Most theories of grammar draw a fundamental distinction between arguments and adjuncts. The former are phrases selected by some predicate; the latter are phrases which are unselected, and which function as "modifiers". Although the adjunct-argument distinction is a sharp one conceptually, it is well-known that certain classes of phrases do not pattern clearly with respect to it. This is so for phrases of source, path and goal, like those in (1), and for phrases of instrumentality and agency, like those in (2) and (3):

(1)a. John ran (from the house) (to the store) (along the river)
    b. Every boy (from Impanema)
    c. A trip (from the house) (to the store) (along the river)

(2)a. John cut the salami (with a knife)
    b. The destruction of the city (with rockets)

(3)a. John was seen (by Felix)
    b. The letter (by Felix)

Such expressions appear to share properties of adjuncts and arguments alike, and have been referred to in the literature as optional or "implicit" arguments (Roeppe (1983)).

In this paper I present an analysis of implicit arguments within the framework of Situation Semantics (Barwise and Perry (1981a,b; 1983)) according to which these elements are neither arguments nor adjuncts in the usual sense. Rather they are phrases licensed by a form of extragrammatical "inference" involving knowledge about events and the relationships holding among them. In Situation Semantics, sentences – or, more properly, utterances $U$ – are taken to describe events $e$:

$$U \rightarrow D \rightarrow e$$

Furthermore, events are viewed as linked to one another through various types of "constraints" ($\mathcal{C}$), which reflect how we individuate properties and relations, and how the world is:

$$e \rightarrow \mathcal{C} \rightarrow e'$$
In virtue of these chains of relations, utterances indirectly describe events $e'$:

$$U \rightarrow D \rightarrow e \rightarrow C \rightarrow e'$$

It is this latter, indirect relation, I propose, which is semantically exploited by implicit argument phrases. While other sentence elements determine aspects of $e$, a described situation, implicit argument phrases contribute semantically to an inferred event $e'$, whose existence is determined by necessary or conventional constraints. This form of licensing accounts, as I show, for the joint adjunct-argument behavior of implicit arguments.

In Section 1, I briefly review the status of implicit arguments with respect to argument- or adjunct-hood. I then proceed, in Section 2, to informally introduce the basic proposal argued for here, concentrating on implicit arguments of source and goal. In Section 3, a precise, Situation Semantical analysis for verbal constructions like *John walked to the store* and *Max ran from house* is given; the analysis is then applied, in Section 4, to ditransitive and nominal constructions. In Section 5, I discuss how the basic approach might be extended to other implicit arguments, such as path phrases and PPs occurring with action nominalizations.

### 1. The Ambiguous Status of Implicit Arguments

Adjuncts and arguments are typically identified empirically according to a number of criteria, two major ones being optionality and interability. Arguments are obligatory elements whose presence in a given clause is required by some predicate, such as a verb or preposition. The indicated NP, PP and AdvP in (4a–c), for example, would be standardly analyzed as arguments since the verbs *devour*, *put* and *pay* appear to demand their presence:

(4)a. John devoured *(that meat

*∅

b. John put the car *(in the garage

*∅

c. The job paid *(well

*∅

Adjuncts, on the other hand, are optional elements. In (5a–c), the NP, PP and AdvP are adjuncts; they are freely deletable without loss of well-
formedness:

(5)a. John left \{that day \}
    \{\emptyset\}

b. John waxed the car \{in the garage \}
    \{\emptyset\}

c. The man sang \{well\}
    \{\emptyset\}

The second empirical property distinguishing adjuncts and arguments – iterability – is illustrated with the following example from Bresnan (1982):


As (6) shows, it is possible to get an in-principle indefinite number of adjunct phrases of a given semantic type (MANNER, TEMPORAL, LOCATIVE, etc.). With arguments, on the other hand, such iteration is not permitted:

(7)a. *John ate that meat that beef

b. *The job paid steadily well

Thus (7a) is ill-formed irrespective of whether that meat and that beef refer to the same object; likewise for (7b).

Differing behavior with respect to these properties has traditionally motivated very different semantic analyses for adjuncts versus arguments. Under a view standard since Frege, arguments have been taken to supply coordinates of properties or relations. The verb devour in (4a), for example, is associated with a two-place relation DEVOUR(x, y), with the phrases John and that meat supplying the values of x and y. Once such a value is provided, the relevant coordinate in the relation is “saturated”; hence the non-iterability of arguments. Furthermore, absence of an argument results in absence of a value for one of x or y, and so, ultimately, a failure of the sentence to designate a truth-value. Hence the obligatoriness of arguments. In contrast, adjuncts are standardly analyzed as functions on predicates or clauses (Montague (1974), Thomason and Stalnaker (1973), Dowty (1979)). They supply no values to the relational structure of predicates, and so are optional. Furthermore, the combination of an adjunct with a predicate yields a predicate of the same type (e.g., a VP modified by a locative adverb
remains a VP). This permits a modified phrase to be itself subject to modification; hence the iterability of adjuncts. 2

1.1

Phrases of source, goal, path, instrument and agency, like those in (1–3) (repeated below as (8–10)) show an interesting “mixture” of adjunct and argument properties:

(8)a. John ran (from the house) (to the store) (along the river)
   b. Every boy (from Impanema)
   c. A trip (from the house) (to the store) (along the river)
   d. The letter (to Felix)
(9)a. John cut the salami (with a knife)
   b. The destruction of the city (with rockets)
(10)a. John was seen (by Felix)
   b. The letter (by Felix)

On the one hand, like adjuncts, these expressions are in general completely optional. As the parentheses show, elision of a phrase of source, goal, agency, etc. does not affect well-formedness. Furthermore, these elements co-occur not only with verbal predicates, but also with simple nominals which would not be plausibly viewed as selecting them. The common nouns boy and letter in (8d) and (10b), for example, appear to be simple one-place predicates of objects, and do not seem to involve notions of source or agency in any essential way.

On the other hand, phrases of source, goal agent, etc. also manifest properties of arguments. Significantly, they are not iterable: only one such phrase may co-occur with a given head. Implicit arguments thus appear to “saturate” other predicates:

(11)a. *John flew to New York to Kennedy Int’l Airport
   b. *Max got a letter from Felix from his friend
   c. *John cut the salami with a knife with a big Ginsu
   d. *John was seen by the principal by Oscar

Moreover this particular class of phrases often shows overt argument-like behavior cross-linguistically. Phrases of source, goal, instrument, etc. are realized in many languages by simple case-marked NPs, like other verbal arguments. And in languages with so-called “applicative” constructions, phrases of the kind in (8–10) are productively assimilated into the verbal complex and undergo operations typically confined to argument expressions (e.g., passive) (see Marantz (1984), Baker (1985)). English itself has
an echo of this. As is well-known, certain phrases of goal and beneficiary participate in “dative shift” alternations where they are “promoted” to direct objects (I gave a book to John/I gave John a book; I baked a cake for Max/I baked Max a cake).³

This constellation of properties raises an obvious question under the standard analysis of arguments and adjuncts stated above. In its bare form, this analysis simply forbids phrases from functioning simultaneously as arguments and adjuncts, since there is no way an expression can simultaneously be an argument of, and a function on, one and the same predicate. What then is the status of phrases of source, goal, path, instrumentality etc.? Are they arguments or adjuncts? And given either answer, What is the source of the “complementary” set of properties?

2. IMPLICIT ARGUMENTS AND INFERRED EVENTS

Work by Gruber (1965) and Jackendoff (1972, 1976, 1983) suggests an approach to these questions. Consider (12a–c):

(12)a. The train traveled from New York to New Jersey
   b. Harry gave the book to the library
   c. The prince changed from a handsome young man to a frog

Jackendoff and Gruber observe that (12a–c) exhibit an important underlying uniformity in that in each case, an object is presented as “moving” from one point or situation to another. In the first sentence this “motion” involves a change of position: the train is first present at some location l and then at some other location l’; in the second sentence a change of possession occurs: the book is in the keeping of Harry and later in the keeping of the library; and in the third a change of identity or properties is involved.

To capture the uniformity in these examples, Jackendoff (1976) suggests a strategy of lexical decomposition: he analyzes the meanings of verbs into abstract predicates which may be shared. Travel, fly, jump, give, change, etc. are all hypothesized to contain as a discriminable sub-part of their meaning, an abstract three-place relation GO, which holds of some triple (x, y, z) just in case the individual x moves from y to z:⁴

(13) \[ \text{GO}(x, y, z) \]

With such a predicate, the common aspects of (12a–c) can be stated in a simple and uniform way: that point or state from which “motion” originates supplies the value of the y coordinate. That point or state to
which "motion" proceeds supplies the z coordinate. And that which undergoes "motion" supplies the value of x. This view takes source and goal phrases as true arguments, and also allows a traditional and rather plausible view of prepositions like from and to, viz., that they function very much like (Ablative and Dative) "case-marking" in identifying the argument linking of their NP objects. 5

2.1

The idea that implicit arguments are the genuine arguments of an abstract predicate can be reconstructed in an interesting way within the framework of Situation Semantics (Barwise and Perry (1981a,b; 1983)). This reconstruction involves taking elements like GO, not as components or "atoms" in the lexical decomposition of verb meanings, but rather as constituents of what might be called thematic situation types – event-types which capture a broad level of uniformities shared by certain kinds of events.

In Situation Semantics, "meaning" in its most general form is taken to arise through the presence in the world of certain systematic relations holding between events or types of events. Such relations are called constraints. Linguistic meaning is an instance of this. Sentences – or more properly, the utterances which contain them – are taken to describe situations, and linguistic meaning is understood in terms of this conventional constraint of describing (\( \varnothing \)) holding between utterance situations \( U \) and described situations \( e \):

\[
U \longrightarrow \varnothing \longrightarrow e
\]

Thus an utterance of John kisses Mary is linked by conventional constraints to a situation in which John kisses Mary, etc.

Conventional relations like 'describing' are not the only kind of constraint. Other, so-called necessary constraints arise as a consequence of how the world is, and of how we individuate properties and relations. This is so for the example of John kissing Mary. There is a necessary constraint \( \mathcal{C} \) holding between the type of situation in which kissing occurs and the type in which touching occurs. In view of this, any actual situation \( e \) in which John kisses Mary will also be one \( e' \) in which he touches her:

\[
e \longrightarrow \mathcal{C} \longrightarrow e'
\]

Constraints like \( \varnothing \) and \( \mathcal{C} \) evidently "interlock" in a certain way, and this means that utterance situations will often provide information about
more than what is contributed by their literal constituents. An utterance of *John kissed Mary* describing an actual event *e*, for example, will also indirectly describe a situation *e'* in which *John* touches *Mary*, by virtue of the relations holding between *U*, *e* and *e'*:

\[ U \rightarrow e \rightarrow e' \]

Suppose, now, that a large number of situations *e*₁, *e*₂, ..., *e*ₙ described by *U*₁, *U*₂, ..., *U*ₙ were all connected by constraints to the same situation type *E* – that is, suppose situations *e*₁, ..., *e*ₙ were all necessarily of some type *E*:

\[ \begin{align*}
U₁ & \rightarrow e₁ \\
U₂ & \rightarrow e₂ \\
& \vdots \\
Uₙ & \rightarrow eₙ \\
\end{align*} \rightarrow E \]

Then one could imagine grammar making use of the broad, pervasive regularity represented by *E*. Specifically, one could imagine grammar allowing constituents into an utterance *U*ᵢ in virtue of a semantic contribution they make to *E*, the situation indirectly described by *U*ᵢ, rather than to *e*ᵢ, the directly described situation. Such elements would, in effect, be licensed by an “inference” – by the fact that the *U*ᵢ are linked by conventional constraints to the *e*ᵢ, which are linked by necessary constraints to *E*.

Broadly put, this is the view of implicit arguments I want to propose here. I want to suggest that (utterances of) sentences involving “motion” verbs (*travel*, *go*, *fly*, *give*, *donate*, *change*, *mutate*, etc.) describe situations which are all linked to a common event type of “motion”, *E₇̅O*, in which something *x* goes from *y* to *z*:

\[ \begin{align*}
[s\ldots \text{travel}\ldots] & \rightarrow e₁ \\
[s\ldots \text{go}\ldots] & \rightarrow e₂ \\
[s\ldots \text{fly}\ldots] & \rightarrow e₃ \rightarrow E₇̅O: \text{GO}(x, y, z) \\
[s\ldots \text{give}\ldots] & \rightarrow e₄ \\
[s\ldots \text{change}\ldots] & \rightarrow e₅ \\
\end{align*} \]

Implicit argument phrases of goal, source, and path occurring in such Ss are licensed by the semantic contribution they make to *E₇̅O*; they saturate arguments of GO.

On this picture, the distribution of implicit arguments is not a matter of
the argument structures of particular English verbs like *walk, fly* or *travel*. Rather it is a matter of the relations that hold between events – the fact that situations of certain kinds are invariably situations of a certain other kind as well – and the way that grammar allows us to exploit these relations.

3. SOME SITUATION SEMANTICS

We now make this general, intuitive picture precise, and show how it bears on the properties of implicit arguments. In the informal exposition above, reference was made to events, event-types and constraints. In Situation Semantics, events are viewed as collections of facts, where the latter are made up of space-time location, properties and relations, individuals, and a polarity value (1 or 0, yes or no) indicating that the fact does or does not obtain. For example, an event *e* of John walking and not talking at a location *l* is represented as follows:

\[
(14) \text{ in } e: \text{ at } l: \text{ walk, john, yes} \\
\text{ talk, john, no}
\]

Event-types have the same general form as events, except that one or more of their constituents is replaced with an **indeterminate** – a variable-like object which must get **anchored** to an entity. There are indeterminates for each kind of constituent in an event – i.e., locations, individuals, properties and relations, etc.; they are represented with bold face letters. Thus (15a,b) are event-types:

\[
(15a) E := \text{ at } l: \text{ walk, john, yes} \\
(15b) E' := \text{ at } l: \text{ walk, } b, \text{ yes}
\]

(15a) may be understood, informally, as the type of event in which john is walking somewhere; (15b) is the type of event in which someone is walking at *l*, etc.

An event *e* is said to be "of type *E*" if there is an anchoring of the indeterminates in *E* – intuitively, a way of replacing indeterminates with objects – which makes *E* part of *e*. Thus the event *e* in (14) is of type *E* since an anchoring of *l* to *l* makes *E* part of *e*. Similarly, *e* is of type *E'* since an anchoring of *b* to john makes *E'* part of *e*. We use ‘*E*f' to indicate an event-type *E* under an anchoring of indeterminates *f*.

Constraints are a rather special kind of event-type. They are event-types which relate event-types, and have the following general form:

\[
(16) C := \text{ at } l: \text{ involves, } E, E', \text{ yes}
\]
A situation semantical model distinguishes a class of events as actual events (ones which count as "really happening" with respect to the model). The predicate ‘involves’ is a primitive relation which holds between event-types $E$ and $E'$ just in case every actual event of the former type is an event of the latter type; more precisely, just in case $E[f]$ is part of $E'[f]$, whenever $E[f]$ is actual. (16) can thus be understood as guaranteeing that actual events of type $E$ are always part of a "larger" event of type $E'$ in which various additional facts hold. Henceforth, for notational convenience, we will abbreviate (16) as $E \Rightarrow E'$.

These constructs are applied to the interpretation of linguistic expressions in a straightforward way: sentences are taken to describe events, and the subconstituents of sentences contribute the contents of these events. For example, the sentence John is walking and not talking will describe the event in (14). To this end, the NP John contributes the element john, walk and talk contribute walk, b, i and talk, b, i (where i is an indeterminate over polarity values), tense contributes the location l, and so on. In the course of interpreting a syntactic representation, these elements are recursively added into the described event under some anchoring of their indeterminates. A sentence will thus describe an event $e$ iff there is some consistent anchoring of the indeterminates associated with its constituent expressions, such that when the anchored pieces are all assembled together they yield $e$.

3.1. Licensing by Constraints

With these formal tools we now return to implicit arguments. Recall the basic notion to be captured is how an expression may be licensed by constraints relating a described situation to a thematic situation type.

The thematic situation type of motion $E_Go$ we represent as an event-type involving a relation GO between an individual and two event-types $E_1$ and $E_2$. The latter represent the beginning the final state of $b$:

$$E_Go := at 1: GO, b, E_1, E_2, yes$$

$E_Go$ is a uniformity across situations involving "motion" in the broad sense described above. The situations described by (12a–c) are all of this very general kind. Where the latter differ is in the specific relations or properties that hold of $b$ in $E_1$ and $E_2$. In (12a), $E_1$ and $E_2$ involve a change of spatial position (cf. (18a)); in (12b) they involve a change of possession (cf. (18b)); and in (12c) they involve a change of properties (cf. (18c)): 
In each instance here \( l_1 \) temporally precedes \( l_2 \) (‘\( l_1 < l_2 \)’), and \( l_1 \) and \( l_2 \) are contained in \( l \), the location of the event of going (‘\( l \in l_2 \)’ and ‘\( l \in l_2 \)’).

As discussed earlier, the connections between situations described by verbs like \textit{travel} and \textit{give} and situations of the event-type \( E_{GO} \) are ones which presumably follow from the structure of the world and how we individuate its parts. We capture them with a set of (actual) constraints linking events described by verbs of motion and events involving \( E_{GO} \).

(19) is the contraint connecting “situations of traveling” to \( E_{GO} \):

\[
E \Rightarrow E_{GO}, \quad \text{where}
\]
\[
E := \text{at } l: \text{travel, } b, \text{yes}
\]
\[
E_{GO} := \text{at } l: \text{GO, } b, E_1, E_2, \text{yes}
\]
\[
E_1 := \text{at } l_1: \text{present, } b, \text{yes}
\]
\[
E_2 := \text{at } l_2: \text{present, } b, \text{yes}
\]
\[
l_1 < l_2, l \in l_1, l \in l_2
\]

And (20) is the constraint linking “situations of giving” to \( E_{GO} \):

\[
E \Rightarrow E_{GO}, \quad \text{where}
\]
\[
E := \text{at } l: \text{give, } a, b, c, \text{yes}
\]
\[
E_{GO} := \text{at } l: \text{GO, } b, E_1, E_2, \text{yes}
\]
\[
E_1 := \text{at } l_1: \text{possess, } a, b, \text{yes}
\]
\[
E_2 := \text{at } l_2: \text{possess, } c, b, \text{yes}
\]
\[
l_1 < l_2, l \in l_1, l \in l_2
\]

The similarities of structure between (17) and (18) permit us to
characterize their common aspects much in the spirit of Jackendoff and Gruber. Using the situation semantical notion of a complex indeterminate, we can define **SOURCE** and **GOAL** as follows:

\[
\text{SOURCE} = \langle \text{so}, \ E_{\text{GO}} \rangle, \text{where } \text{so} = \langle a, E_1 \rangle \text{ if the latter is a role, otherwise } \text{so} = \langle l_1, E_1 \rangle
\]

\[
\text{GOAL} = \langle \text{gl}, \ E_{\text{GO}} \rangle, \text{where } \text{gl} = \langle c, E_2 \rangle \text{ if the latter is a role, otherwise } \text{gl} = \langle l_2, E_2 \rangle
\]

These complex indeterminates are defined so that when they are anchored to an object, this anchoring is recursively “passed down” in an appropriate way. For example, anchoring **SOURCE** to a value \(x\), will involve anchoring \(\text{so}\) to that same value in \(E_{\text{GO}}\); the latter will in turn involve anchoring \(a\) to \(x\) in \(E_1\). The result is thus that \(x\) gets passed down to \(a\).\(^8\)

**SOURCE** and **GOAL** are utilized in the interpretation rules for the prepositions *from* and *to*. These prepositions will denote two-place relations between an event \(e\) and an individual \(z\). The relation holds just in case \(z\) is anchored to the appropriate complex indeterminate in \(e'\), where the latter is an event related to \(e\) through one of the \(C_{GO}\) constraints (We symbolize this relation by “\(e \rightarrow C \rightarrow e'\)”):\(^9\)

\[
(21) \quad \parallel \text{from} \parallel z, e \iff \text{for some } e' \text{ such that } e \rightarrow C \rightarrow e', \ z \text{ is assigned to } \text{SOURCE} \text{ in } e'
\]

\[
\parallel \text{to} \parallel z, e \iff \text{for some } e' \text{ such that } e \rightarrow C \rightarrow e', \ z \text{ is assigned to } \text{GOAL} \text{ in } e'
\]

Thus, as in the proposals of Gruber and Jackendoff, we take *from* and *to* to establish the argument-linking of their object nominal. The prepositions tell us which indeterminate the object NP must provide the value of.

Finally, we adopt the rules for PP and VP interpretation in (22) and (23) (resp.):

\[
(22) \quad \parallel P \parallel PP \parallel X, e \iff \text{for some } z \in E
\]

\[
X = \{ e : \parallel P \parallel z, e \text{ and } \parallel \text{NP} \parallel z \}
\]

\[
(23) \quad \parallel \text{VP} \parallel VP \parallel PP \parallel z, e \iff
\]

\[
\parallel \text{VP} \parallel z, e \text{ and } e \in X, \text{ where } \parallel PP \parallel X, e
\]

The former states that PP denotes a set of events \(X\), intuitively, those events in which the individual supplied by the object NP is assigned to the indeterminate specified by \(P\). The latter gives VP interpretations as (essentially) relations between individuals \(z\) and events \(e\), and says that in interpreting a VP plus adjoined PP, you simply check to see if the event
in the VP interpretation is in the set of events picked out by the PP interpretation.

Let us look at an example in detail to see the effect of these definitions and rules. Consider (24) below, which contains a goal phrase:

(24) \([s [NP John] [VP [VP traveled] [PP to Rome]]]\)

This sentence will describe an event \(e\) iff the subject NP picks out an individual who "VPs" in \(e\); i.e.,:

(25) \(|[s [NP John] [VP traveled] [PP to Rome]]|e\)

iff for some individual \(z\)

\(|[NP John]|z\) and \(|[VP traveled to Rome]|z, e\)

The first conjunct in (25) will hold if and only if \(z\) is the individual John. Furthermore by the scheme in (23), the second conjunct has the following conditions:

(26) \(|[VP traveled] [PP to Rome]|z, e\) iff \(|[VP traveled]|z, e, and e \in X where |[PP to Rome]|X, e\)

It will be the case that \(|[VP traveled]|z, e\) iff the individual \(z\) (i.e., John) travels in \(e\) at some location \(l\). Setting aside the issue of how location \(l\) is derived, as well as matters of tense (see Larson (1983, forthcoming) for proposals), we thus have:

(27) \(|[VP traveled]|z, e\) iff in \(e\): at \(l\): travel, John, yes

The requirement that \(e\) be a member of the set of events denoted by PP is spelled out via (21) and (22). This will be true iff \(e\) stands in the "|\(\theta\)|-relation" to \(z\), the city Rome. The latter will in turn hold iff there is an actual constraint \(C\) in \(C_{GO}\) and an event \(e'\), where \(e - C \Rightarrow e'\), such that GOAL is anchored to Rome in \(e'\). The requirement that there be a \(C_{GO}\) constraint and an \(e'\) essentially comes down to demanding that there be an actual constraint of the form '\(E \Rightarrow E_{GO}\)' and an event \(e'\), such that \(e\) is of type \(E\) and \(e'\) is of type \(E_{GO}\). We have assumed the actuality of the constraint in (19) (repeated below):

(19) \(E \Rightarrow E_{GO},\) where

\(E \ :=\) at \(l\): travel, \(b\), yes

\(E_{GO} \ :=\) at \(l\): GO, \(b\), \(E1\), \(E2\), yes

\(E1 \ :=\) at \(l1\): present, \(b\), yes

\(E2 \ :=\) at \(l2\): present, \(b\), yes

\(l1 < l2, l2 l1, l2 l2\)

That is, we have assumed that the world is such that every event of
traveling is also of type $E_{GO}$. Thus the conditions imposed by PP reduce to the requirement that there be an $e'$ related to $e$ through the constraint in (19) such that Rome is anchored to $\text{GOAL}$ in $e'$.

For present purposes we can identify the individual Rome with the location $l^*$ occupied by that city. Assembling all of our information, then, and recalling the agreement of values for indeterminates which is enforced by the constraint in (19), we arrive at the following result:

\begin{align}
&\text{If } [\text{NP John} [\text{VP traveled} [\text{PP to Rome}]])\text{ in } e \text{ iff } \\
&\text{in } e: \text{ at } l: \text{ travel, john, yes, and } e \text{ is part of } e', \text{ where } \\
&\text{in } e': \text{ at } l: \text{ GO, john, } E1, E2, \text{ yes} \\
&E1 := \text{ at } l': \text{ present, john, yes} \\
&E2 := \text{ at } l^*: \text{ present, john, yes} \\
&l' < l^*, l \equiv l', l \equiv l^* \\
\end{align}

where $l^*$ is the location of Rome. That is, \textit{John walked to Rome} describes some situation $e$ iff John walked in $e$, and if $e$ was part of an event $e'$ (with the same space-time location) in which John was first present at some (unspecified) location $l'$ and subsequently present in Rome, the desired outcome.

The rules given above instantiate the basic intuitive proposal discussed earlier. The object of the goal phrase makes no direct semantic contribution to the event directly described by the sentence – Rome ($l^*$) appears nowhere in the final specification of $e$. Rather Rome contributes to $e'$, the motion event which is “inferred” from $e$ through a constraint.\(^{10,11}\)

3.2

This analysis goes some way, I believe, toward explaining the behavior of implicit arguments with respect to their optionality and iterability. In Situation Semantics, obligatoriness of complements is handled in a largely traditional way: as we mentioned, sentences will contain predicates (like travel') which are associated semantically with a relation or property ('travel'), and a family of indeterminates for that relation or property ($l$, $a$, etc.). These indeterminates must all be anchored in the sentence containing the predicate is to be a statement; i.e., if it is to describe an event. Since the values for these indeterminates are provided by various complements in the clause, absence of a complement will result in absence of a value, and hence a failure of the sentence to describe an event. Now under the rules above (especially (21)), implicit arguments do not contribute anything semantically to the event described by S. No
indeterminate associated directly with *travel* gets its value fixed by a goal phrase. Accordingly, their optionality is unsurprising: since they contribute nothing to *e*, their absence will be irrelevant to whether the sentence containing them succeeds or fails in describing an event.

The non-iterability of arguments is also straightforward. Again in line with traditional views, Situation Semantics must assume that anchorings of indeterminates is unique, in the sense that once an object is assigned to an indeterminate *a*, no further anchoring of *a* is possible. Given this, the non-iterability of implicit arguments follows from the fact that although these items do not anchor indeterminates associated with a main clause predicate, they do fix the value of an indeterminate in *E戈*. Once this value is supplied, further anchoring is impossible, hence the impossibility of multiple goals, sources, etc.

4. **Other Constructions with Implicit Arguments**

4.1. *Di-transitive Verbs*

In the discussion of (12a–c) di-transitive or dative verbs like *give*, *send*, etc., were suggested to involve the thematic situation of motion in which an object undergoes a change of possession rather than, say, a change of location:

\[(29) \text{John gave/sent/mailed a book [PP to Mary]}\]

Such verbs have often been analyzed in the literature as taking three arguments, including a subject, a direct object and an indirect object, where the latter appears in the PP headed by *to*. This analysis of PP as providing an argument to *V* seems reasonable since the prepositional phrase can be deleted only under rather strict discourse conditions. At the same time, however, there is a clear, intuitive similarity between the *to*-PP appearing in (29) and the phrases of goal which occur in examples like *John traveled to Rome* – examples where we analyzed PP as providing an argument to a predicate in the *E戈* event, and not to *travel* itself. The question arises, therefore, as to whether the two PPs can be treated in a way which captures their fundamentally similar character.

Under the analysis of goal phrases proposed above, the contribution of *to*-PPs can in fact be treated exactly the same. Indeed our rules of implicit argument interpretation will apply correctly to the VPs in examples like (29) with no further elaboration. To see this, assume that *give* is a three place verb and consider the interpretation of the VP *give a book to Mary*:
IMPLICIT ARGUMENTS IN SITUATION SEMANTICS

(30) \[ [\text{VP give a book}][\text{PP to Mary}]][z, e \text{ iff } [\text{VP give a book}][z, e \text{ and } e \in X, \text{ where } [\text{PP to Mary}][X, e]

(30) is completely parallel to (26) above. The first conjunct specifies (in effect) that the individual \( z \) (John, say), must “give a book in \( e \)”. Note carefully that within the smaller VP, there is no phrase which specifies the third argument – the recipient of the giving.

Consider now the second conjunct. This states that \( e \) must be a member of the set of events designated by PP. We have assumed the constraint in (20):

\[(20) \quad E \Rightarrow E_{GO}, \text{ where}
\]
\[E := \text{at } l: \text{give, } a, b, c, \text{ yes}
\]
\[E_{GO} := \text{at } l: \text{GO, } b, E1, E2, \text{ yes}
\]
\[E1 := \text{at } l1: \text{possess, } a, b, \text{ yes}
\]
\[E2 := \text{at } l2: \text{possess, } c, b, \text{ yes}
\]
\[l1 < l2, l2 \leq l1, l1 \leq l2
\]

hence again in parallel with our earlier example, the second conjunct comes down to assuming that there is some \( e' \), \( e' \rightarrow C \rightarrow e' \), such that Mary is anchored to \text{GOAL} in \( e' \).

Now notice that if Mary is assigned to \text{GOAL}, the indeterminate \( c \) in \( E2 \) will have its valued fixed. But then in virtue of the constraint in (20), and the relation it enforces between the indeterminates in \( E \) and \( E_{GO} \), the value of the third argument of ‘give’ in \( E \) will also be fixed as Mary. That is, the existence of an appropriate \( e' \) actually presupposes that \( e \) is an event in which Mary is the person to whom the book is given. It follows then that with di-transitive verbs like \text{give} and \text{send}, the third argument is indeed supplied by our interpretation scheme, albeit via an indirect route: the \text{to-PP} supplies an individual to the inferred situation of type \( E_{GO} \), and in so doing supplies one to ‘give’ in the described situation in virtue of the constraint holding between the latter and the former.\(^{13}\)

It should be pointed out that even though the implicit argument phrase contributes directly to the \( e' \) situation and only indirectly to \( e \), if this phrase fails to occur in a sentence containing a dative verb, then the third argument of that verb will fail to receive a value. The sentence will then fail to designate a statement just as would any sentence with “missing arguments”. Hence the argument-like status of \text{to-phrases} in dative constructions is not sacrificed under this analysis.\(^{14}\)

We might also note that our account will correctly rule out not only iteration of implicit arguments in (31a), but also the subtler “iteration of roles” illustrated in (31b):
(31)a. *John gave the book to Mary to his professor  
b. *John gave the book to Mary from him/himself

We said earlier that it is impermissible to assign two objects to a single indeterminate. Accordingly (31a) is out because it in effect tries to assign two objects to the c indeterminate in (20). Interestingly, (31b) is out for the same reason. As defined above, the object of a from-PP will be anchored to SOURCE, and so, ultimately, to a in El. But the constraint in (20) also requires that the value of the subject NP John be anchored to a. Hence, like (31a), (31b) is out because it attempts to assign two objects to a single indeterminate.

4.2. Nominals

Earlier we noted that implicit arguments may co-occur with nominals which are not plausibly analyzed as determining sources, goals, etc. in their argument structure. As it turns out, such examples can be accommodated naturally in the present analysis. To show this, however, we must first consider nominals and nominal modification briefly.

In the discussion of (24) above, the proper NP [NP John] was analyzed as a simple referring phrase, designating an individual z:

\[\lbrack\text{NP John}\rbrack_z: \text{iff } z \text{ is john}\]

More syntactically complicated NPs like the man or a dog, have a more complex semantics however. Under proposals in Barwise and Perry (1983), these nominals also designate individuals, but do so with respect to a resource event e*:

\[\lbrack\text{NP the man}\rbrack_z, e^*: \text{iff } \ldots\]

Intuitively, the reason for this new event “coordinate” is not hard to see. In an NP like the man or a man, man is functioning as a predicate true of the individual z which NP denotes. Accordingly, in situation semantical terms, when we use the man or a man there must be a fact “around” of the form:

at l: man, z, yes

But facts only occur as part of events, hence there must be some event e* around such that:

in e*: at l: man, z, yes

Hence NPs containing common nouns involve an event e* in their
interpretation. Under Barwise and Perry (1983), NPs of the form the $N$ will designate an individual $z$ with respect to an $e^*$ iff $z$ is the unique $N$ in $e^*$—i.e., iff there is a fact in $e^*$ of the form “at $l$: $N'$, $z$, yes” (where $N'$ is the property corresponding to $N$), and there are no other such facts in $e^*$ involving a different individual. Similarly, NPs of the form $a(n) N$ will designate a $z$ with respect to an $e^*$ iff $z$ is an $N$ in $e$; that is, iff there is a fact in $e$ of the form “at $l$: $N'$, $z$, yes”.

In Larson (1983, forthcoming) it is suggested that nominal modification exploits the $e$ coordinate in the interpretation of NPs. In particular, it is argued that restrictive modification should be analyzed uniformly as “event restriction”. The following general rule is given for restrictive modifiers of NP:

\[(32) \Downarrow_{\text{NP}} \text{NP XP} \Downarrow e, z \iff \Downarrow_{\text{NP}} e', z, \text{ where } e' = e \uparrow \text{XP}\]

According to (32), an NP with a modifier of category XP denotes an individual $z$ with respect to resource situation $e$ iff NP without the modifier denotes $z$ with respect to $e'$, an event which is “the restriction of $e$ by $\text{XP}$”.

Event restriction is a simple operation intuitively. Assume that modifiers XP denote sets $X$. Then to restrict $e$ by means of $X$, we “sort through” the facts of $e$ and eliminate all those which don’t involve an individual from $X$. For instance, suppose that $\text{XP}$ is \{john\}, and $e$ is as in (33). Then $e \uparrow \text{XP}$ is just the event in (34), wherein facts which don’t concern john have been discarded:

\[(33) \quad e: \text{at } l: \text{man, john, yes}
\quad \text{man, felix, yes}
\quad \text{walking, max, yes}
\quad \text{talking-to, max, john, yes}\]

\[(34) \quad e': \text{at } l: \text{man, john, yes}
\quad \text{talking-to, max, john, yes}\]

To see that event-restriction gives a correct characterization of modification, consider a concrete example: the NP a man in a gorilla suit. We want this NP to pick out some individual $z$ who is both a man and a gorilla-suit-wearer. Under the scheme in (32) we have:

\[(35) \quad \Downarrow_{\text{NP}} \text{a man} \Downarrow_{\text{PP in a gorilla suit}} \Downarrow e, z \iff \Downarrow_{\text{NP}} \text{a man} \Downarrow e', z, \text{ where } e' = e \uparrow \text{in a gorilla suit}\]

where $e$ is some resource event. Suppose now that $\text{PP}$ – the set of gorilla-suit-wearers – is \{a, b, c\}. Then under the definition of event-
restriction, $e'$ contains only those facts from $e$ which involve one of $a$, $b$, or $c$. Now we said above that indefinite NPs like a man denote an individual $z$ with respect to a resource event $e$ iff there is a fact of the form “at $l$: man, $z$, yes” in $e$. Accordingly, a man denotes $z$ in $e'$ iff there is a fact of the form “at $l$: man, $z$, yes” in $e'$. But such a fact can only be in $e'$ if was originally in $e$ and got into $e'$ by virtue of $z$ being in \{a, b, c\} – by virtue of $z$ being in the set picked out by the modifier. Taking these points together, then, a man in a gorilla suit will denote $z$ with respect to $e$ iff $z$ is a man in $e$, and $z$ is a gorilla-suit-wearer. This is just what we desired.

4.2.1. Consider now nominals involving implicit arguments. These include common nouns of transit such as trip, journey, excursion, etc., which license phrases of source, goal and path much as verbs of motion do:

\[
(36) \quad \text{We planned a} \begin{cases} \text{trip} \\ \text{journey} \\ \text{excursion} \end{cases} \begin{cases} \text{(from Mainz)} \\ \text{(to Bonn)} \\ \text{(through Koblenz)} \end{cases}
\]

Intuitively, the source of this licensing seems clear: trips and excursions are events or happenings in which individuals undergo a change of spatial position – i.e., they are “motion events”. Accordingly, every event which is a trip is of the event-type $E_{GO}$, and can be taken to have a source and goal, to proceed along a route or path etc. just as events described by motion verbs do.

To accommodate such examples I will appeal to constraints similar to those discussed earlier in connection with travel, fly etc. First, assume (as seems reasonable) that nouns of transit denote properties of events. This means that we will admit facts of the form:

\[
(37) \quad \text{at } l: \text{ trip, } z, \text{ yes}
\]

where $z$ is an individual which is an event. Next we introduce a relation, ‘of-type’, which holds between an event $e$ and an event-type $E$ just in case the former is of the type of the latter – i.e., just in case $E[f]$ is part of $e$ under some anchoring of values $f$ for its indeterminates. Finally, we introduce the following constraint:

\[
(38) \quad E \Rightarrow E', \text{ where } \\
E := \text{at } l: \text{ trip, } e, \text{ yes} \\
E' := \text{at } l'_u: \text{ of-type, } e, \text{ E}_{GO}, \text{ yes, where } \\
E_{GO} := \text{at } l'_u: \text{ GO, } b, \text{ E1, E2, yes}
\]
\[ E1 := at l_1: \text{present, } b, \text{yes} \]
\[ E2 := at l_2: \text{present, } b, \text{yes} \]
\[ l_1 < l_2, l'_1 \geq l_1, l'_2 \geq l_2 \]

Like (19), (38) records that any event designated by \textit{trip} involves the event-type \( E_{GO} \). In particular, according to the constraint, any event which is a trip is also an event of type \( E_{GO} \) in which a change of position occurs.

With these additions, implicit arguments of "transit nominals" can now be interpreted via the rule given above for restrictive PP adjuncts. Consider, for example, \text{[NP [NP a trip] [pp to Rome]]}. This NP will denote an individual \( z \) which is an event. Furthermore like other indefinite NPs it will denote \( z \) with respect to a resource event \( e \). Applying rule (32) we get:

\[
\text{[NP [NP a trip] [pp to Rome]]} \text{[e, } z \text{ iff [NP a trip]} e', z, \text{ where } e' = e \upharpoonright \text{[PP]}]}
\]

That is, \textit{a trip to Rome} denotes \( z \) with respect to \( e \) iff the \textit{a trip} denotes \( z \) with respect to \( e \upharpoonright \text{[PP]} \). Now recall three things: (i) a goal PP like \textit{to Rome} denotes a set \( X \) of events – specifically:

\[
X = \{e_i | \text{for some } e_i \text{ such that } e_i \rightarrow C \rightarrow e, z \text{ is assigned to GOAL in } e_i \text{ and } \|\text{Rome}\|z\} \]

(ii) restricting \( e \) to produce \( e' \) involves discarding all those facts from \( e \) which don’t involve an element of \( X \); and (iii) NPs of the form \( a(n)N \) designate \( z \) with respect to \( e \) iff \( z \) is an \( N \) in \( e \); that is, iff there is a fact in \( e \) of the form "at \( l: N', z, \text{yes}".

For the example at hand, (iii) entails that \textit{a trip} will denote \( z \) with respect to \( e' \) iff there is a fact of the form "at \( l: \text{trip, } z, \text{yes}" in \( e' \). In view of (ii), however, this fact can only be in \( e' \) if it was originally in \( e \) got into \( e' \) by virtue of \( z \) being a member of \( X \) – i.e., by virtue of \( z \) being an event of type \( E_{GO} \) whose goal is Rome. The constraint in (38) guarantees us that all trips are in fact \( E_{GO} \) events. Consequently, taking all our results together, (39) comes down to the following:

\[
\text{[NP [NP a trip] [pp to Rome]]} \text{[e, } z \text{ iff in e: at } l: \text{trip, } z, \text{yes}}
\]

where Rome is anchored to \text{GOAL} in \( z \)

This is intuitively the desired result, \textit{A trip to Rome} picks out a trip in which Rome is the goal.

In short, then, by adopting a simple constraint like (38) for transit nominals, we can actually interpret their associated adjunct phrases of
source and goal like any other restrictive modifiers. No further elaboration in rules is necessary.

4.2.2. A second case of nominals with implicit arguments involves Ns which do not directly refer to motion events, but rather denote objects which typically appear in such events. Consider the source, goal and path phrases appearing in (42):

\[(42) \quad \text{A message (from Felix) (to Horace) (through Max)}\]

Reflecting on matters in an informal way, it seems clear what permits the by-now familiar PPs: (42) is understood much like a “reduced” variant of the participial relative *a message sent from Felix to Horace through Max.* That is, since messages (letters, packages etc.) typically participate in situations of exchange – situations in which they are sent, mailed, given, etc. – there is, in effect, a “hidden” verb meaning which can be reconstructed here. And the source, goal and path phrases are sanctioned by this hidden verb.

Suppose we introduce a constraint to capture the relation between messages and the “transfer of possession” events in which they typically occur:

\[(43) \quad E \supset E_{GO}, \text{ where} \]
\[
E := \text{at } l_1: \text{message}, \, \text{yes} \\
E_{GO} := \text{at } l_2: \text{GO, b, E1, E2, yes} \\
E_1 := \text{at } l_1: \text{possess, a, b, yes} \\
E_2 := \text{at } l_2: \text{possess, c, b, yes . . . etc.}
\]

Then with a very minor adjustment the correct interpretation for examples like (42) can be once again obtained via the general rule for restrictive modifiers. Consider (44):

\[(44) \quad \llbracket_{NP \rightarrow NP \rightarrow PP \text{ to Horace}} || e, z \text{ iff} \]
\[
\llbracket_{NP \rightarrow NP} || e', z, \text{ where } e' = e \llbracket_{PP} \]

According to this biconditional, *a message to Horace* denotes *z* with respect to *e* iff the *a message* denotes *z* with respect to *e* \|PP\|. As usual, the goal PP *to Horace* supplies a set \(X\) of events, viz.:

\[(45) \quad X = \{e_j \mid \text{for some } e_j \text{ such that } e_i \rightarrow C \rightarrow e_j, \ z \text{ is assigned to GOAL in } e_j \text{ and } \|\text{Horace}\|z\}\]

Let us now broaden our view of event restriction slightly. Specifically, let us allow ‘\(e\mid X\)’ to freely mean *either* restricting the facts of \(e\) by means of
X, as before, or restricting e to be itself a member of X. Without going through the details, if we chose the latter option for the case at hand, this will ultimately come down to requiring:

\[(46)\]  
\[\llbracket_{\text{NP}} [\text{NP a message}] [\text{PP to Horace}] \| e, z \iff \text{at } l: \text{message, } z, \text{yes}
\]

and for some \(e'\), \(e \rightarrow C \rightarrow e'\), Horace is assigned to \(\text{GOAL}\) in \(e'\)

where \(C\) is the constraint in (43). That is, a message to Horace denotes \(z\) in \(e\) iff \(z\) is a message in \(e\), and the latter is linked to a “transfer of possession” event in which Horace is the goal (i.e., the final owner). Again, this is the desired result.\(^{17}\)

It is important to note that the constraint in (43) has a rather different status than those discussed earlier. Up to this point we have concerned ourselves strictly with necessary constraints: constraints like those in \(C_{\text{GO}}\) which presumably arise out of the way the world is and the way in which we individuate properties and relations. The constraint in (43) is not of this kind, however. We can see this from the simple fact that it is neither incoherent nor contradictory to conceive of the constraint failing to hold. Intuitively, \(x\) can be a message without ever being sent to, or received by someone, and without being intended to be sent or received.

(43) is what Barwise and Perry term a conventional constraint – a constraint arising out of the social conventions (whether tacit or explicit) holding within some community. Such constraints – which include those governing the use of language – are violable. To take an example from Barwise and Perry (1983), there is a conventional constraint holding between situations in which the sentence “here is a cookie” is uttered and situations in which a cookie is presented, nonetheless it is still possible to utter this sentence when no cookie is available. In a similar way, even though there is a conventional constraint holding between situations of letter writing and situations of letter sending, it is still of course possible to write a letter (message, etc.) without ever sending or intending to send it. In view of the kind of constraint it is, then, (43) simply does not demand that all letters, messages, etc. be sent. Rather it records a certain social convention holding between certain kinds of activities. If these proposals are on the right track, then, it appears that our analysis of implicit arguments as licensed by constraints, just involve not only necessary constraints, but conventional constraints as well.\(^{18}\)
5. EXTENSIONS

5.1. Path and Direction Phrases

The proposals for implicit argument interpretation made above do not treat phrases of path or direction — the sort of thing that would be picked out by PPs like over the river or though the woods. And indeed the latter appear to demand a more complicated analysis than phrases of source or goal. Consider, for instance, the following variant of (12a):

(47)a. The bus traveled from New York to New Jersey through the Lincoln Tunnel

For the path represented by through the Lincoln Tunnel in (47a) it appears that we need something like an “oriented location” — a location whose sublocations are ordered according to a “spatial precedence” relation, and whose “endpoints” are I₁ and I₂. This example contrasts with (47b):

(47)b. Bill inherited the land from his grandfather through his mother

Here the notion of path is considerably more abstract than in the previous sentence. We seem to require something like a “path of possessors” — a chain of persons through whom Bill’s inheritance descends.

The interpretation of path phrases cannot be treated with completeness here, however I can illustrate one plausible line of approach with reference to (47a,b). Speaking in informal terms, it seems that we want the through-phrase in (47a) to “decompose” the event e of type EGO with source New York (NY) and goal New Jersey (NJ):

(48)a. NY → NJ

source e goal

into two subevents — both also of type EGO:

(49)b. NY → LT → NJ

source e' goal, e'' goal

The first subevent (e') has source New York and goal the Lincoln Tunnel (LT), and the second (e'') has source Lincoln Tunnel and goal New Jersey.

Analogous remarks apply to (47b). It seems we want to divide the event e of type EGO with source Bill’s grandfather (BG) and goal Bill (B):
(50a). \[ \text{BG} \rightarrow \text{B} \]
source \( e \) goal

into two subevents – both also of type \( E_{\text{GO}} \):

(50b). \[ \text{BG} \rightarrow \text{BM} \rightarrow \text{B} \]
source \( e' \) goal, \( e'' \) goal

The first subevent \((e')\) has source Bill's grandfather and goal his mother (BM), and the second \((e'')\) has source Bill's mother and goal Bill.

These considerations suggest that prepositions of path might involve lexical rules like the one given below for \textit{through}:

(51) \[ \parallel \text{through} \parallel z, e \iff \text{for some } e^*, e \rightarrow C \rightarrow e^*, \]
\[ e^* = e' + e'', \text{ and } z \text{ is assigned} \]
\[ \text{to GOAL in } e' \text{ and to SOURCE in } e'' \]

As with \textit{from} and \textit{to}, the interpretation of \textit{through} relates an individual \( z \) and an event \( e \), where the relation holds just in case \( e \) is related by a \( C_{\text{GO}} \) constraint to an event \( e^* \). The added dimension with \textit{through}, however, is that \( e^* \) must decompose into two subevents, \( e' \) and \( e'' \), such that \( z \) is anchored to \text{GOAL} in the former and anchored to \text{SOURCE} in the latter.

Given the fact that \text{GOAL} and \text{SOURCE} must be anchored in \( e' \) and \( e'' \), the latter must be of type \( E_{\text{GO}} \). Presumably, the existence of the necessary \( e' \) and \( e'' \) will be guaranteed for verbs like \textit{travel}, \textit{walk}, \textit{fly}, etc. under some version of what researchers interested in aspect have referred to as the "Subinterval Property": the fact that, e.g., every subevent of an event of walking (traveling, etc.) is itself an event of walking. Each such sub-event will fall under the constraint in (19), insuring that it is also of type \( E_{\text{GO}} \). (see Bennett and Partee (1978), Bennett (1981) and Cooper (1985) for discussion of the subinterval property.)

This view of \textit{through}-phrases makes their interpretation "parasitic" upon the interpretation of source and goal phrases in the sense that, under the above proposal, there is no special complex indeterminate \text{PATH}. Rather, the contribution of the directional phrase is worked out in terms of sources and goals. Such phrases are interpreted as involving a collection of sub-events of type \( E_{\text{GO}} \) which "covers" the event of type \( E_{\text{GO}} \) whose ultimate source and goal would be determined by overt PPs headed by \textit{from} and \textit{to}. This derivative semantic status seems at least consistent with the generally derivative morphological character of directional prepositions – that is, with the fact that such items are often explicitly derived from prepositions of source or goal (consider \textit{into}, \textit{onto}, \textit{away from}, etc.).
One might hope to extend this approach to other directional PPs. For example, one could view PPs of the form *along NP* as specifying that *each* point in the spatial extension of NP is source and goal, etc. Nonetheless, it is clear that there will be a variety of additional complications when a fuller class of particles is examined. Directional PPs involving prepositions like *over* and *under*, for example, will evidently require the introduction of some contextual feature of "speaker-orientation" since notions like 'over' and 'under' are determined relative to some reference frame fixing upward and downward directions. I hope to take up the matter of PPs of path and direction in more detail elsewhere.

5.2.

Finally, we might note that the analyses of nominals proposed above could be extended more generally to encompass other kinds of implicit arguments. For example, consider nominals like *destruction* or *elimination* as in (51):

(51)a. The enemy's destruction of the city
b. Ron's elimination of that program

As is noted in Roeper (1983) the phrases *the enemy's*, *Ron's of that program* and *of the city* appearing in these examples have a status much like that of implicit arguments: they are optional (cf. *the destruction* and *the elimination*) but not iterable. At the same time, however, it seems clear that what licenses such phrases is not a matter of canonical thematic event-types like $E_{GO}$, but rather the relation between the nominal and its associated verbal form. Intuitively, the phrases *the enemy* and *the city* appear to bear the same relation to *destruction* in (51a) as they do to *destroy* in (52a). And similarly for (51b) and (52b):

(52)a. The enemy destroyed the city
b. Ron eliminated that program

Hence we expect licensing along the same lines in the two cases.

With the apparatus developed above we can, I believe, capture both the implicit argument-like character of the phrases in (51), as well as the parallelism of licensing in the nominal and verbal forms. Once again we appeal to constraints involving the 'of-type' relation. As with nominals like *trip* and *journey*, we will take action nominalizations to designate properties of events $e$, which are of a certain type $E''$. However rather than identifying $E''$ with a thematic event type like $E_{GO}$, we instead take
$E''$ to be one containing the relation designated by the associated verb. In the case of (51a), for example, we introduce the constraint shown below:

\[(53)\quad E \Rightarrow E', \text{ where}\]
\[E := \text{at } \mathbf{i}: \text{destruction, e, yes}\]
\[E' := \text{at } \mathbf{l}_u: \text{of-type, e, } E'', \text{ yes}\]
\[E'' := \text{at } \mathbf{i'}: \text{destroy, a, b, yes}\]

(53) states that every event which is a destruction is one which is of type $E''$, where the latter contains the relation designated by the verb destroy. (53) thus imposes the (intuitively obvious) condition that every event which is a destruction is one in which, at some location, someone or something destroys someone or something.

The constraint (53) can now be used to license implicit arguments of destruction much as (38) was used to license implicit arguments of trip. Again without attempting to spell out the technical details completely, we might say that an NP which bears the possessive suffix can be anchored freely to any indeterminate in $E''$, while an NP which is object of the preposition of is anchored to the b indeterminate. So with (51a), a gets anchored to the enemy, and b to the city, and analogously for (51b). The rule necessary to achieve this result is just (32), with the set of complex indeterminates suitably extended to cover roles borne by genitive-marked NPs. In brief, then, it appears that implicit arguments of action nominalizations might be brought under a treatment very parallel to that proposed for source and goal phrases of “motion nominals”. In both cases, the phrases in question are interpreted with respect to a predicate supplied through a constraint. In the former, the predicate is one provided by a verb morphologically related to the nominal; in the latter, the predicate is an “abstract” one expressing a generalization over events of certain kinds.\(^{20}\)

**Appendix: Extended Aliass**

The following are extensions of the Singular Aliass fragment presented in Barwise and Perry (1983). These extensions accommodate general noun phrases (General Aliass), certain restrictive modifiers (Restrictive Aliass), and implicit arguments (Implicit Aliass). In presenting these fragments I depart from standard practice in providing no syntax for the fragment. Rather I will simply assume a syntax along the lines of the Government-Binding (GB) theory wherein the input to semantic interpretation is a level of Logical Form at which quantifier scope is structurally represented (cf. May (1977, 1985), Chomsky (1981)). Within this theory a
sentence such as *Every dog likes Molly* is assigned the LF below:

```
  S
 /\                  /
S  NPI_i            NPI_i
   /\            /\     /
  every dog   e   NP_i  I'
         I  VP
            PRES  V  NP
                like  Molly
```

where \([NP, e]\) is the "trace" of the raised, quantified NP *every dog*, and where *I'* corresponds roughly to the notional category of "predicate phrase".

For details regarding how such structures are generated the reader is referred to the above sources. The following fragments will take them as given in advance, and so will specify only a lexicon and its interpretation together with a set of rules for interpreting structural configurations.

I. General Aliass

There are no new syntactic categories in GA, however determiners such as *every* and *some* are included in the class of DETs with interpretations following Barwise and Cooper (1981). The definite determiner *the* is here analyzed as combining with a common noun to produce a generalized quantifier, and not as producing a singular NP as in Barwise and Perry (1983). In addition, there are rules allowing one to interpret the structures in which general NPs occur. (Notation: ‘f’ replaces Barwise and Perry’s ‘σ’ in representing anchors)

Additions to the Lexicon. The new lexical items are the determiners *every, some, no, two* and *the* with SCAT = \{"Y, X\}. The following summarizes the relevant facts about these items:
L5. The expressions every, some, no, two and the are determiners. Their SCAT is \{Y, X\}. Their meanings are given by:

\[
\begin{align*}
    d, c \| every \| f, e & \text{ if } f(X) \subseteq f(Y) \\
    d, c \| some \| f, e & \text{ if } f(X) \cap f(Y) \neq \emptyset \\
    d, c \| no \| f, e & \text{ if } f(X) \cap f(Y) = 0 \\
    d, c \| two \| f, e & \text{ if } |f(X) \cap f(Y)| = 2 \\
    d, c \| the \| f, e & \text{ if } f(X) \subseteq f(Y) \text{ and } |f(X)| = 1
\end{align*}
\]

Additions to the Grammar. There are two new syntactic configurations: one involving "raised" quantifiers, and one involving the trace of such phrases. In addition, the rule for \[\text{NP DET NP}\] structures in Singular Aliass (NP3) is amended to accommodate general NPs.

DEFINITION 1. Given an \(\alpha\) and a triple \(d, c, f\) in the domain of \(\|\alpha\|\), define the extension-\(i\) of \(\alpha\) in \(e\) by:

\[
d, c, f \text{Ext}(i)(\alpha, e) = \{f'(a_i) | d, c \|\alpha\| f', e \text{ where } f' \text{ agrees with } f \text{ expect possibly on } a_i\}
\]

S Rules

\[(S5) \quad d, c \|_{S\text{NP, S}} l f, e \text{ iff there is some } f' \text{ extending } f \text{ such that } d, c \|\text{NP, } l f', e \text{ and } f'(Y) = d, c, f \text{Ext}(i)(S, e) \text{SCAT} = (\text{SCAT}(\text{NP}) - \{Y\}) \cup (\text{SCAT}(S) - \{a_i\})\]

NP Rules

\[(NP3) \text{ (revised)} \quad d, c \|_{\text{NP DET N}} l f, e \text{ iff there is some } f' \text{ extending } f \text{ such that } d, c \|\text{DET, } l f', e \text{ and } f'(X) = d, c, f \text{Ext}(N, f(e_i)) \text{ SCAT} = (\text{SCAT}(\text{DET}) \cup \text{SCAT}(N) \cup \{e_i\}) - \{X\}, \text{ where } e_i \text{ is any event indeterminate}\]

\[(NP5) \quad d, c \|_{\text{NP, e}} l f, e \text{ iff } f(a) = a_i \text{ SCAT} = \{a, a_i\}\]

II. Restrictive Aliass

This fragment introduces nominal modification by restrictive relatives and PPs (see Larson (1983, forthcoming) for discussion). The modification structures are once again assumed to be given through a GB-style theory. Thus a relative like the man that saw me will have the structure:
where "0_i" is an empty operator and e_i is its trace. The attachment of restrictive PP is analogous (i.e., the "Chomsky-adjunction" configuration). There are no additions to the lexicon of GA in RA.

Additions to the Grammar. RA interprets NP modifiers by means of a single general scheme. For simplicity, we treat only non-wh relatives here, although extension to the wh-cases is straightforward. No new rules of trace interpretation are required for the relative structures, however I assume (following Andrews (1975)) that the COMP node of a non-wh relative is marked with a feature [+R], and I assume (following Aoun, Hornstein and Sportiche (1982)) that COMP inherits the index of the operator it dominates at S-structure.

**DEFINITION 2.** If e is a course of events and X is any set, then e | X is the largest e' ≤ e, such that if ⟨l, ⟨(r, a_1, ..., a_i)⟩⟩ ∈ e', then α ∈ X for some α ∈ {l, a_1, ..., a_i}.

**S' and NP Rules**

\[(S'1)\]

\[d, c) [S, COMP, S] \downarrow \text{f}, e \Leftrightarrow f(Z) = d, c, f \text{Ext}(i)(S, e)\]

\[\text{SCAT} = (\text{SCAT}(S) - \{a_i\}) \cup \{Z\}\]
(NP6) \(d, c|_{\text{NP}} NP, XP|_f, e\) iff \(d, c|_{\text{NP}} f', e\), where \(f'\) agrees with \(f\) except on \(e_i\), and where \(f'(e_i) = f(e_i) \uparrow f(Z)\) \(\text{SCAT} = \text{SCAT(NP)} \cup (\text{SCAT(S')} - \{Z\})\)

III. Implicit Alias

This fragment contains the verbs travel and give and the common nouns trip and letter, as well those additions to noted in the text. This includes the following definitions:

\[
\text{SOURCE} = \langle s_o, E_{GO} \rangle, \text{where } s_o = \langle a, E_{1} \rangle \text{ if the latter is a role, otherwise } s_o = \langle i_{s}, E_{1} \rangle
\]

\[
\text{GOAL} = \langle g_l, E_{GO} \rangle, \text{where } g_l = \langle c, E_{2} \rangle \text{ if the latter is a role, otherwise } g_l = \langle i_{l}, E_{2} \rangle
\]

together with those constraints involving \(E_{GO}\) stated above in (19), (20), (38), (43)

Additions to the Lexicon. The additions to the lexicon include interpretations for verbs, nominals and the prepositions from and to:

(L6) The expression travel is an intransitive verb (i.e., a unary relation symbol in Determiner Free Alias). Its SCAT and meaning are analogous to other members of the class.

(L7) The expression give and send are ditransitive verbs (i.e., ternary relation symbols in Determiner Free Alias). Their SCAT and meaning are analogous to other members of this class.

(L8) The expressions trip and letter are common nouns (again, unary relation symbols in Determiner Free Alias). Their SCAT and meaning are analogous to other members of this class.

(L9) The expressions from and to are prepositions. Their SCAT is \(\{e_{i}, a\}\). Their meanings are given by:

\[
d, c|_{\text{from}} f \text{ iff for some } e', \text{ and } C \in C_{GO} \text{ such that } f(e_i) \text{ MO } C e', f \text{ anchors SOURCE in } e' \text{ and } f(\text{SOURCE}) = f(a)
\]

\[
d, c|_{\text{to}} f \text{ iff for some } e', \text{ and } C \in C_{GO} \text{ such that } f(e_i) \text{ MO } C e', f \text{ anchors GOAL in } e' \text{ and } f(\text{GOAL}) = f(a)
\]

Additions to the Grammar. The additions to the grammar are the interpretation rules for source and goal PPs and the VP configuration in which implicit arguments occur:
(PP1) \[ d, c[[PP \ P \ NP]]_f, e \text{ iff} \]
\[ f(Z) = \{ f'(e_i) | d, c[[P]]_f' \text{ and } d, c[[NP]]_f', e \} \]
where \( f' \) agrees with \( f \) except possibly on \( e_i \).
\[ \text{SCAT} = \{Z\} \]

(VP1) \[ d, c[[VP \ VP \ PP]]_f, e \text{ iff} \]
\[ d, c[[VP]]_f, e, \text{ and } e \in f(Z) \]
\[ \text{SCAT} = (\text{SCAT}(VP) \cup \text{SCAT}(PP)) - \{Z\} \]

Notes

* An early version of this work was presented at Stanford University in Spring 1984 as part of a seminar in Situation Semantics organized by Jon Barwise. I am grateful to Jon Barwise for inviting me to participate. I am also indebted to audiences at Stanford and MIT, to Steven Abney, and to an anonymous Linguistics and Philosophy reviewer for their comments. Preparation of this manuscript was supported by the Center for the Study of Language and Information, Stanford University and by the MIT Center for Cognitive Science under grants from the A. P. Sloan Foundation’s particular program in cognitive science.

1 (7a,b) are of course acceptable on an (irrelevant) “afterthought” reading.

2 The general point made here is valid for other predicative analyses of adjuncts, e.g., Davidson (1966), according to which adverbs are predicates of events. It is not valid, however, for the analyses of adverbs presented in Keenan and Faltz (1985) and McConnell-Ginet (1982), according to which adverbs are arguments of a predicate whose relational structure has been extended.

3 These facts distinguish the class of implicit argument PPs, and (in my view) justify treating them differently than other prepositional complements, including complements like those in (i) where, the P object is functioning as a verbal object:

(i)a. John started at Mary
b. Max is hoping for a miracle
c. Oscar is relying on your discretion

Verb-preposition amalgams of the latter sort are, to my knowledge, much more idiosyncratic in their distribution and doubtless require syntactic specification. For more on prepositions within the framework of Situation Semantics, see Gawron (1986).

4 Meanings of individual verbs which share a common “motion substructure” are distinguished by Jackendoff (1976) through a set of semantic markers, including POSIT(ional), POSS(essional), and INDENT(ificational), THROUGH THE AIR, etc. These serve to differentiate verbs like travel, give, change, fly in the required way.

5 Marking by these elements cannot, of course, be uniformly associated with having the semantic role in question. In (12b), Harry has the role of “source of movement”, but is not marked by from, etc.

6 Here and throughout the body of this paper, I adopt many simplifications of the apparatus of Situation Semantics; thus I ignore discourse events and connections, I represent events in the non-technical style of Barwise and Perry (1983), I do not interpret examples in terms of constructing an anchor for the indeterminates which they involve, but rather give the conditions on the events directly, etc. This is of course done for expository purposes. In the Appendix, a formally explicit extension of Barwise and Perry’s Singular Alias fragment is provided.

7 Barwise and Perry (1983) give constraints a status rather similar to that of meaning postulates in earlier semantic theories (e.g., Montague (1974)). Constraints are imposed as
global conditions on models, and an "admissible" model or structure of situations is one which respects the relevant constraints.

8 The condition 'if the latter is a role' in these definitions makes allowance for situations like (19) when \( b \) is not a constituent of \( E_1 \) or \( E_2 \). Under the definitions in Barwise and Perry (1983), \((b, E)\) is a role iff \( b \) is in \( E \) (i.e., iff \( E(b, \ldots) \)), hence SOURCE and GOAL must be given an alternative characterization in this case.

9 "\( e \rightarrow C \rightarrow e' \)" is meant to abbreviate what Barwise and Perry (1983) call the "meaningful option" relation. We may read it "\( e' \) is a meaningful option from \( e \) under \( C \)."

10 Another interesting aspect of the "inferential" character of the use of from and to is revealed in certain discourse contexts. Consider the following sentence, said of my cat, Sam, after a recent trip from New York to Massachusetts:

(1) Sam howled from Port Jeff to Boston

Note carefully that although howl is not a motion verb we readily assign an interpretation to (1). In particular, it seems that we can understand the sentence along the lines of "Sam traveled from NY to MA, howling all the while". On this reading, there is understood motion of Sam, and howling occurs cotemporally with that movement.

The proposals made here allow a plausible account of how this "motion interpretation" is obtained. Since events of howling are precisely not motion events, the presence of source and goal phrases in (1) obliges us to "reason backwards" and to assume that the understood event is only partly described by (i) — that some motion predicate (travel, fly, etc.) is involved in \( e \) as well. Since howling went on at the location of \( e \), and since the latter is also the location of "GO-ing", the two are co-temporal, and howling is understood "dura-tively", etc. Source and goal phrases thus appear to furnish another example of how constraints may be used to provide what Barwise and Perry (1983) call "backwards information".

11 An anonymous Linguistics and Philosophy reviewer has inquired about the interaction of this analysis with negation. For example, how are we to analyze John didn’t travel to Rome? We don’t want to simply negate the main verb relation since if we do, we won’t be able to invoke the appropriate \( C_{GO} \) constraint (recall that such constraints uniformly involve a "yes" in the antecedent \( E \)).

I can only suggest a possible line at this point, one which is adapted from proposals by van Eijk (1985) regarding negation in Discourse Representation Theory. Briefly, suppose we interpret (sentence) negation by means of constraints and take NOT(\( \alpha \)) to describe a constraint \( \alpha \Rightarrow e^- \), where \( \alpha \) describes the event \( e \), and where \( e^- \) is some distinguished nonactual situation \( e \) (e.g., the nonactual situation containing the fact "at 1: same, z, z, no" for some individual \( z \)). Then we would want John didn’t travel to Rome to describe the constraint \( e' \Rightarrow e^- \), where \( e^- \) is as before, and where \( e' \) is the \( E_{GO} \) event given in (28). Recall that in virtue of how constraints work, the \( e' \) involved in interpreting John traveled to Rome will actually contain \( e \), the event described by John traveled. Hence if such a constraint holds, we are in effect saying that the \( e' \) in (28) implies a (necessarily) nonactual situation.

The basic idea here is of course analogous to those treatments of negation in propositional logic which make use of a distinguished false proposition \( \perp \) and then dispense with \( \neg \varphi \) in favor of \( \varphi \Rightarrow \perp \). To implement this solution it would, of course, be necessary to provide rules showing how a negation appearing in the main clause could constrain the larger event invoked with the goal PP. At this point, I can do no more than issue the usual promissory note on "future research", however van Eijk’s general approach does seem to be compatible with the analysis of implicit arguments developed here.

12 Uniqueness of assignments is nowhere actually stated in Barwise and Perry (1983), but is implicit in their discussion.

13 More precisely, the smaller VP with give is assigned a set of indeterminates corresponding to its arguments, and the anchoring of these arguments is related systematically by the
constraint in (20) to the anchoring of indeterminates in $E_{GO}$. In particular, an anchoring of mary to GOAL in $e'$ will simultaneously anchor mary to the third argument of 'give'.

14 This analysis of the assignment of a value to the third argument of dative verbs seems quite compatible with the views of Marantz (1984), who takes the assignment of values to such arguments to be crucially mediated by the role assigned by the preposition. I assume that dative verbs cannot take a third argument directly – allowing a sentence like John gave a book a man, with the reading 'John gave a book to a man' in virtue of principles of Case theory (see Chomsky (1981)).

15 This analysis may be seen as generalizing on proposals by Davidson (1966) according to which (certain) adverbial modifiers are modifiers of events. Here we are taking nominal modifiers to be event-modifiers as well. This step becomes possible precisely because of our view of certain NPs as "event-sensitive" in their interpretation.

16 A precise definition of event restriction is provided in the Appendix.

17 As it turns out, extending the definition of event restriction will have no unhappy consequences with respect to the examples we considered earlier. The choice of how to do event restriction may be left completely free since applying it "in the wrong way" will simply lead to an undefined semantic result. For example, an attempt to interpret our earlier example a man in a gorilla suit by the second notion of event restriction would only yield a defined semantic result if an event could be a member of the set of gorilla suit wearers. But this is impossible. Likewise an attempt to interpret a message to Horace via the first notion would only yield a defined result if a message could be a member of a set of events. Again, this is impossible.

18 Conventional constraints have been invoked to deal with other natural language phenomena. For example, Hinrichs (1983) has argued that conventional constraints allow an interesting resolution of the so-called "imperfective paradox", involving progressive aspect.

19 For much insightful discussion of this topic see Jackendoff (1983).

20 By-phrase implicit arguments appear to involve both of these kinds of licensing. When they occur with strong agentive force, as in NPs like a letter by John, by-phrases seem to require an abstract predicate parallel to GO – i.e., 'CAUSE', etc. On the other hand, in passive constructions they appear to involve the kind of licensing observed with action nominals. Thus (i):

(i) The dot is surrounded by the circle

might be analyzed as describing an event $e$ containing an intransitive predicate 'be-surrounded'. $e$ would then be linked by a conventional constraint to an event $e'$ containing the transitive predicate 'surround', and by would anchor its object in this inferred "active" event. Passive morphology on the verb would, in effect, represent the "visible index" of the conventional constraint holding between the "intransitive" and "transitive events".

This analysis suggests an interesting approach to various phenomena involving implicit arguments of passives, including "control" of passive-sensitive adverbs, agent-oriented adverbs and purpose clauses (see Roeper (1983) and McConnel-Ginet (1982) for a discussion of the relevant facts). However, these topics are beyond the scope of the present paper.

References


*Dept. of Linguistic and Philosophy*

20D-219 *Massachusetts Institute of Technology*