic function of the noun phrases. The definitions simultaneously limit the possible fillers: noun phrases which could never have that function because of some inherent semantic property will always be excluded.

the referent of the noun phrase *ice cream* would be an ice cream on a stick or ice cream sandwich (some rigid form of ice cream), but in (2-38) the referent is probably melted ice cream.

For some roles, it seems more likely that the restrictions follow from properties of the roles themselves: as an example, agents are animate entities.[18] Entities are often classified according to whether they function as instruments, forces, or locations. The noun phrases *hammer, needle, broom* are considered instruments, while *wind, sun, lightning* are considered forces. But not all noun phrases which are considered instruments (or locations or forces) are always appropriate; the verb in the sentence restricts the possibilities, as the verb *slice* does in (2-39)-(2-40).

(2-39) John sliced the bread with a knife.
(2-40) # John sliced the bread with a hammer.

A predicate-argument representation is able to provide a level of abstraction where certain semantic well-formedness judgements can be made. Given that such a representation is part of the proposed level of underlying representation, this ability suggests that the semantic acceptability of a sentence should be determined at the level of underlying representation. This assumption implies that the underlying representation of a sentence will have to include any information necessary to determine its acceptability.

The semantic restriction on each role in the predicate-argument representation of a sentence must be satisfied, if the sentence is to be acceptable. The restrictions on the possible fillers of the role are determined by the verb. The restrictions on each role are independent of those on the other roles in the role structure of a verb. There are no restrictions that depend on relations between the roles. These properties of the semantic

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18. There are exceptions such as robots, banks, governments, organizations, or other entities that have been personified.

restrictions on the roles follow from a limitation on the predicate-argument representation: it is inherently verb-centered (see Section 2.2). As a result of this limitation, only variations in semantic acceptability caused by variations in the noun phrases that fill a given grammatical relation (illustrated by (2-32)-(2-33)) can be explained by a failure to meet the semantic restrictions on a predicate-argument relation. If the semantic acceptability of a sentence depends on a more complex interaction between the noun phrases in a sentence, some other explanation will be required. The control relation will be proposed for this reason.

The control relation, which will be introduced as a part of the underlying representation to provide a solution to the Instrumental Problem, is needed to explain acceptability facts concerning the preposition *with*. Just as there are restrictions on the noun phrases that can fill a predicate-argument relation, there are semantic restrictions on the participants of the control relation. The control relation requires that the role of the Controller be filled by an animate entity and that the role of Controlled Object be filled by an object which an animate entity can control. A hammer but not a wall could be a possible controlled object since the former, unlike the latter, is manipulable. This is brought out by the difference in acceptability of (2-41) and (2-42).

(2-41) John broke the vase with the hammer.
(2-42) # John broke the vase with the wall.

Instances of either relations such as the control relation or predicate-argument relations must satisfy the restrictions on them if the sentence they occur in is to be acceptable.

The examples presented show that the unacceptability of certain sentences is due to semantic reasons. Assuming that semantic acceptability is determined at the level of underlying representation, a semantically unacceptable sentence is one that does not meet certain restrictions on the

underlying representation. A semantically acceptable sentence, therefore, is one whose underlying representation is well-formed. The next question is: how does one determine whether a sentence's underlying representation is well-formed? An answer requires a second assumption concerning semantic acceptability.

I will assume that the well-formedness of the underlying representation is determined with respect to a model of the world which a speaker of a language has. The underlying representation of a sentence must be consistent with the world model if the sentence is to be acceptable. I will not be concerned with discovering the structure of the world model. The exact criteria which determine acceptability are not relevant; instead, I will assume that it is possible to determine whether or not the underlying representation of a sentence meets the well-formedness conditions.

For example, to decide whether the control relation is possible in a particular situation requires knowledge of the world. The preposition *with* can be used instrumentally if the control relation can apply. An unacceptable use of instrumental *with* reflects the impossibility of expressing an instance of the control relation. Consider the sentences (2-43) and (2-44):

(2-43) John broke the window with a hammer.
(2-44) # John broke the window with a wall.

The fact that people do not usually say (2-44) is based on the knowledge that a person is likely to be able to control (manipulate) a hammer, but unlikely to be able to control a wall. Of course there are exceptions, as in (2-45).

(2-45) Superman broke the window with a wall.

Witherspoon's [1977] discussion of the phenomenon of "subject-object inversion" in Navajo gives additional motivation for the assumption that semantic acceptability should be determined with respect to the model of the world that a speaker of a language has. Navajo allows

two orders of the actor (agent) and goal (patient) in a sentence. The actor can precede the goal or vice versa; the option selected is indicated by a prefix on the verb. For a given choice of noun phrases as actor and goal, there are constraints on which orders are possible. Witherspoon suggests that the impossibility of certain orders given a choice of noun phrases is not due to a syntactic violation but that the constraints depend on the model of the world that a Navajo speaker has.

There are other approaches to determining semantic acceptability. An alternative proposal for dealing with semantic restrictions on predicate-argument relations is to state the relations explicitly, for example by using a feature system such as semantic markers [Katz and Fodor 1964]. There are problems with any attempt at making the restrictions explicit since judgements cannot be absolute but must be made relative to a situation. Unusual contexts where the expected possibility is violated would also create difficulties for such approaches.

One final assumption needs to be made concerning the relation between the mapping carried out by the realization rules[19] and the problem of determining the semantic well-formedness of the underlying representation. This assumption, which will be referred to as the Independence Assumption, is that the realization rules and the process of determining semantic well-formedness are independent. Another way to say this is that determining the semantic acceptability of the underlying representation of a sentence is independent of mapping the underlying representation to grammatical relations. As a consequence of this assumption, the realization rules need only be sensitive to the structure of the

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19. This is the set of rules that relates the level of underlying representation and the level of grammatical relations. I will not make any claims about the nature of these rules, although they should be as simple as possible.

underlying representation of a sentence -- to what is explicit in the representation itself. In the context of a predicate-argument representation, this means that the realization rules will be able to refer to the predicate-argument relations but should not be sensitive to properties of the noun phrases which fill the relations. This second ability is necessary for making acceptability decisions.

The Independence Assumption will enable the realization rules to ignore the problem of the semantic well-formedness of the underlying representation of a sentence. It is not necessary to separate the process of determining acceptability from the mapping since it is possible to incorporate a filter within the mapping rules to determine acceptability. Not only would this sacrifice simplicity by complicating the rules, but it would also sacrifice modularity. The purpose of the realization rules is to relate the level of underlying representation to the level of grammatical relations; determining semantic acceptability is not the responsibility of these rules.

2.4 Summary

The overall framework set out in this section,[20] which will be used as a basis for the investigation of the Instrumental Problem, can be summarized as follows: There are two levels of representation, the level of underlying representation and the level of grammatical relations, which will be related by a set of realization rules. The level of grammatical relations provides a description of a sentence in terms of the grammatical relations in the sentence. The level of underlying representation is supposed to provide a level of semantic abstraction which brings out the aspects of the semantic structure of a sentence relating to the sentence as a description of an event

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20. The framework as summarized here resembles that set out in Jackendoff [1978].

and its participants. For this reason, the underlying representation of a sentence will include a predicate-argument representation of the sentence. There are conditions on the well-formedness of the underlying representation of a sentence which must be satisfied if the sentence is to be semantically acceptable. I will assume that a sentence is semantically acceptable if its underlying representation is well-formed and that the well-formedness judgements are made with respect to a world model.

3. The Instrumental Problem

Finding an account of the distribution of instrumental *with* in English[1] is part of a larger problem, the Instrumental Problem: that of determining the factors that govern the acceptable occurrences of *with* and locative phrases with an instrumental function in English. The conception of instrument found in work on case and thematic relations is inadequate for explaining the distribution of *with*. The typical approach to the problem is to give an intuitive definition of the Instrumental role, and then, to assume the preposition *with* is the default marker of the Instrumental role in agentive sentences. This approach fails to recognize that the notion of instrument appears to be expressed by certain locative phrases as well as *with* phrases. If the notion of instrument is to be retained the distribution of *with* must be examined in the larger context of the Instrumental Problem.

Having redefined the problem, this section presents the first part of the argument for the control relation; it introduces the form that a solution to the Instrumental Problem must take. The properties of the two types of instrumental phrase cannot be explained within a predicate-argument representation. Although there is evidence for assigning the object of both prepositions to the same role, there is also evidence against this. A solution will be possible if the locative and *with* phrases are taken to indicate unmarked and marked occurrences of the Instrumental role in the underlying representation, respectively.

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1. By distribution of a grammatical relation or prepositional phrase, I mean the set of acceptable occurrences of that grammatical relation or prepositional phrase in English sentences.

3.1 The Instrumental Role in Other Work

Assume initially as part of the level of underlying representation a predicate-argument representation such as the one discussed in Section 2.2 and exemplified by systems of case and thematic relations. How is the distribution of *with* explained within this framework? An account will require identifying the role filled by the object of the preposition,[2] as well as a realization rule that maps the appropriate instances of the role to the prepositional phrase whose head is *with*, and the semantic well-formedness conditions that must be met by a noun phrase which fills this role within the underlying representation. A role definition as found in work on case and thematic relations is, in a sense, a statement of these conditions since it gives a method of discriminating between occurrences of that role and other roles. A comparison of the acceptable occurrences of *with* with those predicted by the definition provides check on the validity of the solution.

In work in case and thematic relations, the instrumental use of *with* is recognized as one of two options typically used for expressing the Instrumental role at the level of grammatical relations. The other option is to use the grammatical relation subject. The verb *break* has been used as a paradigm example for showing the grammatical relations associated with the Instrumental role; it can appear in subject position in the absence of an Agent or marked by *with* otherwise, as illustrated in (3-1).

(3-1).a John broke the window with a hammer.
(3-1).b The hammer broke the window.

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2. For brevity, I will say "the object of the preposition fills the role *X*" instead of "the noun phrase which is the object of the preposition fills the role *X* in the underlying representation of the sentence it is in." In the same way, "the direct object fills the *X* role" will mean that "the noun phrase which is in the grammatical relation direct object in the sentence fills the role *X* in the underlying representation of the sentence."

The definitions of Instrument found in work on case and thematic relations were formulated with this paradigm in mind. As an initial characterization of the Instrumental role, some definitions found in this work are given below:

> The case of the inanimate force or object causally involved in the action or state identified by the verb. [Fillmore 1968]
>
> Some object which plays a role in bringing a process about, but which is not a motivating force, cause, or instigator. [Chafe 1970]
>
> Something used to perform an action. [Grimes 1975]

These definitions all identify some common properties of the entity which fills the Instrument role in the predicate-argument representation of a sentence; it is an entity which can be used by an agent in bringing about an action. The definitions given here have purposefully not been made more precise, since this vagueness deriving from a superficial attempt to capture semantic intuition is typical. I will refer to a definition such as these as the intuitive definition of the Instrument role.

The effectiveness of the intuitive definition of Instrument cannot be evaluated in isolation; it must be evaluated with respect to the data it is supposed to describe. The definition is meant to be an explicit characterization of the semantic function of instrumental phrases, which distinguishes them from other roles. If the role of a participant in an action satisfies the definition of Instrument, then one would expect that it fills the Instrumental role and should appear as the object of *with*.

The intuitive definition of the Instrument role can be used to determine whether a participant in an action can function as an instrument. The ability to make this decision is necessary to predict whether the underlying representation of an action is well-formed. If the *break* sentences (3-1) are taken as a guide, the distribution of instrumental phrases

can easily be described. At the level of grammatical relations, there are two ways to indicate that a noun phrase fills the Instrumental role in the underlying representation of a sentence: the preposition *with* can indicate that its object is the noun phrase which fills the Instrumental role in sentences with an Agent, or the noun phrase can be used as the subject otherwise.[3]

If this account of the distribution of *with* is correct, then it follows that a noun phrase which according to the intuitive definition fills the Instrumental role should occur as the object of *with*. But, the account fails to predict only acceptable occurrences of *with*. There are entities whose function in an action satisfies the conditions on the Instrumental role, according to the intuitive definition given, but the sentence describing the action is unacceptable if the noun phrase denoting the entity occurs as the object of *with* at the level of grammatical relations. As an example, consider the acts of cooking or baking: an oven might be considered an instrument of these actions since it is used by the agent to bring about the cooking of food. Yet, sentences (3-2) and (3-3) are unacceptable.

(3-2) # The chef cooked the meat with the oven.
(3-3) # The chef baked the cake with the oven.

Instead, these actions are usually described as in (3-4) and (3-5), using a locative preposition instead of *with*.

(3-4) The chef cooked the meat in the oven.
(3-5) The chef baked the cake in the oven.

The preposition *with*, which indicates the presence of the Instrumental role in agentive sentences, does not occur with these verbs. The behavior observed with these verbs is not exceptional; sentences

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3. In the following chapters, the focus will be on understanding the distribution of *with* phrases with an instrumental function, since this is directly relevant to the control relation. The problem of subjects which seem to have an instrumental function will be ignored.

(3-6)-(3-11) illustrate other examples of locative phrases with an instrumental function.[4]

(3-6) John saw Mary in the mirror,
(3-7) John saw the stars through the telescope.
(3-8) John cut his foot on a piece of glass.
(3-9) John came in the car.
(3-10) John broke the vase against the wall.[5]
(3-11) John tore his coat on the fence.

Assuming a level of predicate-argument representation with an Instrumental role as defined above and a corresponding realization rule leads to an incorrect prediction because the existence of locative phrases with an instrumental function has generally been ignored.[6] Any attempt to provide an explanation of the distribution of instrumental *with* in isolation is unlikely to succeed. An account must be found in the context of the Instrumental Problem, that of determining the acceptable occurrences of locative and *with* phrases with an instrumental function and characterizing the appropriate conditions for the use of each. Having recast the problem, there are two possible options to investigate: (1) the locative and *with* phrases both indicate the presence of the same role, the Same Role Hypothesis, or (2) the object of the locative prepositions and *with* fill distinct roles. The next section will present evidence for the Same Role

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4. The locative prepositions will be treated as if they were one preposition since it is the opposition between the locative prepositions as a class and the preposition *with* that matters. I will not be interested in the problem of determining which of the locative prepositions can occur with a given instrumental noun phrase but only in knowing whether that noun phrase can occur in a locative phrase with an instrumental function.

5. The locative phrase in this sentence may not appear to have an instrumental function, but evidence that it does will be presented. Notice that the wall is not the location of either John or the vase.

6. Grimes [1975], Nilsen [1973], and Wojcik [1976] mention the existence of such phrases. They consider the locative phrases to be instances of the Instrumental role but do not provide an account of the differences between them and *with* phrases.

Hypothesis and the following section evidence against it.

3.2 Evidence for the Same Role Hypothesis

One way to decide between the options is to look for evidence in favor of the Same Role Hypothesis: that the role of the object of *with* and the locative prepositions is the same. In the examples given in the previous section, the semantic function of both phrases seems to satisfy the intuitive definition of the Instrumental role. This section will present further support for considering the locative and *with* phrases to indicate occurrences of the Instrumental role, as defined above. To begin, it is necessary to establish a set of criteria for deciding whether two grammatical relations are alternative syntactic manifestations of the same role. There are at least two criteria which these phrases should meet in order for them both to be considered indicators of the presence of the Instrumental role in the underlying representation:

(1) They should have a similar semantic function.
(2) They should be unable to co-occur in the same sentence.

The first criterion follows trivially from the purpose of identifying roles: if the locative and *with* phrases are considered to indicate the presence of noun phrases that fill the same role in a predicate-argument representation, then they should show a similar semantic function. This seems to be true of the phrases presented above, (3-6)-(3-11). This intuition can be brought out by a test which will be referred to as *questioning the phrase*.[7] Evidence that the locative phrases do not behave like true locatives will be presented as well.

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7. This test has been discussed in Nilsen [1973] as the relative pronoun test. It has also been used by Wojcik [1976].

How is the *wh*-word used to question the Instrumental role; the other *wh*-words cannot be used for this purpose.[8] That is, to elicit the Instrumental role used in an action as the response to a question, the question asked uses the word *how*. For example, corresponding to the declarative sentence (3-12), there is the interrogative sentence (3-13). Sentence (3-13) would be used to find out what John used to break the window. Either the declarative sentence (3-12) or the instrumental phrase alone, (3-14), would be appropriate answers.

(3-12) John broke the window with the hammer.
(3-13) How did John break the window?
(3-14) With a hammer.

The locative phrases with an instrumental function share with *with* phrases the ability to be questioned by *how*. Questioning the locative phrases brings out the intuition that the underlying semantic function of these phrases is instrumental and can also serve as a test for distinguishing these locatives from true locatives. The test is based on the observation that the *wh*-word used to question true locatives is *where*, while *how* is used for instrumental phrases. This phenomenon is illustrated in (3-15) and (3-16).

(3-15).a # How did John put the book? On the table.
(3-15).b Where did John put the book? On the table.

(3-16).a How did John break the vase? With the hammer.
(3-16).b # Where did John break the vase? With the hammer.

The locative phrases with an instrumental function can be questioned by

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8. The *wh*-word *how* is not used exclusively to question the Instrumental role. It can be used to question manner and force phrases as in (i) and (ii), respectively.

i. How did John sing the song? With enthusiasm.
ii. How did the branch break? From the wind.

Therefore, it is only a property of a noun phrase which fills the Instrumental role that it can be questioned by *how*. The ability to question a noun phrase with *how* does not guarantee it fills the Instrumental role.

how rather than *where*:[9]

(3-17) How did John break the vase? On the hammer.
(3-18) How did John cut his foot? On a piece of glass.
(3-19) How did John come? On the train.
(3-20) How did John cook the meat? In the oven.
(3-21) How did John see the comet? Through a telescope.

Questioning the locative phrases with an instrumental function allows them to be distinguished from true locatives. There is another test that also brings out the difference in semantic function: *there* can be used as an anaphoric form which refers to a true locative, but not a locative phrase with an instrumental function. As the unacceptability of (3-23) demonstrates, the verb *put* requires a locative phrase complement. Sentence (3-24) is acceptable, so *there* must be serving as a locative complement.

(3-22) John put the book on the table.
(3-23) # John put the book.
(3-24) John put the book on the table and Bill put one there too.

Conjoining the (b) phrases to the (a) phrases in (3-25)-(3-27) should be possible if the locative phrases have a locative function. The unacceptability of these sentences is further evidence that certain locative phrases do not function as true locatives.

(3-25).a John cut his hand on the knife,
(3-25).b # ... and Bill cut his there too.

(3-26).a John saw the stars through the telescope,
(3-26).b # ... and Bill saw them there too.

(3-27).a John broke the dishes against the wall,
(3-27).b # ... and Bill broke the glasses there too.

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9. *Where* may sometimes seem to be a possible alternative to *how* since, in examples such as (i)-(ii), they both elicit the same response.

i. Where did John cut his foot? On the rock.
ii. How did John cut his foot? On the rock.

Although the response to both questions is the same, the semantic function of the response is not. The phrase *on the rock* is used as a true locative in (i) and as an instrumental phrase in (ii).

The use of the term *locative* in a traditional case analysis when referring to the phrase *on the knife* in (3-28) is misleading. Many case systems fail to distinguish the various uses of locatives. The obvious distinction is between the use of a locative as a sentence-level modifier and its use as a predicate-argument relation. But case systems fail to recognize that within the latter category further distinctions can be made. The locative in (3-28) not only describes where the action took place, but the location is involved in bringing about the state change that occurs. The knife is certainly not John's location, but it is an object which John's hand came in contact with and which played a role in cutting John. In (3-29), the locative is not causally involved in bringing about the action.

(3-28) John cut his hand on the knife.
(3-29) John put the book on the table.

Or consider sentence (3-30).

(3-30) John saw Mary in the mirror.

In this sentence, the mirror is the location of neither John or Mary.[10] Yet, if these phrases had a locative function, they should describe either the location of the action or the location of one of the participants in the action, as true locatives do.

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10. Although it may not be apparent, the noun phrase *Mary* in (3-30) does not refer to image-Mary, the image of Mary in the mirror, but to real-Mary, Mary as a physical object. Sentence (3-30) should not be confused with (i) where *Mary* refers to image-Mary.

(i) John saw Mary in the picture.

The acceptability contrast between (ii) and (iii) provides evidence for this difference.

(ii) # Mary was in the mirror.
(iii) Mary was in the picture.

This contrast suggests that people can be located in pictures but not in mirrors. The acceptability of (3-30) means that *in the mirror* does not function as a locative and therefore does not refer to image-Mary.

If the locative and *with* phrases both indicate the presence of the Instrumental role in the underlying representation, they should not be able to co-occur in a sentence. There is a constraint, recognized by Gruber [1965], which prevents the occurrence of more than one instance of each role[11] in a sentence.[12] Gruber observed that a sentence with the verb *buy* can only have one Goal [Gruber 1965]. Sentence (3-31) with two Goals is unacceptable; the subject of *buy* is Goal and the prepositional phrase marked by *to* indicates a second Goal. The unacceptability of (3-31) reflects a general constraint on the predicate-argument representation of a sentence: in a well-formed predicate-argument representation there is only one occurrence of each role.

(3-31) # John bought the book to Bill.

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11. Conjoined noun phrases, such as in (i), have to be considered one instance of a role in underlying representation.

i. John broke the window with the hammer and chisel.

Such sentences are often cited as counter-examples to this constraint; for example, see Nilsen[1973].

12. Sentences such as (i)-(ii) with locative or temporal phrases appear to be exceptions to this constraint, depending in part on the syntactic structure assigned to the sentence.

i. John meets with Mary on Tuesday at 4:00.

ii. John went to Boston to his friend's house.

The locative and temporal phrases in these sentences are being used to further specify the same referent, suggesting that a single referent can be described with a sequence. Two temporal or locative phrases are not always possible, as (iii)-(iv) illustrate, but in these examples the phrases cannot refer to the same time or place.

iii. # John meets with Mary on Tuesday on Wednesday.

iv. # John saw Mary in her home in the market.

Examples (iii)-(iv) suggest that the constraint should be reformulated: two occurrences of the same role are possible in a sentence only if they can have the same referent. Tesniere [1959] states a similar constraint: two occurrences of the same role are possible if they do not exclude each other. In fact, some people find (3-32) acceptable if they can imagine a single causal sequence involving both the hammer and the wall.

This constraint implies that the inability of two phrases to co-occur could be taken as evidence that their objects fill the same role in the underlying representation. This constraint holds for the two types of instrumental phrases, as illustrated by the unacceptability of (3-32).[13]

(3-32).a # John broke the vase with the hammer against the wall.
(3-32).b # John broke the vase against the wall with the hammer.

If, rather than the Same Role Hypothesis, the phrases were assumed to fill different roles, there would be no explanation; the constraint would have to be stipulated.

Sentences (3-33)-(3-35) illustrate that this constraint is generally true.

(3-33) # John saw Mary with the telescope in the mirror.
(3-34) # John brought Mary with the cart on the train.
(3-35) # John cooked the meat with the hairdryer over the fire.

If the locative phrases and the *with* phrases did not fill the same role, they would be expected to co-occur. In fact, locative and *with* prepositional phrases do co-occur, as in (3-36).

(3-36) John put the log in the fire with tongs.

This behavior would be expected since *put* requires a true locative as a complement. Two instrumental locatives cannot co-occur, as shown by (3-37)-(3-38), but a true locative and a locative phrase with an instrumental function can, as in (3-39).

(3-37) # John tore his shirt on the piece of glass on the spike.
(3-38) # John saw Mary in the mirror through the telescope.
(3-39) John cut his foot on the piece of glass on the floor.

Another property of the *with* marked instruments is that corresponding to transitive agentive sentences in which the instrumental noun phrase appears as the object of the preposition *with*, there are

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13. The only possible readings of (3-32) are those in which one of the prepositional phrases modifies a noun phrase.

non-agentive sentences in which the instrumental noun phrase appears as subject. Sentences (3-40) and (3-41) are such a pair.

(3-40) John broke the vase with the hammer.
(3-41) The hammer broke the vase.

The sentences below, (3-42)-(3-44), show that agentive transitive sentences with locative phrases that function as Instruments have non-agentive counterparts with no explicit Agent in which the noun phrase which was the object of the locative preposition in the agentive sentence occurs in subject position.

(3-42).a John cut his foot on the rock.
(3-42).b The rock cut John's foot.

(3-43).a John brought Mary in the car.
(3-43).b The car brought Mary.

(3-44).a John cooked the meat on the stove.
(3-44).b The stove cooked the meat.

Furthermore, there are some transitive verbs which allow either locative or *with* phrases with an instrumental function, but do not allow instrumental subjects irrespective of the preposition used in the agentive counterpart, as in (3-45)-(3-46).

(3-45).a John saw the imperfection with the magnifying glass.
(3-45).b # The magnifying glass saw the imperfection.

(3-46).a John saw Mary's reflection in the pond.
(3-46).b # The pond saw Mary's reflection.

This similarity would be expected given the Same Role Hypothesis.

Having an Instrumental role as defined in this section as part of the level of predicate-argument representation is supported only to the extent that it helps to capture generalizations. The intuitive definition of Instrument was originally intended to describe the intuitive semantic role of noun phrases marked by *with* in sentences such as (3-1), but it also turns out to describe the role of certain noun phrases in locative phrases. In view

of the evidence presented that the two types of phrases share similar properties, it seems that the Same Role Hypothesis should be adopted so that both types of phrases are recognized as having an underlying instrumental function. The existence of the similarities would be predicted by the hypothesis, preventing the properties from having to be stated independently for the two different phrases. The co-occurrence restrictions would also be expected and would not have to be stipulated.

3.3 Evidence against the Same Role Hypothesis

In the previous section, further evidence was presented for adopting the Same Role Hypothesis, proposed as an explanation of the similarity in semantic function of certain locative and *with* phrases. As a result of this similarity, the account of the Instrumental Problem given in work on case and thematic relations has to be abandoned, and a solution still needs to be found. The conditions governing the acceptable occurrences of each preposition must be investigated in order to formulate a solution. The investigation of acceptability data in this section will bring out differences in the semantic restrictions on the objects of *with* and locative prepositions. A closer examination of the phrases will reveal that there is a difference in meaning associated with the prepositions. The evidence that will be presented in this section, therefore, tends not to support the Same Role Hypothesis because there is no way to account for differences in behavior between the phrases if they have the same role.

The factors governing the choice of preposition which indicates the occurrence of an instrumental noun phrase are not obvious. There seems to be a variety of possible alternatives. For some choices of instrumental noun phrase, only one of the prepositions may be acceptable, as in (3-47), while with another choice, either preposition may occur, as in (3-48).

(3-47).a John baked the cake in the oven.

(3-47).b # John baked the cake with the oven.

(3-48).a John cut his foot on the rock.
(3-48).b John cut his foot with the rock.

For a given verb, examples of both kinds can be found according to the choice of instrumental noun phrase; this is illustrated by sentences (3-49)-(3-50) with the verb *tear*.

(3-49).a John tore his coat with the scissors.
(3-49).b John tore his coat on the scissors.

(3-50).a # John tore his coat with the fence.
(3-50).b John tore his coat on the fence.

These examples show that there is an apparent lack of regularity in the distribution of locative and *with* phrases with an instrumental function. The examples do show that the prepositions are certainly not always interchangeable or always in complementary distribution. These would have been the simplest possibilities, and also in line with the Same Role Hypothesis. What the examples do suggest is that the verb alone does not fix the choice of instrumental preposition,[14] but that the acceptability of a use of an instrumental preposition depends, at least in part, on the instrumental noun phrase.

Consider the example with the verb *tear* again. Sentences (3-49) show that either instrumental preposition is possible with this verb, while the unacceptability of (3-50).a is due to the choice of instrumental noun phrase. Together these sentences show there are constraints on the set of possible objects of the prepositions. This pattern of acceptability is attributed to semantic restrictions[15] since the sentences (3-49) and (3-50) differ only

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14. An instrumental preposition is a preposition which indicates that its object fills the Instrumental role in the underlying representation. The instrumental prepositions are *with* and the locative prepositions.
15. See Section 2.3.

in the objects of the prepositions. The data suggest that there is a difference in the semantic restrictions on the possible objects of *with* and the locative prepositions.

It is clear from this example that the Same Role Hypothesis does not provide an explanation for the existence of different semantic restrictions. If the two prepositions indicate instances of the same role, the acceptability of (3-50).b, with a locative preposition, means that *the fence* is a possible instrument. Yet, if *with* also indicates the same role, why is (3-50).a unacceptable? The Same Role Hypothesis alone appears to be inadequate since it gives no reason to expect the observed differences in semantic restrictions.

Pairs of sentences such as (3-48)-(3-49) and also (3-51)-(3-52), below, show that the set of possible objects of the instrumental prepositions are not disjoint.

(3-51).a John cut his foot with a piece of glass.
(3-51).b John cut his foot on a piece of glass.

(3-52).a John saw Mary with the mirror.
(3-52).b John saw Mary in the mirror.

Although the prepositional phrases in both sentences have an instrumental function, the sentences are not synonymous.[16] In (3-51).a John could have used the piece of glass to cut his foot, but this is not an appropriate description of (3-51).b. The mirror John saw Mary in could have been hanging on the wall in (3-52).b, but not in (3-52).a. The sentences in each pair differ only in the choice of instrumental preposition, so any semantic difference must be related to the preposition used. The existence of two types of instrumental prepositions itself would lead one to expect a

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16. I will not try to bring out the exact difference here, since all that matters is to recognize that it exists. The difference will be characterized in Section 4.1.

difference.

Not only is there a difference in the set of possible objects of the locative prepositions and *with*, but when a noun phrase meets the semantic restrictions on both prepositions, there is a difference in meaning between pairs of sentences such as (3-51) above which can only be attributed to the choice of preposition. Just as the difference in semantic restrictions associated with the instrumental prepositions does not offer support for the Same Role Hypothesis, neither does the non-synonymity of such pairs of sentences. Since the Same Role Hypothesis was suggested on the basis of the similarity in semantic function of the *with* and locative phrases, this proposal is thereby weakened.

3.4 The Marked Instrument Hypothesis

The proposal for dealing with the locative and *with* phrases with an instrumental function, the Same Role Hypothesis, is inadequate since it cannot explain the differences in their behavior. The alternative to this hypothesis within the representational framework presented above would be that the objects of the locative prepositions and *with* fill different roles in the level of underlying representation, but this solution is also problematic since it would fail to account for the similarities. There is evidence in favor of retaining both options since each handles different phenomena, but this is not possible since they are incompatible. The similarities and differences in the behavior associated with the instrumental use of locative and *with* phrases seems to impose conflicting demands on their underlying representation.

A solution to this impasse is possible if a preconception about the framework the proposed solutions are based on is recognized. The proposals above are the alternatives one would expect if the level of underlying

representation consisted only of a level of predicate-argument representation. The inability to find a solution to the Instrumental Problem within a predicate-argument representation suggests that this framework is too rigid. But it is not necessary that the solution should be in this framework since, as noted in Section 1.1, there is no reason to equate the underlying representation with the predicate-argument representation. In a level of predicate-argument representation, two noun phrases in different sentences either do or do not fill the same role in the underlying representation of their sentence; there are no other possibilities. Similarities in behavior follow if noun phrases fill the same role, while differences in behavior are expected from noun phrases with different roles. The behavior of locative and *with* phrases cannot be explained within a level of predicate-argument representation since the phrases show behavior consistent with either possibility.

If the underlying representation of a sentence includes but is not limited to a predicate-argument representation, will an account of the behavior of the locative and *with* phrases be possible? Assume the Same Role Hypothesis: that the object of locative and *with* phrases both fill the Instrumental role in the underlying representation of a sentence. Besides the general similarity in semantic function, there are other properties which make it desirable to retain this hypothesis.[17] But, this hypothesis alone is not adequate; an explanation of the differences in semantic restrictions and meaning associated with the prepositions must be found.[18] The underlying representation of a *with* phrase will have to differ from that of a locative phrase to account for the differences although it is no longer required that

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17. See Section 3.2 for details.

18. If, instead, the object of the preposition were assumed to fill different roles, an explanation of the similarities would be required. Neither this alternative or the Same Role Hypothesis alone are sufficient to account for the problem.

the differences be in the role of the instrumental noun phrase.

The justification for assuming a difference in the underlying representation of these phrases comes from the existence of a semantic difference between pairs of sentences such as (3-53).

(3-53).a John saw Mary in the mirror.
(3-53).b John saw Mary with the mirror.

The locative and *with* phrases both have an instrumental function in spite of the semantic difference between these sentences. Under certain conditions, then, the presence of the Instrumental role can be indicated by either preposition. But, the non-synonymity of the sentences indicates that a speaker of English must choose between two semantically different ways of expressing the notion of instrument. The semantic difference must be attributed to the prepositions, so the choice of preposition reflects the option chosen at the level of grammatical relations. Differences encoded in the choice of preposition should be explicit in the underlying representation since it is supposed to provide a level of semantic abstraction. Therefore, the underlying representation of the instrumental phrases should differ.

The form that the difference should take is suggested by a property of the semantic restrictions on the *with* phrases. Evidence for the difference in semantic restrictions on the object of the *with* and locative prepositions was provided by examples such as:

(3-54).a John tore his coat on/with the scissors.
(3-54).b John tore his coat on/#with the fence.

Compare this example with other examples of this phenomenon given in (3-55)-(3-57).

(3-55).a John came in/with his car.
(3-55).b John came on/with his bicycle.
(3-55).c John came on/#with the train.
(3-55).d John came on/#with the jumbo jet.

(3-56).a John broke the vase on/with the hammer.
(3-56).b John broke the vase against/#with the wall.

(3-57).a John figured out the result on/with the calculator.
(3-57).b John figured out the result in/#with his head.

There is one property that these examples have in common: there are many fewer acceptable occurrences of *with* phrases than there are of locative phrases. Not only does the data show that the distribution of *with* is more limited, but it suggests that the set of possible objects of *with* is a subset of the set of possible objects of the locative prepositions. I will assume that this is generally true. When a noun phrase is not a possible object of a locative preposition, it is not a possible object of *with*, as in (3-58).

(3-58).a # John knew the answer on his calculator.
(3-58).b # John knew the answer with his calculator.

An occurrence of instrumental *with* is acceptable if the underlying representation of the sentence that contains it is well-formed. These observations suggest that in the underlying representation of an acceptable sentence containing instrumental *with* the noun phrase which fills the Instrumental role must satisfy an additional constraint that would not be imposed on the underlying representation of sentences with instrumental locatives. This would explain the greater number of acceptable locative phrases. By postulating the existence of this extra constraint, the subset relation between the sets of possible objects to the prepositions can be explained while retaining the Same Role Hypothesis.

The need for such a constraint suggests that the locative prepositions and *with* could be considered, respectively, the indicators of the unmarked and marked instances of the Instrumental role in the underlying representation of the sentences they occur in.[19] A constraint on the marked

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19. This hypothesis will be referred to as the Marked Instrument Hypothesis.

instance of a phenomenon would not be applicable to the unmarked instance if it follows from the marked/unmarked distinction.

The existence of a semantic difference in sentences such as (3-51) and (3-52) suggests that the speaker of English has two options available when expressing the notion of Instrument. Assuming the Marked Instrument Hypothesis, the options can be identified. Just as the Instrumental role is an optional role that one can choose to express in English; the option to express that the Instrumental role is marked is also available. The choice will have to be made explicit in the underlying representation. For example, there might be a feature present in the underlying representation if it includes a marked Instrument.[20] The existence of the semantic difference between the phrases also supports the assignment of different underlying representations to them.

Given the Marked Instrument Hypothesis, the remaining problem, formulating a realization rule for the Instrumental role, will have a trivial solution.[21] The realization rule will be extremely simple since the semantic difference reflected in the choice of preposition must be explicitly represented in the underlying representation of the sentence and any instance of the Instrumental role will be either marked or unmarked. When mapping from the Instrumental role in the underlying representation to grammatical relations, the realization rule selects the appropriate preposition according to whether the Instrument is marked or unmarked.[22] If marked, then the

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20. By marked (or unmarked) Instrument, I mean an occurrence of the Instrumental role that is marked (or unmarked).

21. With the Same Role Hypothesis alone, it would not have been possible to formulate a realization rule, since there is no way to distinguish the underlying representation of a sentence with an occurrence of instrumental *with* from one with an occurrence of a locative phrase with an instrumental function.

22. The realization rule will not be concerned with issues of semantic acceptability because of the Independence Hypothesis.

noun phrase filling the Instrumental role will be the object of the preposition *with*; if unmarked, the noun phrase will be the object of a locative preposition.

The Marked Instrument Hypothesis, in some ways, comes very close to the account of the Instrumental Problem given in work in case and thematic relations and suggests why these accounts were proposed. In these accounts, *with* is considered the marker of the Instrumental role while the locative phrases with an instrumental function are usually completely ignored. *With* phrases, as marked Instruments, might be more easiliy identifiable. The intuitive definition of instrument is too general, but it suffices to describe the semantic function of *with* if the *with* and locative phrases with an instrumental function do not need to be distinguished.

If the identification of the marked/unmarked distinction is possible,[23] the Marked Instrument Hypothesis together with the Same Role Hypothesis provide a solution to the Instrumental Problem. The Marked Instrument Hypothesis is compatible with the Same Role Hypothesis since it requires that the locative and *with* phrases are surface manifestations of the same role, the Instrumental role. The Marked Instrument Hypothesis can be used to account for those properties of the instrumental phrases that the Same Role Hypothesis does not account for. The existence of a difference in the semantic restrictions is consistent with the Marked Instrument Hypothesis, as is the existence of a semantic difference. But, the proposed solution is only acceptable if the properties follow from the marked/unmarked distinction and do not need to be stipulated.

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23. See Section 4.1 for a detailed discussion of the difference between marked and unmarked instances of the Instrumental role.

3.5 Conclusion

With and locative phrases with an instrumental function, respectively, indicate the presence of a marked or unmarked occurrence of the Instrumental role in the underlying representation of an English sentence. The simple approach to instrumental *with* taken in work on case and thematic relations proves to be inadequate because finding an explanation of the behavior of instrumental *with* turns out to be tied to the problem of accounting for locative phrases with an instrumental function. There is evidence both for and against assigning the two phrases to the same role, two seemingly contradictory alternatives. A way out of this problem is possible if the solution is not restricted to a predicate-argument representation. The observation that the set of possible objects of *with* are a subset of those of the locative prepositions leads to the Marked Instrument Hypothesis, which assigns the two phrases to the same role while providing a source for the differences in their behavior: they can be attributed to markedness. This solution, which is consistent with the behavior observed, allows a solution to the Instrumental Problem by providing internal structure to a role, something that is not found in a rigid predicate-argument representation.

4. The Control Relation

The proposed solution to the Instrumental Problem will only be valid if the semantic factor which distinguishes the underlying representation of a sentence containing a marked Instrument from that of an unmarked Instrument can be identified. An explanation of the variation in meaning and acceptability of *with* phrases is contingent on the characterization of the marked/unmarked distinction. If a uniform account of these phenomena follows from this characterization, it will support the introduction of the Marked Instrument Hypothesis. In this section, it will be shown that the addition of a semantic relation, the control relation, to the underlying representation of sentences with a marked Instrument will allow an explanation of the subtleties found in the examples. The lack of regularity in the data turns out to be only apparent: the set of acceptable uses of *with* follow from well-formedness constraints on this relation, and the differences in meaning are systematic.

4.1 The Notion of Control

The Marked Instrument Hypothesis predicts that if an instrumental noun phrase can participate in an action as either a marked or an unmarked Instrument, the sentences describing the possible actions should not be synonymous. Such semantic differences have been observed between pairs of sentences, for example (4-1) or (4-2).

(4-1).a John saw the face with the mirror.
(4-1).b John saw the face in the mirror.

(4-2).a John cut his foot with a piece of glass.
(4-2).b John cut his foot on a piece of glass.

Given the Marked Instrument Hypothesis, the difference in meaning in either pair, which seems to be associated with the choice of preposition, should actually be attributed to the presence of the marked Instrument in the

underlying representation in each of the (a) sentences and the unmarked Instrument in each of the (b) sentences, since otherwise, the underlying representation of both sentences in each pair would be identical. An attempt to characterize the difference precisely is needed to reveal the nature of the marked/unmarked distinction.

Consider first sentences (4-1). Even though *the mirror* is the Instrument in both these sentences, there is a subtle semantic difference between the two due to the marked/unmarked distinction. In (4-1).a, John is understood as having manipulated the mirror in such a way that he could see the face. The implication that John was manipulating the mirror for some specific reason is lacking in (4-1).b. Sentence (4-1).b would be appropriate if the mirror were hanging on the wall, but (4-1).a cannot be used in this way.

If there is a common semantic difference, an examination of a second pair of sentences, (4-2), will help determine it. If John, while walking barefoot on the street, unknowingly stepped on a piece of glass and cut himself, then (4-2).b could be used to describe what happened, but (4-2).a could not be used to describe the event. Sentence (4-2).a can only be used if John used the piece of glass to cut himself, whether by forcing himself to step on it or by actually manipulating it.

A similar contrast is found with the verb *cut* when a different instrument is used, as in (4-3).

(4-3).a John cut his hand with a knife.
(4-3).b John cut his hand on a knife.

In (4-3).a John was using the knife to perform an action when he cut his finger. The action he is performing could be cutting his finger, but it does not have to be limited to that, as shown by (4-4).

(4-4) Mary cut herself with the knife while coring an apple.

In (4-3).a, John must be manipulating the knife, but (4-3).b is possible even

if he is not necessarily using it. The reading that does seem to be excluded in (4-3).b is the one in which John uses the knife for the express purpose of cutting.

A comparison of the three sets of sentences, (4-1)-(4-3), shows that there is a regularity in the difference in meaning. The difference is not in the instrument that caused the actions described in the sentences, seeing and cutting, but in the relation between the agent and the instrument during the performance of the action. While this relation is difficult to characterize,[1] probably, it is best described by the term "control": the use of *with* in a sentence suggests that the agent has control over the instrument for some purpose.[2] The control relation, as this relation will be called, is a relation between two participants, which will be referred to as the controller and the controlled object. Both participants are essential to the relation; there is no controller without a controlled object and vice versa. If the marked Instrument occurs, the instrumental noun phrase participates in the control relation as a controlled object; it is understood as receiving a controlled interpretation. In all the examples so far the agent is understood as the controller.

In (4-1)-(4-3), the implication that the Instrument is being controlled, which is found in the sentences using *with*, is not necessary in the locative counterparts to these sentences. The use of *with* could indicate that the Instrumental role receives a controlled interpretation and the use of

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1. This discussion is supposed to convey an intuitive feeling of what is meant by the notion of control. I am not interested in giving a precise definition but only in showing how it provides a solution to some of the problems raised about instrumental *with*.

2. The notion of control should not be confused with intention; both of the following are possible:

i. John intentionally cut himself with the knife.

ii. John accidentally cut himself with the knife.

any locative preposition that it does not, but this possibility has to be rejected. The use of a locative preposition does not always seem to be a sign of the absence of a controlled interpretation as sentences (4-5) illustrate.

(4-5).a John cut his hand on the knife.
(4-5).b John cut his foot on the rock.
(4-5).c John cut his face on the corner of the bookcase.

In (4-5).a, John may or may not be controlling the knife, but the knife was what cut him. For example, he could have grasped it by the blade or touched the blade without realizing how sharp it was. In (4-5).b, a situation in which the instrument receives a controlled interpretation is difficult to imagine, and in (4-5).c a controlled interpretation seems even less likely. Sentence (4-6) with the verb *come* indicates more clearly that the notion of control is irrelevant to locatives.

(4-6) John came in the car.

This sentence can be used to describe the mode of transportation John used irrespective of whether John was the driver or a passenger.

As shown by the examples above, the use of a locative preposition indicates the occurrence of the Instrumental role in the underlying representation of a sentence without making any commitment to the possibility that the instrument receives a controlled interpretation.[3] In order to force a controlled interpretation, the preposition *with* must be used. The difference in meaning that has been found between sentences with locative and *with* phrases with an instrumental function is exactly what would be expected given the Marked Instrument Hypothesis, if the Instrumental role is considered to be marked or unmarked for whether the instrument receives a controlled interpretation. Not only does the Marked Instrument Hypothesis

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3. This statement should be qualified: the instrument may be controlled but the reading in which the instrument is being controlled for the express purpose of carrying out the action in the sentence does not seem possible.

predict the existence of a difference in semantic function between locative and *with* phrases, but the form that the difference takes is consistent with the hypothesis.

The characterization of the marked/unmarked distinction just given is a purely semantic one and does not reveal how the distinction should be represented. Since the underlying representation of sentences with marked and unmarked Instruments must differ, I will assume that it is possible to determine from the underlying representation of a sentence whether an occurrence of the Instrumental role is marked or unmarked. The question of how the difference should be represented will be left open in order to avoid making an arbitrary decision. To distinguish the underlying representation of a sentence with a marked Instrument from that of a sentence with an unmarked Instrument, one possible option might be to assign to the Instrumental role a feature which attributes to it the property of being a controlled object. An alternative would be to include an explicit instance of the control relation whose Controlled Object is filled by the same noun phrase that fills the Instrumental role.

The distinction between marked and unmarked Instruments reflects whether the instrument receives a controlled interpretation, i.e. whether the instrumental noun phrase participates in an instance of the control relation as the controlled object. Since the marked and unmarked Instruments both fill the same role in the underlying representation, the differences in behavior between locative and *with* phrases are not due to properties of the Instrumental role. The behavior unique to the *with* phrases, which follows from the fact that the marked Instrument indicates a controlled interpretation, reflects properties of the Controlled Object in the control relation.

4.2 A Controlled Instrument Must Be Controllable

The Marked Instrument Hypothesis was first suggested by the existence of a systematic relation between the semantic restrictions on the preposition *with* and those on the locative prepositions. This observation could be explained if there were a semantic constraint on the marked Instrument that was not applicable to the unmarked Instrument. The control relation provides a source for such a constraint.

Just as there are semantic constraints on the possible fillers of a role one would expect there to be constraints on the possible fillers of the Controlled Object in the control relation. When there is an occurrence of a marked Instrument in a sentence, the noun phrase which fills the Instrumental role is also the Controlled Object in the control relation and subject to the constraints on both. If the noun phrase failed to meet the constraints on the Controlled Object, then even if it met those on the Instrumental role, the sentence would be unacceptable. The unmarked Instrument is only subject to the constraints on the Instrumental role. This difference would lead to the observed pattern of semantic restrictions. The problem is to identify the constraint.

Consider pairs of sentences such as (4-7) and (4-8).

(4-7) # John broke the dish with the ceiling.
(4-8) John broke the dish against the ceiling.

The unacceptability of (4-7) cannot be attributed to the constraints on the Instrumental role not being satisfied since the acceptability of (4-8) shows that *the ceiling* is a possible instrument. But the instrumental noun phrase also fills the Controlled Object, providing another source of unacceptability: the failure to meet a constraint on the Controlled Object.

Sentences (4-7)-(4-8) suggest that the control relation forces a distinction to be made between objects which can and cannot be controlled by an agent.[4] Certain uses of *with* are odd because the instrument is not normally used in a controlled fashion; that is, it is typically considered a non-controllable object. A controllable object often means a manipulable object, explaining the contrast between (4-7) and (4-8). To understand (4-8) requires imagining a situation in which a ceiling can be handled by a person. The use of *with*, by indicating the occurrence of a marked Instrument, forces *the ceiling* to receive a controlled interpretation. Sentence (4-8) is strange since *ceiling* is not considered to be a manipulable object.

The constraint, then, is that the filler of the Controlled Object must be controllable. The instrumental use of *with* is required in a sentence to express that the instrument receives a controlled interpretation by indicating an occurrence of the marked Instrument. A use of *with* is acceptable only if the semantic well-formedness conditions on the Instrumental role and the Controlled Object are met, that is if the instrument is controllable.

The property of controllability, which depends on inherent properties of an object, does not have to be explicitly represented in the underlying representation. It can be determined by considering whether an object is controllable by an agent with respect to an action. An object may be controllable with respect to one action, but not with respect to a second; controllability is in part a function of an object's role in an event. Even in

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4. To begin, I will ignore the interdependence of the controller and Controlled Object which determines controllability. The examples will be restricted to sentences in which the controller is an animate entity and focus on controllability of objects in this context. Section 4.3 will address the problem of controllability in general by examining the relation between the controller and Controlled Object.

a given event, controllability may not be absolute; it is often possible to imagine a situation where the default classification no longer holds.

The existence of pairs of sentences such as (4-9), which differ only in whether the Instrumental role is marked or unmarked, shows that when a controllable object fills the Instrumental role, the instrument does not receive a controlled interpretation.

(4-9).a John cut his hand with the knife.
(4-9).b John cut his hand on the knife.

Although a knife is a controllable instrument, previous discussion of sentences such as (4-9)[5] showed that the noun phrase *the knife* must receive a controlled interpretation in (4-9).a but could receive either a controlled or non-controlled interpretation in (4-9).b. A controllable object which is used as an instrument is only forced to receive a controlled interpretation when the noun phrase which denotes it occurs as the object of *with*, the preposition which indicates an occurrence of the marked Instrument.[6]

The distinction between controllable and non-controllable objects influences the acceptability of a use of *with* but not the presence of *with* (except indirectly). The process of determining acceptability is distinct from that of choosing marking prepositions. The following sentences, (4-10) and (4-11), illustrate the possible interactions of controllability with an instrument that receives a controlled interpretation.

(4-10) John saw the stars with the telescope.
(4-11) # John saw the reflection with the pond.

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5. See (4-5) in Section 4.1.
6. The property of controllability is inadequate as a predictor of the control relation since controllable objects used as instruments do not need to be controlled. Not only does controllability not offer a viable alternative to explicitly indicating that the Instrumental role receives a controlled interpretation in the underlying representation, but it also confirms the need to do so.

Sentence (4-10) is acceptable since it has a controlled use of a controllable instrument. In (4-11), there is a controlled use of a non-controllable object; therefore, the sentence is unacceptable.

The controllable/non-controllable distinction is not pertinent to determining the acceptability of locative phrases. A use of the locative preposition indicates that the Instrumental role is unmarked for a controlled interpretation, so both controllable and non-controllable noun phrases can fill the unmarked Instrumental role. In (4-12) and (4-13), the (a) sentences illustrate that the instrument is potentially controllable in (4-12) but not in (4-13), yet both can be used as unmarked Instruments, the (b) sentences.

(4-12).a John burned his hand with the candle.
(4-12).b John burned his hand on the candle.

(4-13).a # John burned his hand with the stove.
(4-13).b John burned his hand on the stove.

If a controllable object is not used as an instrument in a controlled manner, the locative preposition must be used even though this preposition simply indicates that the Instrumental role is unmarked for control rather than not controlled. Non-controllable objects used as instruments can occur as objects of locative prepositions since, unlike the preposition *with*, they do not force a controlled interpretation. The presence of only the non-controlled interpretation in (4-13).b is not due to the use of the locative preposition but to inherent properties of the instrumental noun phrase: it is impossible for a non-controllable object to have a controlled interpretation.

Sentences (4-14)-(4-15) provide a another example of the pertinence of control to understanding preposition distribution.

(4-14) John warmed his dinner on the stove.
(4-15) John warmed himself with an electric heater.
(4-16) # John warmed himself with an open fire.

In these sentences, the notion of control does not refer to the agent's ability to manipulate the object that does the warming but rather to a more abstract

notion of control. An agent can control the use of a heater in warming himself. He can turn it on or off, he can regulate the amount of heat, and he can choose its location if it is portable. But an agent cannot control the amount of heat that a fire gives off in the same way that he can control a heater. Usually a stove, oven, or broiler are seen as cooking food independently of the agent that uses them; the agent does not control the actual cooking process but only sees to it that it comes about. The same explanation applies to the observation that sentence (4-17) with the verb *cook* is acceptable but (4-18) is not.

(4-17) John cooked the soup on the stove.
(4-18) # John cooked the soup with the stove.

Understanding the relation between acceptable uses of *with* and the control relation allows a glimpse of the model of the world a speaker of English has, in particular the perception of objects brought out by the notion of control. Although a stove appears to be an instrument in the tool sense because of its function in the preparation of food, the unacceptability of *with* in (4-18) reveals that it is not regarded as a controllable object. This does not mean controllable objects are never used as instruments in cooking. A hairdryer is not a usual instrument in cooking, but can be if controlled, as in (4-19).

(4-19) John cooked the meat with a hairdryer.

As a further example consider verbs of motion. For verbs of motion the Instrumental role would be expected to describe the means of motion, that is the vehicle used. Sentences (4-20) and (4-21) illustrate

two ways[7] of expressing the vehicle. The prepositional phrases in these sentences have an instrumental function; they describe how John came.

(4-20).a John came in the car.
(4-20).b John came on the bicycle.

(4-21).a John came with the car.[8]
(4-21).b John came with the bicycle.

But sentences (4-22)-(4-23) show that both options are not always possible.

(4-22).a John came in the jumbo jet.
(4-22).b John came on the train.

(4-23).a # John came with the jumbo jet.
(4-23).b # John came with the train.

The control relation can be used to explain why vehicles should be differentiated in this way.

All vehicles are controllable by some agent, but since most vehicles can carry many passengers, it is unlikely that the agent of a sentence will be the person in control of the vehicle. This leads to the contrast between (4-24) and (4-25).

(4-24).a John came with the car.
(4-24).b John came in the car.

(4-25).a # John came with the plane.

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7. There is a third way of expressing vehicle through the use of the preposition *by* found in the phrases *by car* or *by train*. These expressions differ from the other vehicle expressions in having no determiner. They describe motion in a generic sense by means of some kind of vehicle. The *by* phrases focus on the type of vehicle used without referring to a specific vehicle, as (i) shows.

i. # John came by his car.

This use of *by* seems to be a special generic use, distinct from the use of *by* with passives which allows determiners.

ii. John was seen by the children. This use will be ignored here.

8. Many people find the instrumental use of *with* with intransitive verbs of motion like the verb *come* unacceptable. They cannot get the instrumental reading of sentences such as (4-21).

(4-25).b John came on the plane.

A car is for a small number of riders, so it is possible that it is under the control of the agent of a sentence, but this is not necessary. The locative phrase in (4-24).b describes how John came without specifying who drove the car; the question of control is left open. A plane can carry hundreds of people, so it is unlikely that any one person will be its pilot. It is hard to get a reading of (4-25).a where *John* is the pilot, but if *John* is the only person on the plane or the plane is very small such a reading is possible. Using a possessive determiner which identifies the vehicle with the agent makes the instrumental use of *with* more acceptable. Thus, (4-26) is less awkward than (4-25).a.

(4-26) John came with his plane.

An occurrence of the instrumental use of the preposition *with* in a sentence means that the object of the preposition is being controlled by an agent to bring about the event described in the sentence. The object of the preposition must also fill the Instrumental role in the predicate-argument representation of the sentence. An unacceptable sentence containing *with* indicates an instance of the marked Instrument which fails to meet the constraints on either the Instrumental role or the Controlled Object. The constraint on the Controlled Object which must be satisfied is that the controlled object must be one that is controllable by the agent. This constraint is reflected in the difference in the semantic restrictions on the objects of *with* and the locative prepositions which first led to the Marked Instrument Hypothesis.

4.3 Control Must Be Expressed as a Relation

The semantic constraint on the Controlled Object which was introduced to account for the unacceptable uses of *with* that satisfy the constraints on the Instrumental role will turn out to be inadequate for this purpose. It fails to explain certain unacceptable uses of *with* because it ignores the interdependence of the two participants in the control relation, the Controller and the Controlled Object. An alternative constraint, proposed in this section, will also suggest an answer to another question: how should the distinction between marked and unmarked Instruments be represented?

Pairs of sentences such as (4-27) provided evidence for the semantic constraint on the Controlled Object: the Controlled Object must be controllable.

(4-27).a # *John tore his jacket with the fence.*
(4-27).b John tore his jacket on the fence.

These sentences show that the unacceptability of (4-27).a must be due to a constraint on the Controlled Object rather than on the Instrumental role. There are similar sets of sentences, for example (4-28)-(4-30),[9] which show that the situation is more complicated: the well-formedness judgement necessary to determine if a use of *with* will be acceptable cannot be made on the basis of either participant in the control relation alone but is determined by their interaction.

(4-28) # The Trojans destroyed Ulysses' fleet with the wind.
(4-29) Zeus destroyed Ulysses' fleet with the wind.
(4-30) The Trojans destroyed Ulysses' fleet with incendiary bombs.

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9. Sentence (4-29) was suggested by (115) on p. 112 of Ruwet [1972]. I originally noticed a similar pattern of data involving the verb *come*, but because of dialect differences concerning the instrumental use of *with* with *come*, I chose to use this example. Also, the example with *come* raises questions about the interaction of agency and the control relation which confuse the issue. These questions are avoided with *destroy* since, unlike *come*, it is a transitive verb.

The verb *destroy* is a transitive verb whose subject fills the Agent role and direct object fills the Patient role. The preposition *with* indicates an occurrence of the Instrumental role. The unacceptability of (4-28) cannot be due to the agent alone because (4-30) and (4-31) are acceptable.

(4-31) The Trojans destroyed Ulysses' fleet.

Nor can the unacceptability be due to the instrument alone, since in (4-29) the phrase *with the wind* is acceptable.[10] It appears that constraints on roles alone will not explain the unacceptability, but that it must result from the interaction between the agent and instrument choices.

The use of *with* indicates that the instrument receives a controlled interpretation. It participates in the control relation as a controlled object, while the agent is understood as controller in (4-28)-(4-30). The use of *with* will be acceptable only if the instrument is controllable. Typically a natural cause or force is not controllable by a human, although a god or supernatural being can control a force. The contrast in acceptability between (4-28) and (4-29) illustrates this. The source of unacceptability in (4-28) could be either that the noun phrase *the wind* is not controllable or that the noun phrase *the Trojans* is not a possible controller. Neither view of the problem is accurate because (4-29) shows that *the wind* can be controllable and (4-30) that *the Trojans* is a possible controller.

A restriction on either the Controller or Controlled Object is not sufficient. The root of the problem is that the wind is not controllable by the Trojans, or, conversely, the Trojans are not a possible controller of the wind. The well-formedness of sentences such as (4-28) depends on knowing

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10. The fact that forces normally are not acceptable as fillers of the Instrumental role has been noted by Nilsen [1973] and others. This observation has lead to stipulating a constraint on the Instrumental role or to postulating a Force role. As (4-29) shows, under some conditions forces are possible as fillers of the Instrumental role. The approach taken to them has been based on insufficient evidence.

that a control relation with a given controller and controlled object is possible. To judge the well-formedness of the control relation requires both its participants since the decision depends on their interaction. The Instrumental Problem requires a relation between participants, a capability that the predicate-argument representation does not provide. The predicate-argument representation of a sentence can only be used for constraints on the individual participant because it is a verb-centered representation. Therefore, the underlying representation must be enriched so that the control relation can be explicit in the underlying representation of appropriate sentences.[11]

The *destroy* example brings out that an acceptable use of ***with*** does not depend on the Controlled Object alone but on the relation of the Controlled Object to the Controller. The notion of controllability also depends on the Controller as well as the Controlled Object. Controllability cannot be treated as a property of an object, but must be determined by considering whether an object is controllable by an agent with respect to a given action.[12] An acceptable use of the control relation is one in which the controller is capable of controlling the controlled object to use it to bring about an action.

An analysis of the interaction of the control relation with the verbs *buy* and *sell* provides further evidence that the well-formedness of an instance of the control relation depends on both participants in the relation. The control relation offers an explanation for an observation of Gruber's [Gruber 1965] concerning the distribution of instrumental ***with*** with the verbs *buy* and *sell* illustrated in (4-32): *buy* can take an instrument, but

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11. See Section 1.1.

12. Such a decision must be made with respect to a world model since the outcome depends on the situation. The exact conditions that determine well-formedness are irrelevant.

sell cannot.

(4-32).a John bought the book with a $10 bill.
(4-32).b # John sold the book with a $10 bill.

Gruber, by attributing the difference between the verbs in (4-32) to the fact that the agent of *buy* is also the goal of the transfer of the book, while the agent of *sell* is the source of the transfer, fails to explain the difference. Instead his account provides a correlation of the difference with the difference in the underlying role of the subjects of the two verbs.

The subject of both verbs are animate entities and therefore are capable of controlling the instrument, *a $10 bill*. An examination of the semantics of the situation reveals that only the subject of one of the sentences is in actual control of the money. An instrumental phrase can occur with *buy* because the subject of *buy* has the money necessary to bring about the transfer, and, therefore, controls the money. The subject of *sell* as the recipient of the money has no control over the money's transfer.

The examination of transfer verbs shows once again that the controller must be able to control the instrument for an acceptable use of *with*: the presence of an agent alone is not sufficient. The control relation provides additional motivation for Gruber's choice of predicate-argument structure for these verbs. If the subject of these verbs filled only the Agent rile, there would be no way to account for the difference in their behavior with respect to control. To explain the distribution of *with*, it is necessary to know that the subject of *buy* fills the Goal and the subject of *sell* the Source so that the role of the agent in the transfer of the money can be determined.

The interaction of the control relation with the verbs of transfer leads to several correct predictions concerning another verb of transfer, *rent*. As noted in Section 2.1, sentence (4-33) is ambiguous: there is no way of knowing whether *John* is the source or goal of the transaction.

(4-33) John rented the house.

Context may allow a choice to be made. Adding either the phrase *to Bill* or *from Bill* to sentence (4-33) disambiguates it. For example, if the phrase *to Bill* is added, the subject must be interpreted as the source since there cannot be two occurrences of the same role in the sentence. In the same way, if a *with* instrument describing the sum of money involved is added to (4-33) the sentence should no longer be ambiguous. The possible reading will be determined by the control relation. For the control relation to be well-formed and the sentence acceptable, the subject of *rent* should be interpreted as the goal of the transaction since the goal controls the money transfer. This is confirmed in (4-34).

(4-34) John rented the house with $500.

Sentence (4-35) has only the reading in which the subject fills the Source role.

(4-35) John rented the house with an ad in *The Globe*.

The landlord, the source of the renting, is responsible for advertising that the house is for rent; therefore, he controls the appearance of ads that say the house is for rent. If the *with* is replaced by *through*, the control relation no longer necessarily holds. The expected reading of such sentences would not be the controlled reading, that is one in which the subject is understood as the prospective tenant, the goal. Since the source of the transaction is typically responsible for advertising while the goal is not; the usual reading of (4-36) is with the subject interpreted as the goal.

(4-36) John rented the house through an ad.

Both participants in the control relation are necessary for determining its well-formedness. The presence of the Controller and Controlled Object alone does not guarantee that the control relation will be well-formed; well-formedness requires that the controller must be able to control the controlled object. An acceptable occurrence of the preposition

with depends on the semantic well-formedness of the instance of the control relation it indicates. The influence of the well-formedness of the control relation on the acceptability of *with* suggests that it must be part of the underlying representation of the sentence since semantic well-formedness decisions are made at this level.

In the examples presented here the controller has always been the noun phrase which filled the Agent Role. As a result, it may seem that as far as the representation is concerned, the control relation can be dispensed with and a feature indicating that the Instrumental role is marked will suffice instead. There is evidence that the controller must be made explicit since it is not always the noun phrase that fills the Agent role. Compare the (a) sentences with *send* and the corresponding (b) sentences with *come* in (4-37)-(4-42).

(4-37).a Bill sent John in the car.
(4-37).b John came in the car.

(4-38).a Bill sent John with the car.
(4-38).b John came with the car.

(4-39).a # Bill sent the books with the car.
(4-39).b # The books came with the car.

(4-40).a Bill sent the books in the car.
(4-40).b The books came in the car.

(4-41).a Bill sent John in the plane.
(4-41).b John came in the plane.

(4-42).a # Bill sent John with the plane.
(4-42).b # John came with the plane.

The parallels between the sentences suggest that there is a control relation between the direct object of *send* and the vehicle when the direct object will allow an agentive interpretation, that is when it is an animate entity in the examples above. If the object of *send* receives an agentive

interpretation when it is animate just as the subject of *come* does (see Section 2.2), the explanations used for the *come* data could be extended to cover the *send* data. The similar patterns of acceptability make this desirable. In some circumstances the subject of *send* can be the controller, as in (4-43).

(4-43).a John sent the chair across the room with a shove.
(4-43).b John sent Mary across the room with a shove.

These examples are not presented in detail since they are only intended to show that the controller is not necessarily the noun phrase that fills the Agent role. Therefore, the control relation must be made explicit in the representation.[13]

4.4 Summary

The validity of using the Marked Instrument Hypothesis as part of the proposed solution to the Instrumental Problem rests on the ability to find a uniform account of the observed variations in meaning and acceptability between marked and unmarked Instruments through a characterization of the marked/unmarked distinction. The control relation was introduced for this purpose. The variations in meaning turn out to be systematic: the instrument receives an exclusively controlled interpretation only if there is an occurrence of the marked Instrument in a sentence. This means that the noun phrase which fills the Instrumental role participates in the control relation as the controlled object. The difference in semantic restrictions results from an additional semantic well-formedness constraint on the marked Instrument; the marked Instrument must meet the conditions on the control relation as well as those on the Instrumental role. The well-formedness of an instance of the control relation depends on the interaction of its two

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13. I will not consider the problem of how it should be stated further here.

participants: the controller must be able to control the controlled object. This is a revised version of a simpler constraint, that the controlled object must be controllable; this constraint ignored that the notion of control defines a relation.

5. Conclusion

The Instrumental Problem has provided a vehicle for arguing that the conception of the underlying representation as a predicate-argument representation found in other work is inadequate. Instead, a richer conception of the underlying representation is needed. The proposal here is that, besides a predicate-argument representation, the underlying representation must include at least certain semantic relations such as the control relation. The control relation differs from a predicate-argument relation in that it is a direct relation between two noun phrases, unlike a predicate-argument relation which is a relation of a noun phrase to a verb.

Rather than reiterating the argument for the control relation, the question I will turn to next is: *why* is the notion of control able to account for the Instrumental Problem? The control relation succeeds where the predicate-argument representation fails because the control relation specifies a relation between noun phrases and not a relation of a noun phrase to a verb as the Instrumental role does. The acceptability of a use of *with* does not depend on the object of *with* alone. An explanation of the acceptable occurrences of *with* requires an alternative to a predicate-argument relation since conditions on the acceptability of *with* do not take the form associated with a predicate-argument relation. Introducing the control relation, a relation between noun phrases, allows this property of *with* to be represented at the level of underlying representation. Given the control relation, the use of *with* indicates an instance of the control relation in which the object of *with* participates as the controlled object. The acceptability of a use of *with* reflects the well-formedness of this instance of the control relation.

The inability to find a solution to the Instrumental Problem using a predicate-argument representation alone cannot be the result of a particular choice of predicate-argument representation (that is, the set of predicate-argument relations identified), but is attributable to a basic property of the predicate-argument representation: it is a verb-centered representation. This property of the representation restricts the phenomena that a predicate-argument representation can explain. For example, it prevents a solution to the Instrumental Problem from ever being possible with only a predicate-argument representation. The solution requires a relation between arguments which, as a verb-centered representation, the predicate-argument representation cannot provide. Yet, this property is essential if the predicate-argument representation is to capture generalizations necessary to the level of underlying representation as a level of semantic abstraction. The existence of the limitation, once recognized, justifies introducing a relation between noun phrases because, otherwise, in a purely verb-centered representation, a significant generalization about instrumental *with* is lost.

The control relation was proposed to give an account of the acceptable occurrences of instrumental *with*. Since the control relation, by providing an independent semantic constraint, offers an explanation of the observed behavior of instrumental *with*, this is sufficient reason to adopt it in view that a predicate-argument representation is inadequate for this purpose. The evidence for the control relation is strong because there is one semantic concept which consistently accounts for the variations in acceptability found with instrumental *with* and the difference in meaning between the locative prepositions and *with*.

This raises a question: are there other phenomena which will require the addition of a relation similar to the control relation? The existence of such phenomena would further support the proposed solution,

introducing a relation between noun phrases, by showing that it is not a special purpose solution applicable in only one instance. I will point out two other phenomena that show properties similar to the Instrumental Problem, suggesting that semantic relations may be necessary to account for each of them.

The first example, concerning causative verbs, is based on an observation by Cruse [1972]. Sentences (5-1) illustrate the paradigm typically associated with causative verbs.

(5-1).a John moved the chair.
(5-1).b The chair moved.

In the sentences above, the object of the transitive use of the verb and the subject of the intransitive use of the verb fill the Patient role while the subject of the transitive verb fills the Agent role. Compare (5-1) with (5-2).

(5-2).a # John moved the shadow.
(5-2).b The shadow moved.

This example illustrates that the set of possible patients of the transitive use of the causative verb is more restricted than that of the intransitive use of the verb. Sentence (5-2).b and shows that the noun phrase *the shadow* is an acceptable patient of the verb *move*, so the unacceptability of (5-2).a cannot be attributed to the restrictions on the Patient role not being met. Nor can it be attributed to the choice of agent because (5-1).a is acceptable.

These examples suggest that the presence of an agent restricts the set of acceptable patients. There must be some sort of relation between the two that must be well-formed to guarantee the acceptability of the transitive use of the causative verb, in addition to the restrictions on the Agent and Patient roles. Cruse suggests that the acceptability depends on whether or

not the agent can be the direct cause of the action.[1] In the acceptable transitive sentences the agent is the direct cause of the action, moving or flying, but the agent cannot cause the actions directly in the unacceptable sentences.

As a second example, I will consider the phenomenon of "Subject-Object Inversion" in Navajo.[2] Navajo transitive sentences have the general form shown in (5-3), where *x* is a prefix which determines which noun phrase is interpreted as actor and which as goal.

(5-3) NP1 NP2 *x*-V

The two possible prefixes, *yi* and *bi*, together with the resulting interpretation of the noun phrases are illustrated in (5-4)-(5-5).

(5-4) Actor Goal *yi*-V
(5-5) Goal Actor *bi*-V

For a given verb, whether (5-4), (5-5), or both are possible depends on the choice of noun phrases, as illustrated in (5-6)-(5-8) (I am only giving English glosses intended to convey the pertinent information).

(5-6).a horse mule *yi*-kick
(5-6).b mule horse *bi*-kick

(5-7).a # horse boy *yi*-kick

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1. An alternative analysis proposed for causative verbs is that the transitive sentence (5-1).a is derived from an underlying representation in which the verb is decomposed, as in (i).

i. John CAUSE (the chair MOVE)

Even if this analysis were adopted, the acceptability will depend on a direct cause relation existing between the Agent of CAUSE and the embedded predication. Cruse points out that the choice of subject is restricted as well. The subjects of (ii)-(iv) are all possible causes, but this is not enough: the sentence is only acceptable if the subject is a direct cause of the action.

ii. John melted the ice.
iii. The sun melted the ice.
iv. The power failure melted the ice.

2. The discussion of this phenomenon, which was first mentioned in Section 2.3, is based on [Witherspoon 1977].

(5-7).b boy horse *bi*-kick

(5-8).a girl water *yi*-drink
(5-8).b water girl *bi*-drink

In (5-6), for example, where both alternatives are possible, the horse does the kicking and the mule gets kicked. The question is how to account for the unacceptable sentences?

The problem, according to Witherspoon, is not syntactic; all the sentences are syntactically well-formed. An account of Subject-Object Inversion involves the meaning of the sentence; in particular, the question of who can control or act upon whom:

> This is determined primarily by the level of one's intelligence and, to a lesser extent, by the potency of one's animation... Beings and entities in the Navajo world are categorized and ranked accoring to a scale based on who can control whom. Beings of lower intelligence cannot control or act upon beings of higher intelligence, unless the beings of higher intelligence willfully or inadvertently yield to the control of beings of lower intelligence. (Witherspoon, p. 77)

Witherspoon explains the contrast in (5-7) as follows:

> This sentence [i.e. (5-7).a] is rejected by speakers of Navajo ... because in the Navajo conception of the world human beings are more intelligent than horses, and thus horses cannot will and carry out actions against human beings without the action being stimulated or causes by the conscious will of the human being or by his careless, inadvertent behavior. In sentence (16) [i.e. (5-7).b] the boy is the prime mover of the action and also is the recipient of the action; the horse is only the agent or means by which the action is accomplished. The resulting semantic context of the sentence is more like the English passive. This sentence might better be translated "the boy had himself kicked by means of the horse". (Witherspoon, p. 73)

Given this approach to Subject-Object Inversion, it is a mistake to consider that pairs of sentences such as (5-6) correspond to active-passive pairs. The sentences show a difference in meaning: in (5-6).a the horse kicked the

mule, but in (5-6).b, the mule let the horse kick it. Witherspoon proposes that the oddness of (5-8).b is brought out if it is translated as "the water got itself drunk by means of the girl," or "the water let the girl drink it."

How would these facts be made explicit at the level of underlying representation? The pattern of data in (5-6)-(5-8) is reminiscent of the instrumental and locative phrases. The existence of at least one acceptable sentence in every pair shows that the noun phrases are acceptable actors and goals, so the restriction must have another source. Witherspoon's analysis suggests that the noun phrase in NP1 position in (5-3) has attributed to it the power to control the action's coming about (if NP1 is the actor, by bringing about the action, or, if NP1 is the goal, by allowing the action to happen). For a sentence to be acceptable, NP1 must have the ability to control the action's coming about; this ability is determined by the relative ranking of NP1 and NP2 in terms of position on the hierarchy. The Navajo sentence conveys who has control over the occurrence of an action as well as the roles of the participants in the accomplishment of the event itself.

Once a relation such as the control relation has been introduced in the underlying representation, the underlying representation of a sentence will no longer be restricted to a purely verb-centered representation. The causative and Navajo examples above suggest that besides the control relation, there may be other relations of this kind. The question is what consequences will this have for the level of underlying representation? The entire conception of the underlying representation could change because new accounts of other phenomena may be possible. One immediate consequence is that a shift is required in the form that the underlying representation takes: from a predicate-argument notation to a semantic network of some sort. Perhaps the analysis most likely to be affected will be that of the causal structure of the sentence, the description of the participants in the action responsible for bringing it about. The notion of instrument, together with

the notions of agent and force, is central to this aspect of the semantic structure of a sentence, so any changes in the treatment of instrument could influence the approach to the other two.

Appendix I - Grammatical Relations

Grammatical relations provide a way of identifying the relation that each noun phrase in a sentence bears to the verb[1] in syntactic terms. The purpose of this section is to introduce some vocabulary for describing sentences in terms of grammatical relations. By grammatical relations, I will mean the relations of subject, direct object, and indirect object, together with the relations indicated by prepositions, that is prepositional phrases. In English, the grammatical relations of subject, direct object, and indirect object are identified by their position in a sentence. In other languages the grammatical relation of a noun phrase may be determined by morphological clues or by a combination of position and morphology. There are several ways of describing the position of the noun phrases; two possibilities are in terms of position in phrase structure or in terms of linear position in a sentence. The following definitions,[2] based on those in Chomsky [1965], will suffice for the examples here (in most circumstances the definitions can be replaced by the informal restatements given in parentheses).

subject: the NP dominated by S (the noun phrase which precedes the verb).

direct object; the NP dominated by VP (the noun phrase which follows the verb).

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1. The notion of grammatical relations can be extended to include the relations of noun phrases to nouns, adjectives, and prepositions, but I will not consider this use. Also I will ignore sentences with sentential, verbal, or adjectival complements to the verb. The examples will be restricted to sentences made up of verbs and noun phrases bearing grammatical relations to the verb.

2. I have not given a definition of the relation of indirect object since I will not be concerned with it in any of the examples.

All the other grammatical relations are marked by prepositions. I will refer to the preposition in the prepositional phrase as the head of the prepositional phrase and to the noun phrase as the object of the preposition. I will call one set of prepositional phrases locative phrases; these are prepositional phrases that describe location such as those marked by *at*, *on*, *in*, or *against*. It is also necessary to make a distinction between two uses of prepositional phrases. Prepositional phrases can be used both as grammatical relations to describe the relation of a noun phrase to a verb and as sentence-level modifiers. When used to describe the relation of a noun phrase to a verb, prepositional phrases are dominated by the verb phrase node, and therefore part of the verb phrase. When used as sentence-level modifiers this is not the case. The two uses can usually be distinguished in the following way: only sentence-level modifiers may be moved to the front of the sentences while the other use of prepositional phrases cannot be moved. Sentence-level modifiers are usually locative or temporal phrases. These phrases can also bear grammatical relations so that occasionally with some verbs the two uses are difficult to distinguish. This will not be a problem in the examples here.

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