A similar clear case is the principle that if someone does not let an event happen, it doesn't happen. If E represents the claim that some event took place, we can use the notation NOT E to represent the claim that the event did not take place; similarly NOT prefixed to an expression for a state of affairs represents the claim that the state of affairs did not obtain. Then we can express this second principle of inference as (62).

(62) $\text{NOT} \begin{bmatrix}\text{LET (X, E)} \\ \text{Z}\end{bmatrix} \Rightarrow \text{NOT E}$

Since this sense of NOT is rendered in English by sentence negation, (62) enables us to make inferences such as these:[10]

(63) a. Max didn't drop the pancake on the floor.
NOT LET (MAX, $\text{GO}_{\text{Posit}}$ (THE PANCAKE, y, THE FLOOR))
⇒ The pancake didn't fall on the floor.
NOT $\text{GO}_{\text{Posit}}$ (THE PANCAKE, y, THE FLOOR)

b. Joe didn't leave the pancake on the table.
NOT LET (JOE, $\text{STAY}_{\text{Posit}}$ (THE PANCAKE, THE TABLE))
⇒ The pancake didn't remain on the table.
NOT $\text{STAY}_{\text{Posit}}$ (THE PANCAKE, THE TABLE)

c. Joe didn't accept the money from Max.
NOT LET (JOE, $\text{GO}_{\text{Poss}}$ (THE MONEY, MAX, JOE))
⇒ Joe didn't get the money from Max.
NOT $\text{GO}_{\text{Poss}}$ (THE MONEY, MAX, JOE)

d. The doctor didn't leave Alice sick.
NOT LET (THE DOCTOR, $\text{STAY}_{\text{Ident}}$ (ALICE, SICK))
⇒ Alice didn't stay sick.
NOT $\text{STAY}_{\text{Ident}}$ (ALICE, SICK)

The converses of (60) and (62) are (64a) and (64b) respectively. They are not valid rules of inference.

(64) a. $\text{NOT} \begin{bmatrix}\text{CAUSE (X, E)} \\ \text{Z}\end{bmatrix} \Rightarrow \text{NOT E}$

b. $\begin{bmatrix}\text{LET (X, E)} \\ \text{Z}\end{bmatrix} \Rightarrow \text{E}$

(64a) is falsified by examples like (65).

(65) Joe died, but Max didn't kill him.

[10] Note that the negation in these sentences must be read as sentence negation for the entailment to hold. If it is associated with a focus (e.g. Joe didn't get the money from *Max*, but from *George*), a different semantic interpretation is derived, which does not meet the structural description of (62). Cf. SIGG, sections 6.6, 6.7, and 8.6.

Obviously, something may happen even if no particular thing one can name is the cause. (64b) is falsified by examples like (66).

(66) Joe wasn't in the room, even though the FBI still allowed Joe in the room.

However, the inference is sometimes valid; for example, if something is *dropped*, it *falls*. Apparently a more limited form of (64b) is valid, the limitation having to do with the form of the expression E. I will not try to deal with the modification here. However, in section 4.5, rules (64a,b) will reappear as rules of "invited inference".

### *4.2. Inferences from STAY and GO to BE*

The next set of inference rules relates the motional and durational functions to the punctual. First, there is the obvious principle that if something *stays* someplace for a period of time, it *is* in that place at any instant during that period. To express this rule we need reference to time, which has not yet been formalized here. I will adopt an obvious notation, using it in a way that I hope will be neutral to the eventual formulation of the semantics of time.[11] Note that the rule includes an extralinguistic condition.

(67) $\begin{bmatrix}\text{STAY (X, Y) FROM } t_1 \text{ TO } t_2 \\ \text{Z}\end{bmatrix} \Rightarrow \begin{bmatrix}\text{BE (X, Y) AT } t_3 \\ \text{Z}\end{bmatrix}$

Condition: $t_1 \leqslant t_3 \leqslant t_2$

(67) permits us to derive entailments such as (68).

(68) a. Carl remained in the room from Tuesday to Friday.
STAY$_{\text{Posit}}$ (CARL, THE ROOM) FROM TUESDAY TO FRIDAY
⇒ Carl was in the room on Wednesday.
BE$_{\text{Posit}}$ (CARL, THE ROOM) AT WEDNESDAY

b. Margo kept the book from 1970 to 1972.
STAY$_{\text{Poss}}$ (THE BOOK, MARGO) FROM 1970 TO 1972
⇒ Margo had the book on June 22, 1971.
BE$_{\text{Poss}}$ (THE BOOK, MARGO) AT JUNE 22, 1971

c. Fred stayed a doctor from when he was 19 to when he was 41.
STAY$_{\text{Ident}}$ (FRED, A DOCTOR) FROM $\begin{bmatrix}\text{X} \\ \text{BE}_{\text{Ident}}\text{ (FRED, 19) AT X}\end{bmatrix}$ TO $\begin{bmatrix}\text{Y} \\ \text{BE}_{\text{Ident}}\text{ (FRED, 41) AT Y}\end{bmatrix}$
⇒ Fred was a doctor when he was 37.
BE$_{\text{Ident}}$ (FRED, A DOCTOR) AT $\begin{bmatrix}\text{X} \\ \text{BE}_{\text{Ident}}\text{ (FRED, 37) AT X}\end{bmatrix}$

[11] In particular, I will avoid standard expressions of quantification in order to keep it clear that the issue of formalization is being left quite open.

Alternatively, (67) could be divided into two parts, used successively ((69a) is probably biconditional):

(69) a. $\begin{bmatrix}\text{STAY (X, Y) FROM } t_1 \text{ TO } t_2\\ \text{Z}\end{bmatrix} \Leftrightarrow \begin{bmatrix}\text{BE (X, Y) FROM } t_1 \text{ TO } t_2\\ \text{Z}\end{bmatrix}$

b. $\begin{bmatrix}\text{BE (X, Y) FROM } t_1 \text{ TO } t_2\\ \text{Z}\end{bmatrix} \Rightarrow \begin{bmatrix}\text{BE (X, Y) AT } t_3\\ \text{Z}\end{bmatrix}$

Condition: $t_1 \leqslant t_3 \leqslant t_2$

Then the inference in (68a), for example, would go by way of the intermediate step *Carl was in the room from Tuesday to Friday*, also a valid inference from the premise, and a further class of inferences would follow.

Observe that the condition in (67) or (69b) does not require the existence of a sentence or even a semantic representation. I take it, rather, that this condition is a truth-condition, i.e. it involves matters of fact and its truth may well be determined pragmatically. Tightening this condition to require the existence of an actual sentence conveying the information $t_1 \leqslant t_3 \leqslant t_2$ is a move that some might find more palatable. However, it is not the sentence *Wednesday is between Tuesday and Friday* that makes (68a) a valid inference—it is the *fact* that Wednesday is between Tuesday and Friday. Therefore, at least for the present theory's notion of valid inference, the condition may be nonlinguistic.

There is a similar entailment following from the principle that if someone does not stay someplace during an interval, there is a time during the interval when he is not there:

(70) $\text{NOT} \begin{bmatrix}\text{STAY (X, Y) FROM } t_1 \text{ TO } t_2\\ \text{Z}\end{bmatrix}$

$\Rightarrow$ (for some time $t_3$) $\text{NOT} \begin{bmatrix}\text{BE (X, Y) AT } t_3\\ \text{Z}\end{bmatrix}$

Condition: $t_1 \leqslant t_3 \leqslant t_2$

This inference rule is involved in an inference like (71). Because of the difficulties of quantification here, I will not work out the entailment formally.

(71) Ann didn't stay in the room from 5 to 6.
$\Rightarrow$ Ann wasn't in the room all the time from 5 to 6.

The parallel entailment for GO is slightly more complex. The principle is that if something goes from one place to another, it must have been at the first place at some time and at the second place sometime, and it was at the first place first.

(72) $\begin{bmatrix}\text{GO (X, Y, Z) AT } t_1\\ \text{W}\end{bmatrix} \Rightarrow$ for some times $t_2$ and $t_3$ such that $t_2 < t_1 < t_3$,

$\begin{bmatrix}\text{BE (X, Y) AT } t_2\\ \text{W}\end{bmatrix}$ AND $\begin{bmatrix}\text{BE (X, Z) AT } t_3\\ \text{W}\end{bmatrix}$

(72) derives entailments such as (73).

(73) a. The train went from Kankakee to Mattoon.
$GO_{Posit}$ (THE TRAIN, KANKAKEE, MATTOON)
⇒ At some time, the train was in Kankakee, and at some time, the train was in Mattoon.
$BE_{Posit}$ (THE TRAIN, KANKAKEE) AT SOME TIME AND $BE_{Posit}$ (THE TRAIN, MATTOON) AT SOME TIME

b. Phil gave the bill to Cathy.
CAUSE (PHIL, $GO_{Poss}$ (THE BILL, PHIL, CATHY))
$\xrightarrow{(60)}$ $GO_{Poss}$ (THE BILL, PHIL, CATHY)
$\xrightarrow{(72)}$ Phil had the bill, and then Cathy had it.
$BE_{Poss}$ (THE BILL, PHIL) AT $t_1$ AND $BE_{Poss}$ (THE BILL, CATHY) AT $t_2$, such that $t_1 < t_2$

c. Things went from bad to worse.
$GO_{Ident}$ (THINGS, BAD, WORSE)
⇒ Things were bad, and then they were worse.
$BE_{Ident}$ (THINGS, BAD) AT $t_1$ AND $BE_{Ident}$ (THINGS, WORSE) AT $t_2$, such that $t_1 < t_2$

### *4.3. Inferences Involving Set Inclusion*

We would like to make an inference such as that if Bill is in Kenya, Bill is in Africa. The necessary inference rule is easy to state.

(74) $\begin{bmatrix}\text{BE (X, Y)} \\ \text{Z}\end{bmatrix} \Rightarrow \begin{bmatrix}\text{BE (X, W)} \\ \text{Z}\end{bmatrix}$
Condition: W ⊃ Y

Note that the condition is again pragmatic and not linguistic in nature. One does not, in natural language, need to *say* that Kenya is in Africa; it need only be a *fact* in order for one to draw the inference.

(74) generalizes to Identificational location, for in that domain it enables us to ascertain that Socrates is mortal from the assertion that Socrates is a man and the fact (stated or unstated) that men are mortal. However, it apparently does not generalize to Possessional location, since we are not entitled to infer that John has a million dollars from the fact that John has a friend Sue and that *she* has a million dollars.

There seem to be two ways to deal with this problem. The first and less interesting way is to restrict the parameter Z in (74) so as to exclude the marker *Possessional*. A more interesting way is to seek a more precise and motivated statement of the condition W ⊃ Y. For Positional location, it clearly must be interpreted as spatial

inclusion. But for Identificational location, it must be interpreted as property inclusion and not spatial: we do not want to infer that Africa $is_{Ident}$ small from the fact that Kenya $is_{Ident}$ small and Kenya $is_{Posit}$ in Africa. Perhaps it is the case that no relevant notion of inclusion is available for Possessional location. I will not speculate at this point on how to formulate a satisfying solution; but the problem is clearly not insoluble within this framework.

### *4.4. Inferences with Negated Locations*

The next kind of inference we would like to make is that if John is not inside the house, he must be outside the house. Part of this inference is based on the pragmatic relation between *inside* and *outside*, namely that *inside x* and *outside x* together exhaust all the possible places one could be. This relation does not hold of other pairs such as *to the left of* and *to the right of*, for example.

However, there is another part of the inference that is perfectly general: the principle that if something is not in a particular place, it is somewhere else. So far we have no way to express the notion "somewhere else" within the formal system. To represent "someplace other than X", we will introduce the notation NOT X. As will be seen in section 5, this choice of notation is not totally ingenuous; we will make crucial use of the identity of the NOT denoting "somewhere else" and the NOT of sentence negation. We have now given an interpretation to NOT prefixed to functions and to Locations, Sources, and Goals; we have not given any meaning to NOT prefixed to a Theme.

Using the new notation, the desired principle is formalized as (75a); a related principle is the converse (75b), the principle that if something is someplace, it is not someplace else. Both appear to be biconditionals.[12]

(75) a. $\text{NOT} \begin{bmatrix}\text{BE (X, Y)}\\ \text{Z}\end{bmatrix} \Leftrightarrow \begin{bmatrix}\text{BE (X, NOT Y)}\\ \text{Z}\end{bmatrix}$

b. $\begin{bmatrix}\text{BE (X, Y)}\\ \text{Z}\end{bmatrix} \Leftrightarrow \text{NOT} \begin{bmatrix}\text{BE (X, NOT Y)}\\ \text{Z}\end{bmatrix}$

So, for example, from (76a) can be derived the inference (76b); from (76c), (76d).

(76) a. John was not inside of the house.
NOT $BE_{Posit}$ (JOHN, INSIDE OF THE HOUSE)

b. $BE_{Posit}$ (JOHN, NOT INSIDE OF THE HOUSE)

c. John was inside of the house.
$BE_{Posit}$ (JOHN, INSIDE OF THE HOUSE)

d. NOT $BE_{Posit}$ (JOHN, NOT INSIDE OF THE HOUSE)

[12] Actually, the inferences from BE to NOT BE in both rules require pragmatic conditions, as was pointed out to me by Noam Chomsky. The conditions have to do with the spatial extent of the Theme: for example, the atmosphere is both inside and outside the house. Also, there must be boundary conditions: is John inside or outside when he stands in the doorway?

To complete the desired inference we must appeal to the (unformalized) fact that *not inside of x* and *outside of x* define coextensive areas (ignoring boundaries, as is pragmatically possible in this particular case, though not in general). We can then appeal to inference rule (74) to get from (76b) to (77).

(77) John was outside of the house.
$BE_{Posit}$ (JOHN, OUTSIDE OF THE HOUSE)

To reach a conclusion from (76d) we must appeal to inference rule (78), equivalent to (74) and derivable from it and (75) by substituting U for NOT Y and T for NOT W.

(78) $\text{NOT} \begin{bmatrix} \text{BE (X, U)} \\ \text{Z} \end{bmatrix} \Rightarrow \text{NOT} \begin{bmatrix} \text{BE (X, T)} \\ \text{Z} \end{bmatrix}$
Condition: $U \supset T$

This enables us to infer (79) from (76d).

(79) John was not outside of the house.
NOT $BE_{Posit}$ (JOHN, OUTSIDE OF THE HOUSE)

Notice that since *not to the left of x* includes *to the right of x* but not vice versa (as in the previous case), only one of the parallel inferences goes through. From (80a) can be derived the intermediate stage (80b), and from (80c), (80d).

(80) a. The duck is not left of the cat.
NOT $BE_{Posit}$ (THE DUCK, LEFT OF THE CAT)
b. $BE_{Posit}$ (THE DUCK, NOT LEFT OF THE CAT)
c. The duck is left of the cat.
$BE_{Posit}$ (THE DUCK, LEFT OF THE CAT)
d. NOT $BE_{Posit}$ (THE DUCK, NOT LEFT OF THE CAT)

In the case of (80b), there is no further inference involving *right of*, since the condition of (74) is not met. But since NOT LEFT OF THE CAT $\supset$ RIGHT OF THE CAT, (78) can be applied to (80d) to derive (81), as desired.

(81) The duck is not right of the cat.
NOT $BE_{Posit}$ (THE DUCK, RIGHT OF THE CAT)

With Identificational location, similar inferences can be drawn. Under the assumption that *sick* and *healthy* are exhaustive and mutually exclusive, we can construct inferences like (82).

(82) a. Hal is sick.
$BE_{Ident}$ (HAL, SICK) $\xrightarrow{(75b)}$ NOT $BE_{Ident}$ (HAL, NOT SICK)
$\xrightarrow{(78)}$ Hal is not healthy.
NOT $BE_{Ident}$ (HAL, HEALTHY)

b. Hal is not sick.

$$\text{NOT BE}_{\text{Ident}}\ (\text{HAL, SICK}) \xrightarrow{(75a)} \text{BE}_{\text{Ident}}\ (\text{HAL, NOT SICK}) \xrightarrow{(74)} \text{Hal is healthy.}$$
$$\text{BE}_{\text{Ident}}\ (\text{HAL, HEALTHY})$$

But since *tiny* and *big* do not exhaust a scale but are only mutually exclusive, only one of the parallel inferences goes through in (83).

(83) a. Pliny is tiny.

$$\text{BE}_{\text{Ident}}\ (\text{PLINY, TINY}) \xrightarrow{(75b)} \text{NOT BE}_{\text{Ident}}\ (\text{PLINY, NOT TINY}) \xrightarrow{(78)} \text{Pliny is not big.}$$
$$\text{NOT BE}_{\text{Ident}}\ (\text{PLINY, BIG})$$

b. Pliny is not tiny.

$$\text{NOT BE}_{\text{Ident}}\ (\text{PLINY, TINY}) \xrightarrow{(75a)} \text{BE}_{\text{Ident}}\ (\text{PLINY, NOT TINY}) \not\rightarrow \text{Pliny is big.}$$
$$\text{BE}_{\text{Ident}}\ (\text{PLINY, BIG})$$

Parallel to inference rules (75) for BE, there is a pair relating GO and STAY, expressing the principle that if someone goes from one place to another, he has not stayed in either of those places, and (contrapositively) if someone stays somewhere, he has not gone anyplace from there.

(84) a.
$$\begin{bmatrix}\text{GO (X, Y, W)}\\ \text{Z}\end{bmatrix} \Rightarrow \begin{Bmatrix}\text{NOT}\begin{bmatrix}\text{STAY (X, Y)}\\ \text{Z}\end{bmatrix}\\ \text{NOT}\begin{bmatrix}\text{STAY (X, W)}\\ \text{Z}\end{bmatrix}\end{Bmatrix}$$

b.
$$\begin{bmatrix}\text{STAY (X, Y)}\\ \text{Z}\end{bmatrix} \Rightarrow \text{NOT}\begin{bmatrix}\text{GO (X, Y, W)}\\ \text{Z}\end{bmatrix}$$

(These rules obviously must be supplied with time-dependencies, which I omit, pleading the reader's indulgence.) By now the kinds of relevant examples should be clear. Notice that the converses of these rules are not valid: not going somewhere in particular does not imply staying somewhere, and not staying somewhere in particular does not imply going somewhere.

One further principle needs to be mentioned, namely that if one goes from Y to W, Y and W are distinct places. We need this principle to exclude sentences like (85).

(85) a. *The train went from Chicago to Illinois.
b. *Algernon received a flower from himself.
c. *The light changed from crimson to red.

The principle in question can be stated as (86).

(86) $\begin{bmatrix}\text{GO (X, Y, W)}\\ \text{Z}\end{bmatrix} \Rightarrow \begin{cases}\text{W} \subset \text{NOT Y}\\ \text{Y} \subset \text{NOT W}\end{cases}$

Notice that this rule is not stated in purely linguistic terms, but rather yields a pragmatic inference. (86), incidentally, is what entitles us to leave either the Source or Goal of GO unspecified and still infer that a change has taken place.[13]

*4.5. Rules of Invited Inference*

All the inferences we have been concerned with so far have been logical inferences. However, we will mention briefly another kind of inference that has been of interest, "invited inference" or "implicature" (in the sense of Grice (1975)). Such an inference is not a foregone conclusion, but a guess made on the basis of the given sentence. As such it can be incorrect.

One of the ways an invited inference can be overridden is with *but*. Compare the following examples:

(87) a. Sue killed Bill, $\begin{Bmatrix}\text{*and}\\ \text{*but}\end{Bmatrix}$ $\begin{Bmatrix}\text{he died. (redundant)}\\ \text{he didn't die. (anomalous)}\end{Bmatrix}$

b. Sue didn't kill Bill, $\begin{Bmatrix}\text{and}\\ \text{?but}\end{Bmatrix}$ he didn't die.

c. Sue didn't kill Bill, $\begin{Bmatrix}\text{?and}\\ \text{but}\end{Bmatrix}$ he died (anyway).

In (87a) there is a logical inference in the first clause to *Bill died*, and so there is no way of adding the second clause. But there is no logical inference from *didn't kill*, since there is no inference rule whose antecedent is NOT CAUSE. Why is *and* more felicitous in (87b) and *but* in (87c)? One possibility is that the rule we rejected as a logical inference should appear as a rule of invited inference (the symbol $\overset{?}{\Rightarrow}$ indicates invited inference):

(88) NOT CAUSE (X, E) $\overset{?}{\Rightarrow}$ NOT E

That is, one is led to guess from a statement that some event was not caused (presuppositions aside—see footnote 10) that the event did not take place. Thus in (87b,c) the first clause has the invited inference that Bill didn't die. *And* is appropriate in (87b) because it confirms the invited inference; *but* is appropriate in (87c) because it contradicts the invited inference.

Parallel to (88), there is a rule of invited inference for LET:

(89) LET (X, E) $\overset{?}{\Rightarrow}$ E

[13] The way (86) is stated may conceivably cause difficulty in the analysis of examples like *Bill went from sick to sicker*, since *sicker* is not included in *not sick*. It is not clear to me how to deal with this problem, but it does not appear especially crucial to the main issues here.

This produces a paradigm like (90).

(90) a. David didn't release the bird from the cage, $\left\{\begin{matrix}*\text{and}\\ *\text{but}\end{matrix}\right\}$ $\left\{\begin{matrix}\text{it left. (anomalous)}\\ \text{it didn't leave. (redundant)}\end{matrix}\right\}$

b. David released the bird from the cage, $\left\{\begin{matrix}\text{and}\\ ?\text{but}\end{matrix}\right\}$ it left.

c. David released the bird from the cage, $\left\{\begin{matrix}?\text{and}\\ \text{but}\end{matrix}\right\}$ it didn't leave.

This is exactly the mirror image of (87) with respect to negation. This follows from the fact that the rules of inference and invited inference for CAUSE and LET are also mirror images with respect to negation.

These observations are obviously only the barest beginning of an analysis of invited inferences. However, we have shown that such an analysis is in principle compatible with the theory presented here.

*4.6. Excursus #1*

In this section I have proposed a number of rules of inference that permit sentences to be related via their functional representation and (in some cases) certain pragmatic conditions. It is perhaps useful to point out two things that these rules are *not* before discussing what they might be.

First, rules of inference are not rules of grammar. They do not play a role in relating phonetic representation to semantic representation. Second, they do not constitute the meanings of the functions CAUSE, LET, GO, STAY, and BE; that is, the meanings of these functions are not to be determined solely in terms of what inferences can be drawn from them. Rather, I take it that these functions are cognitive primitives of some sort, and that the way in which they make claims about the real world is more a problem in cognitive psychology than one in linguistics.

Under this view, rules of inference not surprisingly must be regarded as universal, expressing the cognitive relationships among the functions. In fact, the rules have perhaps been stated in terms too immediately dependent on semantic representation; they are in fact principles of much wider pragmatic application. For example, (75a), the principle that if something is not in one place, it is someplace else, is really a principle of identity or conservation of objects. I will have more to say about this in section 7.

The idea of inference rules formalized in terms of semantic representations is not new. For example, Katz (1972) writes such an inference rule to deal with inferences about property inclusion; rules very much like those proposed here are developed rather extensively within a generative semantics theory by Lakoff (1972). What makes the particular rules proposed here of interest is the way they provide evidence for the explanatory power of the present theory of semantic description.

For in this system, a rule of inference is simpler if it generalizes over all modes of location, i.e. Positional, Possessional, and Identificational. In other words, the theory claims that it is not an accident that rules of inference generalize in the way they do, but an essential property of the semantic description that could not be otherwise.

I consider it a striking property of the present system that simple principles, framed in terms of physical space, can be stated formally in such a way as to generalize to domains that bear no a priori relation to physical space. It is in the very nature of the expressive power of the semantic representation to result in inference rules of such generality. Thus the theory can lay claim to a degree of explanatory adequacy not present in previous semantic theories.

For convenience, I will end this section with a compilation of the inference rules devised here. The list is obviously not exhaustive.

(60) $\begin{bmatrix}\text{CAUSE (X, E)}\\ \text{Z}\end{bmatrix} \Rightarrow \text{E}$

(62) $\text{NOT} \begin{bmatrix}\text{LET (X, E)}\\ \text{Z}\end{bmatrix} \Rightarrow \text{NOT E}$

(69) a. $\begin{bmatrix}\text{STAY (X, Y) FROM } t_1 \text{ TO } t_2\\ \text{Z}\end{bmatrix} \Leftrightarrow \begin{bmatrix}\text{BE (X, Y) FROM } t_1 \text{ TO } t_2\\ \text{Z}\end{bmatrix}$

b. $\begin{bmatrix}\text{BE (X, Y) FROM } t_1 \text{ TO } t_2\\ \text{Z}\end{bmatrix} \Rightarrow \begin{bmatrix}\text{BE (X, Y) AT } t_3\\ \text{Z}\end{bmatrix}$

Condition: $t_1 \leqslant t_3 \leqslant t_2$

(70) $\text{NOT} \begin{bmatrix}\text{STAY (X, Y) FROM } t_1 \text{ TO } t_2\\ \text{Z}\end{bmatrix} \Rightarrow$ for some $t_3$, $\text{NOT} \begin{bmatrix}\text{BE (X, Y) AT } t_3\\ \text{Z}\end{bmatrix}$

Condition: $t_1 \leqslant t_3 \leqslant t_2$

(72) $\begin{bmatrix}\text{GO (X, Y, Z) AT } t_1\\ \text{W}\end{bmatrix} \Rightarrow$ for some times $t_2$ and $t_3$ such that $t_2 < t_1 < t_3$, $\begin{bmatrix}\text{BE (X, Y) AT } t_2\\ \text{W}\end{bmatrix} \text{ AND } \begin{bmatrix}\text{BE (X, Z) AT } t_3\\ \text{W}\end{bmatrix}$

(74) $\begin{bmatrix}\text{BE (X, Y)}\\ \text{Z}\end{bmatrix} \Rightarrow \begin{bmatrix}\text{BE (X, W)}\\ \text{Z}\end{bmatrix}$

Condition: $\text{W} \supset \text{Y}$

(78) $\text{NOT} \begin{bmatrix}\text{BE (X, U)}\\ \text{Z}\end{bmatrix} \Rightarrow \text{NOT} \begin{bmatrix}\text{BE (X, T)}\\ \text{Z}\end{bmatrix}$

Condition: $\text{U} \supset \text{T}$

(75) a. $\text{NOT} \begin{bmatrix}\text{BE (X, Y)}\\ \text{Z}\end{bmatrix} \Leftrightarrow \begin{bmatrix}\text{BE (X, NOT Y)}\\ \text{Z}\end{bmatrix}$

b. $\begin{bmatrix}\text{BE (X, Y)}\\ \text{Z}\end{bmatrix} \Leftrightarrow \text{NOT} \begin{bmatrix}\text{BE (X, NOT Y)}\\ \text{Z}\end{bmatrix}$

(84) a. $\begin{bmatrix}\text{GO (X, Y, W)}\\ \text{Z}\end{bmatrix} \Rightarrow \begin{cases}\text{NOT } \begin{bmatrix}\text{STAY (X, Y)}\\ \text{Z}\end{bmatrix}\\ \text{NOT } \begin{bmatrix}\text{STAY (X, W)}\\ \text{Z}\end{bmatrix}\end{cases}$

b. $\begin{bmatrix}\text{STAY (X, Y)}\\ \text{Z}\end{bmatrix} \Rightarrow \text{NOT } \begin{bmatrix}\text{GO (X, Y, W)}\\ \text{Z}\end{bmatrix}$

(86) $\begin{bmatrix}\text{GO (X, Y, W)}\\ \text{Z}\end{bmatrix} \Rightarrow \begin{cases}\text{W} \subset \text{NOT Y}\\ \text{Y} \subset \text{NOT W}\end{cases}$

## 5. Implicative Verbs

### *5.1. Circumstantial STAY*

Consider the interpretations of these sentences:

(91) a. Laura kept David in the room.
b. Laura kept David working.

We know the interpretation of (91a):

(92) CAUSE (LAURA, $\text{STAY}_{\text{Posit}}$ (DAVID, THE ROOM))

Simplicity suggests that we assign (91b) an interpretation as close to (91a) as possible, of the basic form CAUSE (. . . STAY (. . .)). Clearly none of the modes of location we have discussed will provide such an interpretation, since in (91b) *working* describes neither David's physical location, nor whom he belongs to, nor what kind of object he is.

Gruber (1965, section 8.4) alludes to, but does not define, a mode of location called *Circumstantial*, which he uses for certain complement verbs such as *coerce*. Suppose we take an assertion that an individual is in a "circumstantial" location, where the location is an event or state of affairs, to mean that the individual is involved as a participant in that event or state of affairs. Then we can use this mode of location in a straightforward representation for (91b):

(93) CAUSE (LAURA, $\text{STAY}_{\text{Circ}}$ (DAVID, DAVID WORK))

Here the second argument of STAY is the circumstance described by the gerundive *David's working*, from which the subject has been removed by Equi.[14] (93) claims thus that Laura caused David to continue to be involved in the situation of working, precisely the desired interpretation, and furthermore of precisely parallel form to

[14] In an interpretive theory of Equi (cf. SIGG, chapter 5), the subject is a pronoun anaphoric to *David*. In such a theory, DAVID will appear only once in (93), its subject relation to WORK being established indirectly through rules of anaphora.

its Positional analogue (92). According to this analysis, the verb *keep* is essentially the same in (91a,b), changing only the mode of location.

Extending the parallel, compare (94a) and (94b).

(94) a. Linda kept Laura (away) from the cookie jar.
b. Linda kept Laura from screaming.

Although we have not considered the interpretation of the preposition *from*, it is plausible to interpret it in this case as meaning 'at someplace other than'. Gruber proposes such an interpretation (section 4.1), though with somewhat different consequences within his system. Formalizing this interpretation, we get (95) as the representation of (94a).

(95) CAUSE (LINDA, $\text{STAY}_{\text{Posit}}$ (LAURA, NOT THE COOKIE JAR))

This generalizes immediately to the representation (96) for (94b).

(96) CAUSE (LINDA, $\text{STAY}_{\text{Circ}}$ (LAURA, NOT (LAURA SCREAM)))

In (96), the NOT meaning 'other than' can be reinterpreted as sentence negation over the subordinate clause. To keep things perfectly honest, one might want to use two separate negative terms for these two purposes. It seems, though, that in fact the language fully identifies the two uses of negation. As we will see, no adverse results accrue from treating the NOT in (96) as sentence negation.

One way to verify that (93) and (96) are correct representations for (91b) and (94b) is to check what inferences are possible. From (93), by inference rule (60), we infer the event being caused:

(97) $\text{STAY}_{\text{Circ}}$ (DAVID, DAVID WORK)

In turn, by inference rule (69), we get (98).

(98) $\text{BE}_{\text{Circ}}$ (DAVID, DAVID WORK) (at some time)

We have as yet no sentence that has (98) as its representation. We might conjecture that (98) represents the progressive *David was working*, nicely filling a gap both in the syntactic and in the semantic paradigm.[16] Whether or not this is the case, we need a special inference rule for Circumstantial location, (99).

(99) $\text{BE}_{\text{Circ}}$ (X, Y) $\Rightarrow$ Y

(99) is the principle that if one is involved in a circumstance, the circumstance must be taking place. Notice that (99) would be senseless with any mode of location other than Circumstantial, since the location would not be an event or state of affairs. Using (99), we can infer (100) from (98).

(100) DAVID WORK
David worked.

[16] For the syntactic generality of this analysis, see Emonds (1970, section II.2.2).

By a similar process, we get the following inferences from (96). The step from (101b) to (101c) involves the aforementioned identity of the two interpretations of NOT.

(101) a. $STAY_{Circ}$ (LAURA, NOT (LAURA SCREAM))
(This is not *Laura kept from screaming*, which is Agentive.)
b. $BE_{Circ}$ (LAURA, NOT (LAURA SCREAM)) (at some time)
c. NOT (LAURA SCREAM)
Laura didn't scream.

Also, from (101b), by inference rule (75a), we derive (102), which (if the above conjecture about the progressive is correct) is the representation of *Laura wasn't screaming.*

(102) NOT $BE_{Circ}$ (LAURA, LAURA SCREAM)

Next consider the possible inferences from the negatives of (91b) and (94b).

(103) a. Laura didn't keep David working.
NOT CAUSE (LAURA, $STAY_{Circ}$ (DAVID, DAVID WORK))
b. Linda didn't keep Laura from screaming.
NOT CAUSE (LINDA, $STAY_{Circ}$ (LAURA, NOT (LAURA SCREAM)))

Since there is no inference rule whose antecedent is NOT CAUSE, no inferences about the complement clause follow.

These inferences from *keep* and *keep from* appear to be correct: from *keep* one can infer a claim that the complement is true; from *keep from* one can infer that the complement does not take place; from *not keep* and *not keep from* one can derive no inferences about the complement. Such behavior has been described by Karttunen (1971), in whose terms *keep* is a "one-way implicative verb" and *keep from* is a "one-way negative implicative verb". Karttunen accounts for such behavior with meaning postulates either attached idiosyncratically to the verb or referenced by idiosyncratic classificatory features on the verb. He makes no attempt to relate implicative behavior to a general system of semantic representation, though he conjectures that such a relationship should exist. The present study confirms his conjecture: the implicative behavior of *keep* is a direct consequence of its functional semantic representation, and the inferences are derived by much more general rules of inference. Hence the present analysis is potentially more explanatory than Karttunen's, if it can be extended to cover all the cases he discusses.

Many of Karttunen's cases involve verbs of psychological import such as *know* and *remember*. Since we have as yet not introduced a formal representation for mental states and intentions, we will not attempt to deal with such verbs, leaving their analysis for future research. We will however deal with a range of verbs for which

our present descriptive apparatus is sufficient, showing that different classes of implicative verbs emerge from different functional analyses.

First consider *prevent*. This occurs in two frames:

(104) a. Dick prevented Bob from yelling.

b. Dick prevented {the fire / Bob's yelling}.

The analysis of (104a) is just like (94b) with *keep from*, except that *prevent* does not permit the form that takes a positive location. We can assign (104a) the semantic representation (105).

(105) CAUSE (DICK, $STAY_{Circ}$ (BOB, NOT (BOB YELLING)))

This has the same inference properties as *keep from*, i.e. it is a one-way negative implicative.

(104b) lacks the complement and has only a direct object (which may, however, be a gerund). The selectional restriction on this direct object is approximately that it must be something that can *occur* or *take place*. The representation most closely related to (105) that expresses this property is (106).

(106) CAUSE (DICK, $STAY_{Circ}$ ({THE FIRE / BOB'S YELLING}, NOT ({THE FIRE / BOB'S YELLING} OCCUR)))

In other words, in the absence of the *from*-phrase, *prevent* fills in the location of STAY in a specified way. This is precisely parallel to the behavior of *eat*, which in the absence of a direct object fills in the interpretation FOOD. Hence the two subcategorizations of *prevent* are semantically related in quite an ordinary way.

The positive form of *keep* has the nonAgentive counterpart *continue*:

(107) a. Laura continued screaming.

b. {Laura's screaming / The noise} continued.[16]

(107a) has the representation (108a); (107b) has the Circumstantial location specified by the verb, yielding (108b), parallel to (106).

(108) a. $STAY_{Circ}$ (LAURA, LAURA SCREAM)

b. $STAY_{Circ}$ ({LAURA'S SCREAMING / THE NOISE}, ({LAURA'S SCREAMING / THE NOISE} OCCUR))

[16] *Laura continued to scream* may be an instance of either case, depending on whether it is derived by Raising or Equi.

(108a) leads by (69) to the inference (109a), which by (99) leads to (109b).

(109) a. $BE_{Circ}$ (LAURA, LAURA SCREAM)
Laura was screaming. (?)
b. LAURA SCREAM
Laura screamed.

The negation of (107a), *Laura didn't continue screaming*, leads to the chain of inference (110).

(110) a. Laura didn't continue screaming.
NOT $STAY_{Circ}$ (LAURA, LAURA SCREAM) $\xrightarrow{(70)}$
b. (at some time in the relevant interval)
NOT $BE_{Circ}$ (LAURA, LAURA SCREAM) $\xrightarrow{(75a)}$
Laura wasn't screaming. (?)
c. (at some time)
$BE_{Circ}$ (LAURA, NOT (LAURA SCREAM)) $\xrightarrow{(99)}$
d. (at some time)
NOT (LAURA SCREAM)
Laura didn't scream.

In other words, inferences can be drawn from both the positive and negative instances of *continue*: if *continue* is asserted, its complement is asserted for some time; if *continue* is denied, its complement is denied for some time. This is thus an example of a two-way positive implicative verb.

*Avoid* is apparently a negative counterpart of *continue*. Unlike *continue*, it has only a transitive form; to our advantage, it also has a Positional usage.

(111) a. David avoided the beach.
b. David avoided playing checkers.

Avoid means essentially 'stay away from', or in our terms, STAY AT NOT. So (111a,b) have (112a,b) as their respective representations.

(112) a. $STAY_{Posit}$ (DAVID, NOT THE BEACH)
b. $STAY^{*}_{Circ}$ (DAVID, NOT (DAVID PLAY CHECKERS))

By the usual inference rules, we can derive the sentences (113a,b):

(113) a. David wasn't at the beach.
b. David didn't play checkers.

The negations of (111a,b), by inference rules (70) and (75b), imply (114a,b) respectively.

(114) a. David was at the beach. (at some time)
b. David played checkers. (at some time)

Hence *avoid* is a two-way negative implicative.[17]

*5.2. Circumstantial GO*

We motivated Circumstantial STAY by means of the verb *keep*, for which the Positional case provided an analogue. We then extended the use of Circumstantial STAY to other verbs that had the same complement structure but which did not necessarily have a Positional use. We will now do the same for Circumstantial GO. Compare these three uses of *force*.

(115) a. Jim forced the ball into the hole.
b. Jim forced Phil into leaving the room.
c. Jim forced Phil to leave the room.

(115a) has the representation (116) (in part—we briefly mention the markers of manner in section 5.4):

(116) CAUSE (JIM, $GO_{Posit}$ (THE BALL, y, THE HOLE))

If we choose analysis (117) for (115b,c), we can claim that the two uses of *force* are fundamentally the same.

(117) CAUSE (JIM, $GO_{Circ}$ (PHIL, y, PHIL LEAVE THE ROOM))

(117) says that Jim brought about Phil's being involved in the circumstance of leaving the room.

Applying inference rules to (117) yields these results:

(118) a. $\xrightarrow{(60)}$ $GO_{Circ}$ (PHIL, y, PHIL LEAVE THE ROOM)
b. $\xrightarrow{(72)}$ for some times $t_2$ and $t_3$ such that $t_2 < t_3$, $BE_{Circ}$ (PHIL, y) AT $t_2$ AND $BE_{Circ}$ (PHIL, PHIL LEAVE THE ROOM) AT $t_3$
c. 2nd clause of (118b) $\xrightarrow{(99)}$ PHIL LEAVE THE ROOM (at $t_3$)
d. (118a) $\xrightarrow{(86)}$ y ⊂ NOT (PHIL LEAVE THE ROOM)

In short, we are entitled to infer from (115b,c) that at some time $t_2$ Phil was doing something other than leaving the room, and at some later time $t_3$ Phil left the room.

If we negate (115), *Jim didn't force Phil to leave the room*, there are no inferences about the event described by the complement, since there is no inference rule whose

[17] For some speakers, *avoid* has a preferred Agentive use, CAUSE ($NP^1$, STAY ($NP^1$, NOT $NP^2$)). In this use it is of course a one-way implicative, since there is no inference from NOT CAUSE. An inanimate subject such as *the waves* selects the nonAgentive use, though: both inferences go through for *the waves* {*avoided* / *didn't avoid*} {*the beach* / *hitting the beach*}.

antecedent is NOT CAUSE. *Force* can thus be considered a kind of one-way implicative: asserting it asserts its complement for a particular time and denies it for an earlier time, but negating it leads to no inference about the complement.

The negative counterpart of *force* is *stop*, in its Agentive sense:

(119) Dick stopped the car from coughing.
CAUSE (DICK, $GO_{Circ}$ (THE CAR, y, NOT (THE CAR COUGH)))[18]

A procedure like (118) will lead to the inference that at some time $t_2$ the car was doing something other than not coughing (i.e. coughing), and that at a later time $t_3$ the car was not coughing. Likewise, negating (119) leads to no inference, i.e. the car may or may not have been coughing at any given time. We have thus accounted for the one-way negative implicative property of *stop*.

An alternative analysis of (119) would be CAUSE (DICK, $GO_{Circ}$ (THE CAR, THE CAR COUGH, y)). The inferences are essentially the same. The *from* then is the mark of a Source, not of a negated Goal. The question of whether these are separate uses of *from*, or whether there is a generalization being missed, is left for future research.

The nonAgentive verbs *begin* and *cease* are also represented with Circumstantial GO:

(120) a. The car began sputtering.
$GO_{Circ}$ (THE CAR, y, THE CAR SPUTTER)
b. The car ceased moving.
$GO_{Circ}$ (THE CAR, y, NOT (THE CAR MOVE))

Again, the inference rules lead from (120a) to the claim that at some time the car was doing something other than sputtering, and that at a later time it sputtered; from (120b) to the claim that at some time the car was moving, and that at a later time it was not. Also, by (84a), we can infer that in (120a) the car neither kept sputtering nor kept not sputtering, and in (120b) the car neither kept moving nor kept not moving.

We have no inference rule whose antecedent is NOT GO, and so we derive no inferences from the negations of (120a,b). This seems to be correct, since one can say either (121a) or (121b), for example:

(121) a. The car didn't begin sputtering; it never sputtered at all.
b. The car didn't begin sputtering on Tuesday; it was sputtering all along.

The two possibilities correspond to different stresses, and hence to different foci and presuppositions; the consequences are thus to be explicated in terms of the rules of SIGG, chapter 6, dealing with focus and presupposition.

[18] There are many speakers who use this ambiguously, the other sense synonymous with *Dick prevented the car from coughing*. We will ignore this reading, assuming it has the same analysis as its paraphrase.

Notice that *begin* and *cease*, like *continue*, have intransitive variants:

(122) $\left\{\begin{matrix}\text{The noise}\\\text{Bill's yelling}\end{matrix}\right\}\left\{\begin{matrix}\text{began}\\\text{ceased}\end{matrix}\right\}$.

As with *continue*, we can assign these verbs representations in which the circumstance is specified as OCCUR: (123) is *begin*.

(123) $\text{GO}_{\text{Circ}}\left(\left\{\begin{matrix}\text{THE NOISE}\\\text{BILL YELL}\end{matrix}\right\}, y, \left\{\begin{matrix}\text{THE NOISE}\\\text{BILL YELL}\end{matrix}\right\} \text{OCCUR}\right)$

This then is a semantic explication of Perlmutter's (1970) two verbs *begin*.

One might justifiably wonder if some of the representations we have arrived at are somewhat baroque; it is entirely plausible to suggest that the mysterious Circumstantial GO is superfluous in the representation of *force*, and certainly in that of the arch-causative verb *cause*. We have claimed that representations such as (124b) are correct for (124a), yet (124c) appears intuitively correct and is one function simpler.

(124) a. John $\left\{\begin{matrix}\text{forced}\\\text{caused}\end{matrix}\right\}$ Bill to scream.

b. CAUSE (JOHN, $\text{GO}_{\text{Circ}}$ (BILL, y, BILL SCREAM))

c. CAUSE (JOHN, BILL SCREAM)

There are three arguments against (124c). First, without a Circumstantial function, *cause* and *keep* cannot be differentiated; both would have to be represented as (124c). Second, (124b) but not (124c) can explain why (54) implies a change of state, even though the complement is punctual.

(54) Dollie caused Martin to be happy.

A representation of (54) parallel to (124c) is (55), which we rejected in section 3.3 on two grounds: it violates the constraint that the final argument of CAUSE must be an event, and it does not represent the understood change of state.

(55) CAUSE (DOLLIE, $\text{BE}_{\text{Ident}}$ (MARTIN, HAPPY))

A representation parallel to (124b), however, overcomes both objections at once:

(125) CAUSE (DOLLIE, $\text{GO}_{\text{Circ}}$ (MARTIN, y, $\text{BE}_{\text{Ident}}$ (MARTIN, HAPPY)))

The third argument for (124b) is that it provides an account of the semantic difference used classically (e.g. by Rosenbaum (1967)) to argue for the presence of an underlying direct object with these verbs:

(126) a. John forced the doctor to examine Bill.

b. John forced Bill to be examined by the doctor.

Since the underlying structure of the complement is *the doctor examine Bill* in both cases, a (124c)-type representation cannot differentiate between the readings of the two sentences. But if $GO_{Circ}$ is included, the difference can be represented quite plausibly as (127).

(127) a. CAUSE (JOHN, $GO_{Circ}$ (THE DOCTOR, y, THE DOCTOR EXAMINE BILL))
b. CAUSE (JOHN, $GO_{Circ}$ (BILL, y, THE DOCTOR EXAMINE BILL))

In other words, the use of $GO_{Circ}$ enables the system to express certain important semantic differences that have crucial effects on syntactic structure. The direct object of *force* is given a real semantic function. Hence the syntax of *force* is directly related to and explained by its semantics: there is a one-to-one correspondence between syntactic and semantic arguments, as there should be.

We see therefore that the concept of Circumstantial location, although intuitively somewhat murky and philosophically quite suspect, leads to a much more general formal semantic system than could be attained without it.

*5.3. Permissive Agents*

Symmetry requires that we find semantic structures of the form LET $GO_{Circ}$ and LET $BE_{Circ}$, parallel to the attested CAUSE $GO_{Circ}$ and CAUSE $STAY_{Circ}$. As before, the place to start looking for such verbs is among the Positional verbs of appropriate functional form.

(128) a. John released the bird from the cage.
LET (JOHN, $GO_{Posit}$ (THE BIRD, THE CAGE, z))
b. John released Fred from washing the dishes.
(LET JOHN, $GO_{Circ}$ (FRED, FRED WASH THE DISHES, z))

(129) a. John allowed Fred in the room.
LET (JOHN, $BE_{Posit}$ (FRED, THE ROOM))
b. John allowed Fred to wash the dishes.
LET (JOHN, $BE_{Circ}$ (FRED, FRED WASH THE DISHES))

It is more difficult to test the accuracy of these representations than the corresponding ones with $CAUSE_1$ because fewer inferences are possible. Correctly, there is no inference about the truth of the complement from the truth of (128b) and (129b), since there is no inference rule whose antecedent is LET(. . .). There is however an inference from NOT LET, so we will negate these sentences and follow through the inferences.

(130) a. John didn't release Fred from washing the dishes.
NOT LET (JOHN, $GO_{Circ}$ (FRED, FRED WASH THE DISHES, z))

b. $\xrightarrow{(62)}$ Fred didn't stop washing the dishes.
NOT $GO_{Circ}$ (FRED, FRED WASH THE DISHES, z)

(131) a. John didn't allow Fred to wash the dishes.
NOT LET (JOHN, $BE_{Circ}$ (FRED, FRED WASH THE DISHES))

b. $\xrightarrow{(62)}$ Fred wasn't washing the dishes. (?)
NOT $BE_{Circ}$ (FRED, FRED WASH THE DISHES)

c. $\xrightarrow{(75a)}$ $BE_{Circ}$ (FRED, NOT (FRED WASH THE DISHES))

d. $\xrightarrow{(99)}$ Fred didn't wash the dishes.
NOT (FRED WASH THE DISHES)

Again these inferences seem correct, and *release* and *allow* are two further types of one-way implicative.

Here are two more interesting permissive verbs.

(132) a. Jack forbid Jim to fight.
b. Jack exempted Jim from fighting.

These can be assigned representations (133a,b) respectively, incorporating NOT at two different points.

(133) a. NOT LET (JACK, $BE_{Circ}$ (JIM, JIM FIGHT))
b. LET (JACK, $BE_{Circ}$ (JIM, NOT (JIM FIGHT)))

Note again in (133b) how the *from-ing* complement stands for a negative Location, as in many previous examples. From (133a) we can draw the inference that Jim didn't fight, and from its negation there is no inference. From (133b) there is no inference, but from its negation we can draw the inference that Jim fought. Thus *forbid* and *exempt* belong to two additional classes of one-way implicative verbs, and their properties are explicated directly within the theory of thematic relations.

Interestingly, the verb *let* itself appears to be an anomaly. From its Positional use in (134a) we would guess that (134b) contains a $GO_{Circ}$.

(134) a. John let the bird out of the cage.
LET (JOHN, $GO_{Posit}$ (THE BIRD, y, OUTSIDE OF THE CAGE))

b. John let Fred wash the dishes.
LET (JOHN, $GO_{Circ}$ (FRED, y, FRED WASH THE DISHES))

Since the reading (134b) contains the same functions as *release* in (130), we would expect the same inference, i.e. its negation should entail only that Fred didn't stop washing the dishes. In fact, it seems that *let* permits the same inferences as *allow*, namely, the negation of (134b) entails that Fred didn't wash the dishes.

| Semantic Structure | Examples | Inferences |
|---|---|---|
| CAUSE (x, $GO_{Circ}$(z, u, NOT w)) | stop | asserted: *w* asserted for some time; *w* denied later<br>denied: no inferences |
| CAUSE (x, $STAY_{Circ}$(z, w)) | keep | asserted: *w* asserted<br>denied: no inferences |
| CAUSE (x, $STAY_{Circ}$(z, NOT w)) | keep from<br>prevent<br>restrain | asserted: *w* denied<br>denied: no inferences |
| LET (x, z) | let | asserted: no inferences<br>denied: *z* denied |
| LET (x, $GO_{Circ}$(z, u, w)) | release | asserted: no inferences<br>denied: *u* didn't stop |
| LET (x, $BE_{Circ}$(z, w)) | allow<br>permit | asserted: no inferences<br>denied: *w* denied |
| LET (x, $BE_{Circ}$(z, NOT w)) | exempt | asserted: no inferences<br>denied: *w* asserted |
| NOT LET (x, $BE_{Circ}$(z, w)) | forbid | asserted: *w* denied<br>denied: no inferences |

## 6. Pushing the System

We continue with three areas where the theory of thematic relations seems applicable, but for which the results are somewhat more speculative: ethical datives and benefactives, spatial and temporal extent, and verbs of intent.

### *6.1. Ethical Datives and Benefactives*

Gruber observes that there is a sort of converse of Possessive location in the following expressions.

(137) a. Nelson ran out of money.
b. Ari is in the money.
c. Fred came into a lot of money.

By the usual analysis within the present framework, the subjects in these sentences are Themes, and the prepositional phrases are Goals and Locations, though not in any of the locational modes we have discussed. (137c) is related to the ordinary Possessional sentence *Fred got a lot of money* in much the same way as *The circle surrounds the dot* is related to *The circle contains the dot*; that is, the two sentences express the same situation but with different thematic relations. For Positional sentences the locational parameter does not have to be changed, but we must introduce a new

locational mode (call it Poss') to describe (137), giving these sentences descriptions more or less like (138).

(138) a. $GO_{Poss'}$ (NELSON, y, NOT MONEY)
b. $BE_{Poss'}$ (ARI, MONEY)
c. $GO_{Poss'}$ (FRED, y, MONEY)

Understanding the expressions in (137) amounts to understanding the Poss' mode of location.

One might wonder whether there are any other "converse" modes in the language. Consider these well-known constructions.

(139) a. A funny thing happened to Bill.
b. What happened to Bill was Mary punched him.
c. Sue did something evil to Harry.
d. What Sue did to Harry was kiss him.

What is the interpretation of the *to*-phrase in these examples? The choice of preposition suggests a Goal phrase, leaving the subject, an event, as Theme in (139a,b). The end result of the motion of the Theme is the Goal's being involved in the event. Hence these sentences represent the converse of Circumstantial motion: instead of an individual moving to an event, an event moves to an individual. The representations of (139a,b) are therefore (140a,b).

(140) a. $GO_{Circ'}$ (A FUNNY THING, x, BILL)
b. $BE_{Ident}$ ($\left[\begin{matrix}\text{SOMETHING} \\ GO_{Circ'}\text{ (WH-SOMETHING, x, BILL)}\end{matrix}\right]$, MARY PUNCH BILL)

(139c,d) are simply the causative counterparts of (139a,b).

(140) c. CAUSE (SUE, $GO_{Circ'}$ (SOMETHING EVIL, y, HARRY))
d. $BE_{Ident}$ ($\left[\begin{matrix}\text{SOMETHING} \\ \text{CAUSE (SUE, } GO_{Circ'}\text{ (WH-SOMETHING, y, HARRY))}\end{matrix}\right]$, SUE KISS HARRY)

Such an analysis explains two interesting and heretofore mysterious constraints on these constructions. First, the fact that the end result of the motion is that the individual is involved in the event explains the somewhat vague selectional restriction on possible clauses in *what happened to x was . . .* constructions:

(141) a. *What happened to Fred was Transylvania became independent in 1274.
b. *What happened to Fred was the price of bananas went up.

There are two possible resolutions of this anomaly. One is to say that *let* does not have the optimal relation between its two uses, and that the reading in the complement form (134b) is like *allow*: LET (x, $BE_{Circ}$ (. . .)). Alternatively, the representation of (134b) could be simply LET (JOHN, FRED WASH THE DISHES); the complement, instead of replacing the Location phrase of the Positional use, would replace the entire second argument of LET. Under this assumption, inference rule (62) leads directly from the negation of (134b) to the claim that Fred didn't wash the dishes, as desired.

This second solution is worth dwelling on for a moment. *Let* is unusual syntactically in that it requires a bare infinitive complement rather than the *to*-complement generally associated with the verbs of this class. It is not inconceivable that this syntactic anomaly reflects the observed semantic anomaly. As evidence, note that the verb *make* takes the same type of complement as *let*; it is evidently the causative counterpart.

(135) John made Fred wash the dishes.

If the above conjecture about *let* is correct, (135) should be represented by CAUSE (JOHN, FRED WASH THE DISHES), contrasting with *John caused Fred to wash the dishes*, which contains a Circumstantial GO. Now notice that state-of-affairs complements can be embedded more comfortably under *cause* than under *make*:

(136) a. ?*John made {Bill know the answer / the tree be tall}.

b. John caused {Bill to know the answer / the tree to be tall}.

This difference is explicable, since in (136a), the final argument of CAUSE is the anomalous $BE_{Ident}$, whereas in (136b) it is the permissible $GO_{Circ}$. Hence the conjectured structure for the bare infinitive complement explains at least one interesting independent fact. Doubts about the precise syntax of the construction preclude much stronger claims. If this conjecture is correct, however, there is a real deep structure difference from the *to*-infinitive, not merely a trivial *to*-deletion transformation triggered by an exception feature. Again the present semantic analysis reveals an interesting correlation with syntactic structure.

### *5.4. Excursus #2*

By following the general heuristic that a verb means fundamentally the same in all its uses, we were led to discover the notion of Circumstantial location. This is clearly a linguistically significant generalization of the system of thematic relations: it permits the description of a wide range of verbs and their inferences merely by following through mechanically the possibilities provided by the system, and by deriving the inferences by independently motivated inference rules. A set of heretofore classi-

ficatory features, namely those defining implicative verbs, is replaced with a motivated semantic description.

Lest the generalization from Positional to Circumstantial location seem still marginal and unmotivated, we should observe that it is in fact quite pervasive in the language. A few random examples culled from Jespersen, in which the generalization is immediately evident, are *to* COME *to be called Max*, *to* LEAD *someone to believe something*, *to* DRIVE *someone to confess*, *to* BRING *oneself to acknowledge something*, *to* DIRECT *someone to leave*, and, among nominals, the striking example *the* WAY *to find out*. These are not "metaphors" in the usual sense—they are not used for artistic effect, and there is no clash of semantic markers characteristic of true metaphor. Rather, they are generalizations of the meanings of verbs along innately determined lines.

For a more subtle example, consider the meaning of *force*, which we have so far defined up to synonymy with *cause*. *John forced the ball into the hole* can be paraphrased more accurately by *make go* plus a manner phrase: *John made the ball go into the hole by applying pressure against its resistance*. Surprisingly enough, the same manner phrase is exactly right for the circumstantial reading: *John forced Sue to leave* can be paraphrased as *John caused Sue to leave by applying pressure against her resistance*. In other words, the concepts of *pressure*, *applying pressure*, and *resistance* generalize from their physical senses to abstract senses, all in precisely the right way that they can be combined identically in both modes to describe the two senses of *force*. Surely this is no coincidence; it argues that the choice of extensions from Positional to Circumstantial mode is highly predetermined.

We end this section with a summary of the classes of implicative verbs discussed here. Their great variety amply demonstrates the futility of any classificatory system not based directly on semantic structure.

| Semantic Structure | Examples | Inferences |
|---|---|---|
| $GO_{Circ}(x, y, z)$ | begin<br>start | asserted: *z* denied for some time;<br>*z* asserted for some later time<br>denied: no inferences |
| $GO_{Circ}(x, y, NOT\ z)$ | cease<br>stop | asserted: *z* asserted for some time;<br>*z* denied for some later time<br>denied: no inference |
| $STAY_{Circ}(x, y)$ | keep<br>continue | asserted: *y* asserted<br>denied: *y* denied for some time |
| $STAY_{Circ}(x, NOT\ y)$ | avoid<br>refrain | asserted: *y* denied<br>denied: *y* asserted for some time |
| CAUSE (x, z) | make | asserted: *z* asserted<br>denied: no inference |
| CAUSE (x, $GO_{Circ}(z, u, w)$) | cause<br>force<br>coerce | asserted: *w* denied for some time;<br>*w* asserted later<br>denied: no inferences |

(141b) is acceptable only if there is some connection between Fred's fortunes and the price of bananas, that is, if the event could involve Fred in some way.

Since the event is moving to the person, rather than vice versa, the person can have no control over the event. Hence this construction excludes clauses in which the relevant person is Agent:

(142) a. What happened to Fred is he inherited twenty cents. (*Fred* is Goal of clause)
b. *What happened to Fred is he bought an expensive car. (*Fred* is Agent of clause)
c. What happened to Fred was he fell down the stairs. (*Fred* is Theme of clause)
d. *What happened to Fred was he lowered himself down the stairs. (*Fred* is Agent)

(142b) could be used ironically, implying Fred was victimized by a salesman or has fallen prey to bourgeois instincts, i.e. that his control of the situation was only apparent. The irony lies in the conflicting assertion that Fred was both in control and not.[19]

Hence a grammatically motivated interpretation of (139) leads to a plausible explanation of some unusual constraints on its use. Some cases whose analysis is less clear are those in (143).

(143) a. It remained to Dan to clean up the mess.
b. It fell to Ivanovich to throw the bomb.
c. My car broke down on me.

(143a,b) look similar to (139): the prepositional phrase is the Goal of something, and the Theme is apparently the clause. On the other hand, *Dan* and *Ivanovich* are understood as Agents of their respective clauses, violating the Agency constraint observed in (142). This difference can be explained if we notice that what is going to Dan and Ivanovich is not the event, but an *obligation* to bring the event about, and they have no control over the obligation—it is being imposed from without. The semantic difference between these and (139) is reflected as a syntactic difference in complementizer choice.

(143c) represents a different case. Here the *on* phrase, the so-called "ethical dative", represents the recipient of a misfortune. An obvious semantic representation would be one similar to (139).

[19] Gruber (1965) suggests at one point that an Agent is a kind of Source; in the present formalism, this amounts to claiming that CAUSE (x, e) is to be reanalyzed as $GO_{Circ.}$ (e, x, z). He has pointed out (personal communication) that such an analysis would formally explain the constraint illustrated in (142): it would simply be a special case of the general constraint that Source and Goal are distinct. Fairly clear cases of such 'Circumstantial' Sources exist, for instance *he died* FROM *cancer*. However, this treatment of CAUSE entails reducing LET (x, e) as well, to something like STAY (e, NOT x), whose intuitive appeal is far less. I therefore leave the question open.

(144) $GO_{Circ'}$ (MY CAR BROKE DOWN, y, ME)

(144) has intuitive appeal semantically, but it presents syntactic problems, in that the superordinate function $GO_{Circ'}$ is not part of the main verb of the sentences, as would be expected. Alternatively, the $GO_{Circ'}$ could be incorporated as a restrictive modifier on the main verb:

(145) $\begin{bmatrix} GO_{Ident} \text{ (MY CAR, x, BROKEN DOWN)} \\ \text{Manner(?): } GO_{Circ'} \text{ (MISFORTUNE, y, ME)} \end{bmatrix}$

But this is not altogether satisfying semantically. The present system at least provides the correct pieces for the interpretation of (143c). It remains to be seen whether the pieces can be put together in a way that preserves the generality of the rules relating syntactic and semantic structures.

A word about the preposition *on* in this construction. It may well seem unmotivated, since the usual preposition for Goals is *to*. However, *on* can be used to express a Goal, suppleting *to*, when the Goal is a surface and the motion is downward from above:

(146) a. The bomb fell on the field.
b. Bill put the flowers on the counter.
c. The plane landed on the roof.

For lack of better analysis, we indulge in metaphorical speculation. One might guess that suffering misfortune is conceived of as like getting hit on the head by a falling object—the object is out of one's control, and its impact hurts (note the parallel use of *impact*—almost a bad pun, and we accept it ruefully). Like a falling object, the course of events cannot be stopped once it is underway. The use of *on* is consistent with this conception. The existence of such expressions as *Don't lay your troubles on me* and the recent colloquial use of *go down* for *happen* confirm the psychological reality of this metaphor. Presumably, if there is any relationship between *fall* and *befall*, it is to be found here. Also note the expressions *have control* OVER *something*, *be* ON TOP OF *the situation*, *be* UNDER *someone's control*.

Contrasting with ethical datives are so-called benefactive expressions, usually containing a *for*-phrase:

(147) a. What Connie did for Bob was $\left\{ \begin{matrix} \text{bake a cake} \\ \text{??kick him} \end{matrix} \right\}$.
b. Bob sang a tune for Connie.
c. Kick a goal for old Phuque U.

Most of the events associated with these phrases are beneficial to the individual denoted by the object of *for*, whereas in the previous examples the object of *to* and *on* was a victim. Other than this difference, the interpretation seems to be the same: the object of the preposition is the Goal of a circumstance.

Here is a very speculative conjecture about how to represent the difference between the ethical dative and the benefactive. We have seen that the preposition *on* of the ethical dative has a strongly Positional connotation. In contrast, the benefactive *for* has Possessional overtones. For example, *Bill painted* {*a picture for Fred* / *Fred a picture*} is ambiguous between the picture being painted for Fred's amusement or for Fred to own. Many of the *for*-Dative verbs have similar ambiguities.

Now notice that a Circumstantial Theme moving to an individual as Goal need have no special mode of location such as *Circ'* indicated on the function GO; the mode will be indicated unambiguously by the semantic nature of the Theme. Suppose, then, that the mode can be specified either as Positional or Possessional, and that the former denotes ethical datives and the latter benefactives. This would explain in a rather natural way the observed uses of prepositions, while reducing the stock of locational modes by one.[20]

Section 6.3 will mention further evidence for the affinity between Possessional mode and benefactive interpretations. Though this connection may seem somewhat extreme, pushing the theory beyond presently justifiable limits, it is important to thus investigate how the theory might be extended in a more than mechanical fashion.

*6.2. Spatial and Temporal Extent*

(148) raises a number of apparent contradictions to the analysis given so far.

(148) The road {extended / reached} from Altoona to Johnstown.

The *from* and *to* strongly suggest that the semantic representation of (148) should contain GO as its principal function. This conjecture is strengthened by the observation that *goes* can be substituted for the verbs in (148), and both *extend* and *reach* can describe physical motion:

(149) a. John extended his arm over the table.
b. John reached Altoona.

Yet (148) does not express change of any sort, and it fails the test for eventhood that picks out motional verbs:

(150) *What happened was that the road {extended / reached} from N.Y. to L.A.

Furthermore, the usual inferences for GO are not only invalid, but semantically

[20] Alternatively, one might try to develop a feature system for the locational parameter, in which (for example) Positional was unmarked, Possessional and benefactive were marked for possession, and benefactive and ethical dative were marked for Circumstantial Theme. The analysis of Extensional hypermode in section 6.2 strongly suggests such a treatment.

anomalous: it makes no sense to say that first the road was in Johnstown and then it was in Altoona. An example with similar problems, but in the Identificational mode, is (151).

(151) This theory ranges from the sublime to the ridiculous.

These sentences seem to be serious counterexamples to the theory of thematic relations.

(148) and (151) differ from all the previous examples of motional verbs in one very crucial way: they do not make essential reference to the passage of time. It is because of this that they, like punctual verbs, do not describe events, but states of affairs. Since the use of *happen* implies passage of time, (150) is anomalous; since (72), the inference rule for GO, makes reference to passage of time, it cannot be applied to these examples. Thus the difficulties with (148) and (151) follow from the fact that $GO_{Posit}$ and $GO_{Ident}$ are not correct representations for their principal functions.

When the linguistic form of some example has strongly suggested motion, but the theory could not yet express its sense, we have typically responded by creating a new locational mode. The new mode was then justified by showing that it was necessary for durational and punctual verbs as well as for motional. In the present instance, what is called for is not simply a new mode, since both Positional and Identificational modes are involved in the extension of the system. Rather we seem to need a "hypermode" that cross-categorizes (at least in part) with the previous locational modes.

Let us call the new opposition *Transitional* vs. *Extensional*. All previous examples of GO have been $GO_{Trans}$, expressing the locations of the Theme over time. (148) and (151), however, are $GO_{Ext}$, expressing what locations the Theme occupies without reference to time. We will assign them the following representations:

(148′) $GO_{Ext,Posit}$ (THE ROAD, ALTOONA, JOHNSTOWN)

(151′) $GO_{Ext,Ident}$ (THIS THEORY, SUBLIME, RIDICULOUS)

To prevent inference rule (72) from applying to these sentences, it must be restricted to $GO_{Trans}$:

$$(72') \quad \begin{bmatrix} GO_{Trans}\ (X, Y, Z)\ AT\ t_1 \\ W \end{bmatrix} \Rightarrow \text{for some times } t_2 \text{ and } t_3 \text{ such that } t_2 < t_1 < t_3, \begin{bmatrix} BE_{Trans}\ (X, Y)\ AT\ t_2 \\ W \end{bmatrix} \text{ and } \begin{bmatrix} BE_{Trans}\ (X, Z)\ AT\ t_3 \\ W \end{bmatrix}$$

The corresponding inference rule for $GO_{Ext}$ is that if something $goes_{Ext}$ from $y$ to $z$, part of it (in particular, one end) is at $y$ and part of it (the other end) is at $z$:

$$(152) \quad \begin{bmatrix} GO_{Ext}\ (X, Y, Z) \\ W \end{bmatrix} \Rightarrow \text{for some T and U such that T} \subset X \text{ and U} \subset X, \begin{bmatrix} BE_{Ext}\ (T, Y) \\ W \end{bmatrix} \text{ AND } \begin{bmatrix} BE_{Ext}\ (U, Z) \\ W \end{bmatrix}$$

This provides the desired inferences for (148) and (151).

If there is a hypermode of Extension, we would expect to find $STAY_{Ext}$ and $BE_{Ext}$ as well. Notice, however, that since BE never refers to passage of time in any case, there is probably no semantic distinction between $BE_{Ext}$ and $BE_{Trans}$—the two collapse into one semantic function. There remains STAY. What would be a suitable candidate for a verb represented as $STAY_{Ext}$? To answer this, let us speculate on what possible inferences $STAY_{Ext}$ could have. If something $stays_{Trans}$ someplace during a particular interval of time, there is no part of the interval during which it is not there. The relationship between (72′) and (152) seems to be that part of the Theme in (152) corresponds to part of the time in (72′). Making a corresponding alteration in inference rules (69) and (70) for $STAY_{Trans}$, we get these rules:

(153) $\begin{bmatrix}STAY_{Ext}\ (X,\ Y)\\ Z\end{bmatrix} \Rightarrow \begin{bmatrix}BE\ (W,\ Y)\\ Z\end{bmatrix}$
Condition: W is part of X

(154) $NOT\ \begin{bmatrix}STAY_{Ext}\ (X,\ Y)\\ Z\end{bmatrix} \Rightarrow$ for some W, $NOT\ \begin{bmatrix}BE\ (W,\ Y)\\ Z\end{bmatrix}$
Condition: W is part of X

A verb that obeys these inference rules is *contain*, which we previously analyzed as $BE_{Posit}$. If the circle contains a square, every part of the square is in the circle; if the circle does not contain the square, there is a part of the square that is not in the circle. Thus $STAY_{Ext}$ might be taken to mean approximately 'stay within the boundaries of'; the verb of this paraphrase is of course significant.

The potential ramifications of an Extensional hypermode are vast, and I will mention only two of its possible uses. First, there appears to be a notion of nontemporal (i.e. Extensional) causation that includes the idea of logical connection. *P implies Q*, for example, can be represented as $CAUSE_{Ext}$ (P, Q). There is no standard logical connective expressing $LET_{Ext}$ (P, Q), but this sense seems to be conveyed by *Q is consistent with P*. By filling in the Agent with a specified argument, we can represent *P is (logically) possible* with some such expression as $LET_{Ext}$ (LOGIC, P). The parallel expression $CAUSE_{Ext}$ (LOGIC, P) is then, of course, *P is (logically) necessary*. Other kinds of necessity and possibility can be expressed by substituting other kinds of general laws (e.g. NATURE, MORALITY, THE PRESENT SITUATION, etc.) for LOGIC in these formulas. This gives us essentially the range of readings exhibited by the modals *must* and *may*, which are thus CAUSE and LET respectively. Hence, if this speculation is correct, the theory of thematic relations has as a natural consequence the semantic parallelisms observed by Lakoff (1972, section VIII) among the pairs *require* and *permit*, *necessary* and *possible*, and *must* and *may*.

Oddly enough, time reenters in the Extensional hypermode via a new mode of location:

(155) The conference $\left\{\begin{matrix}\text{went}\\\text{lasted}\\\text{extended}\end{matrix}\right\}$ from Tuesday to Friday.

Since the verb *go* and Source–Goal patterns reappear here, we conclude that we are dealing with a motional sentence again. The Source and Goal are of course times. Now notice that only the Extensional inference rule (152) is applicable: we can infer that part of the conference was on Tuesday and part on Friday; it makes no sense to apply (72) and infer that there was a time at which the conference was on Tuesday and a time at which it was on Friday. Hence the appropriate hypermode seems to be Extensional, and the use of the verb *extend* confirms this. We thus must create a new Extensional mode, *Temporal*, representing (155) this way:

(156) $GO_{Ext,Temp}$ (THE CONFERENCE, TUESDAY, FRIDAY)

The existence of the Temporal mode of course renders it possible to express the often-observed relations between the spatial and temporal uses of such words as *precede*, *follow*, *occupy*, *fill*, *before*, *after*, *within*, and of course *at* and *on*. Thus again the theory of thematic relations opens up an important area of semantic description to motivated analysis.

*6.3. Verbs of Intent*

Observe the contrast in the following pairs.

(157) a. Max sailed toward the harbor.
b. Max sailed for the harbor.

(158) a. Max ran toward home.
b. Max ran for home.

Though both *toward* and *for* seem to express direction, they are not identical in meaning:

(159) a. Max sailed $\left\{\begin{matrix}\text{*toward}\\\text{for}\end{matrix}\right\}$ the harbor by setting his course 30° north of the harbor.

b. Max inadvertently ran $\left\{\begin{matrix}\text{toward}\\\text{*for}\end{matrix}\right\}$ home, thinking he was running away from it.

(159a) is anomalous with *toward* because *toward* expresses a physical direction that conflicts with the direction asserted in the means clause. *For*, however, expresses an *intent*, a "mental direction", so it does not conflict with the physical direction in (159a). Conversely, the subordinate clause in (159b) deals with Max's thoughts; it is compatible with the physical direction expressed by *toward*, but not with the

intent expressed by *for* (unless Max is self-destructively neurotic and the *for* expresses an unconscious intent).

Lacking at present any formalization of direction phrases and of mental constructs, we will provisionally express intent as a restrictive modifier of the function CAUSE, thus:

(160) a. $\left[\begin{array}{l}\text{CAUSE (MAX, } \left[\begin{array}{l}\text{GO}_{\text{Posit}}\text{ (MAX, y, z)} \\ \text{Manner: SAILING}\end{array}\right]\text{)} \\ \text{Intent: GO}_{\text{Posit}}\text{ (MAX, x, THE HARBOR)}\end{array}\right]$

b. $\left[\begin{array}{l}\text{CAUSE (MAX, } \left[\begin{array}{l}\text{GO}_{\text{Posit}}\text{ (MAX, y, z)} \\ \text{Manner: RUNNING}\end{array}\right]\text{)} \\ \text{Intent: GO}_{\text{Posit}}\text{ (MAX, x, HOME)}\end{array}\right]$

Note that we can use the presence of the modifier of intent to distinguish those verbs that require animate Agents from those that permit either an animate or inanimate Agent: verbs that express intent may be ascribed only to sentient Agents (and this will include organizations and higher animals in exactly the appropriate way).

The phrase of intent, marked syntactically by *for* and realized semantically as a motional function modifying CAUSE, appears also in nonphysical cases. Contrast these pairs.

(161) a. Phil tried a new job.
b. Phil tried for a new job.

(162) a. The moderator asked the panelist a question.
b. The moderator asked the panelist for a question.

In (161a), the direct object is probably a Location or Goal (as indicated by the nominal *Phil took a try at it*), and in (162a), the object is a Theme (what came from the moderator's mouth). By contrast, in the (b) sentences, the object of *for* is the Goal of an intention, something that is not necessarily claimed to exist other than in the subject's mind.

A complete formalization of these verbs must be somewhat conjectural, but for the sake of pushing the theory, I will attempt it. Let us deal first with *try*. *Try* can take a gerundive object as in *Phil tried working on the XP–70*, indicating the presence of a Circumstantial function in its representation. *A job* can likewise be considered a Circumstance (but not *an apple*, as in *Phil tried an apple*, of which more shortly). (161a) entails that at some time Phil did not have the job, and at some later time he had it. Such inferences suggest that the desired Circumstantial function is GO. Since *try* is clearly Agentive, there must be a CAUSE as well. So far, then, (161a) has the representation (CAUSE (PHIL, $\text{GO}_{\text{Circ}}$ (PHIL, y, A NEW JOB))). What distinguishes *try* from other verbs of this functional structure is the marker of intent, which in (161a) is roughly "Phil get into a better situation". The lexical entry for transitive *try* in (161a) must thus be (163).

(163)
$$\left[\begin{array}{l} /\text{trī}/ \\ +\text{V} \\ +[\text{NP}^1 \_\_\_\_ \text{NP}^2] \\ \left[\begin{array}{l}\text{CAUSE (NP}^1, \text{GO}_{\text{Circ}} (\text{NP}^1, \text{z, NP}^2)) \\ \text{Intent: GO}_{\text{Circ}} (\text{NP}^1, \text{x, BETTER SITUATION})\end{array}\right] \end{array}\right]$$

(161b), on the other hand, is read roughly as 'Phil did something with the intent of getting a job'. Here the object of *for* appears within the intent marker, and the actual action taken by Phil is left unspecified. The complement clause in this reading is infinitival: ***Phil tried to get a job.*** The lexical entry for this sense of *try* could thus be (164).

(164)
$$\left[\begin{array}{l} /\text{trī}/ \\ +\text{V} \\ +[\text{NP}^1 \_\_\_\_ \text{for} \left\{\begin{array}{l}\text{NP}^2 \\ \text{S}\end{array}\right\}] \\ \left[\begin{array}{l}\text{CAUSE (NP}^1, \text{y, e}) \\ \text{Intent: GO}_{\text{Circ}} (\text{NP}^1, \text{x}, \left\{\begin{array}{l}\text{NP}^2 \\ \text{S}\end{array}\right\})\end{array}\right] \end{array}\right]$$

Thus the two senses of *try* differ in which Circumstantial position in the semantic representation is filled in; further, the semantic distinction between the two possible complement types is clearly expressed in the proposed analysis.

Two further related uses of *try* appear when the second NP is not a circumstance:

(165) a. Phil tried an apple.
b. Phil tried for an apple.

The reading of *try* in (165b) is easily assimilated to lexical entry (164), since it can be represented by replacing the $\text{GO}_{\text{Circ}}$ in (164) with $\text{GO}_{\text{Poss}}$: the sentence can this way be paraphrased approximately as 'Phil did something with the intent of getting (to the possession of) an apple'. (165a) is closely related to (161a): it can be paraphrased as 'Phil got involved in a situation involving an apple with the intent of getting a better situation'. Note that the exact nature of the situation involving the apple is unspecified: it could be eating, throwing, painting, levitating, looking at, or sitting on an apple. (166) represents this reading of *try*.[21]

(166)
$$\left[\begin{array}{l} /\text{trī}/ \\ +\text{V} \\ +[\text{NP}^1 \_\_\_\_ \text{NP}^2] \\ \left[\begin{array}{l}\text{CAUSE (NP}^1, \text{GO}_{\text{Circ}} (\text{NP}^1, \text{z}, \left[\begin{array}{l}\text{w} \\ \text{BE}_{\text{Circ}} (\text{NP}^2, \text{w})\end{array}\right])) \\ \text{Intent: GO}_{\text{Circ}} (\text{NP}^1, \text{x, BETTER SITUATION})\end{array}\right] \end{array}\right]$$

[21] Note that $\text{NP}^2$ appears in this entry inside a semantic construction that corresponds syntactically to a relative clause. If this entry is correct, it is an example of what many generative semanticists have claimed to be an impossible lexical item, since within their theory its lexicalization would necessarily violate the Complex NP Constraint.

Thus $\begin{bmatrix}\text{CAUSE } (NP^1, GO_{Circ} (NP^1, z, w))\\ \text{Intent: } GO_{Circ} (NP^1, u, v)\end{bmatrix}$ appears to be the theme of which all the uses of *try* are variations. One could easily conceive of a language in which these senses were assigned to different words, yet they are not so different as to be unrelated.

The relation between the two uses of *ask* in (162) is similar. (162) can be paraphrased roughly as 'the moderator said a question with the intent of getting from the panelist a response to the question': (162b) is roughly 'the moderator said something to the panelist with the intent of getting a question from the panelist'. These senses of *ask* can be formalized as (167a,b) respectively. Note that (167b) leaves unspecified what $NP^1$ says.

(167) a.
$$\left[\begin{array}{l}\text{/æsk/}\\ +V\\ +[NP^1 \text{ \_\_\_\_ } (NP^2)\ NP^3]\\ \left[\begin{array}{l}\text{CAUSE } (NP^1, GO_{Poss} (NP^3, NP^1, NP^2))\\ \text{Intent: CAUSE } (NP^2, GO_{Poss} (\text{ANSWER TO } NP^3, NP^2, NP^1))\end{array}\right]\end{array}\right]$$

b.
$$\left[\begin{array}{l}\text{/æsk/}\\ +V\\ +[NP^1 \text{ \_\_\_\_ } (NP^2) \text{ for } NP^3]\\ \left[\begin{array}{l}\text{CAUSE } (NP^1, GO_{Poss} (z, NP^1, NP^2))\\ \text{Intent: CAUSE } (NP^2, GO_{Poss} (NP^3, NP^2, NP^1))\end{array}\right]\end{array}\right]$$

In these examples, I have represented the communication of information as $GO_{Poss}$, with a Theme that represents linguistic information. We could again invent a new mode of location to represent linguistic communication, and it may well prove necessary; but the use of normally Possessional verbs is suggestive in examples such as *I have a question* and *He'll give you an answer*. See Gruber (1965, section 7.2) in this regard.

Running the risk of oversimplification, we nevertheless observe that this generalization permits both normal Possessional transfer (as in *ask for a book*) and communication (*ask for an answer*) to be represented by $GO_{Poss}$ in the intent marker of (167b). In (167a), of course, only a linguistic $NP^3$ is possible, since only questions can serve as arguments of ANSWER TO $NP^3$ in the intent marker.

Closely related to (162a) is the subcategorization of *ask* with indirect questions, as in *Phil asked Bill who left*. The subordinate clause describes the actual content of the discourse. The communication cannot, however, be represented as GO (WHO LEFT, PHIL, BILL), since WHO LEFT denotes a (partially unspecified) event, not a sentence. A more appropriate representation is $GO_{Poss}$ ($IMAGE_{verbal}$ (WHO LEFT), PHIL, BILL), where the operator IMAGE is a mapping from events into their representations, as described in Jackendoff (1975c). This analysis creates the

possibility of referential opacity and of inexact correspondence between direct and indirect discourse, exactly as desired. This sense of *ask* is represented as (167c).

(167) c. $$\left[\begin{array}{l} /æsk/ \\ +V \\ +[NP^1 \_\_\_\_ (NP^2)\ wh\text{-}S] \\ \left[\begin{array}{l} CAUSE\ (NP^1, GO_{Poss}\ (IMAGE_{verbal}\ (S), NP^1, NP^2)) \\ Intent:\ CAUSE\ (NP^2, GO_{Poss}\ (ANSWER\ TO \\ \qquad\qquad IMAGE_{verbal}\ (S), NP^2, NP^1)) \end{array}\right] \end{array}\right]$$

This is exactly like (167a) except that $IMAGE_{verbal}$ (S) is substituted for $NP^3$.

There are two further subcategorizations of *ask*, with subjunctives and with infinitive complements:

(168) a. Phil asked Bill that Fred leave.
b. Phil asked Bill (for Fred) to leave.

The parallel with the infinitival complement of *try* suggests that *ask* in (168b) be analyzed like (167b), with the complement represented only within the intent marker. On admittedly slim evidence, we could differentiate (168a) from this by giving it a reading more like (167a,c), with the complement represented both in the main function and in the intent: this would claim that (168a) represents more closely than (168b) what was actually said. Such an intuition seems accurate.

Here are some possible forms for the intent marker of (168a,b):

(169) a. $CAUSE\ (NP^2, S)$
b. $\left\{\begin{array}{l} CAUSE \\ LET \end{array}\right\}\ (NP^2, GO_{Circ}\ (NP^1, z, S))$
c. $CAUSE\ (NP^2, GO_{Poss}\ (S, z, NP^1))$

All three of these incorporate the selectional restriction that the S must represent an event over which $NP^2$ can have control (cf. SIGG, section 5.12). Of the three, (169c) is the closest in form to the intent markers in the other uses of *ask*: the major difference is in the Theme, which is simply S substituted for the $NP^3$ in (167b). This captures the intuition that, as with *try*, the *for*-complement is most closely related to the *for*-object.

Under the conjecture of section 6.1, the $GO_{Poss}$ in (169c) would represent a benefactive whose benefactor is $NP^1$. Such a benefactive interpretation is not implausible. Contrast (168b) with *Phil yelled to Bill for Fred to leave* or with *Phil ordered Bill to leave*, both of which seem much more neutral with respect to possible benefits for the subject: saying *Do this for me* is *asking*, whereas saying just *Do this* is *ordering*. The difference could be represented by assigning *order* and *yell* intent markers more like (169a,b), where there is no benefactive connotation, and assigning *ask* the more

complex but also more generalizable intent marker (169c). There are thus two considerations favoring (169c) as the representation of intent in (168).

We have thus analyzed the five subcategorizations of *ask* as variations on a semantic theme, the differences being in the possible interpretations of $GO_{Poss}$, in whether the direct object or complement appears both in the main function and the intent or only in the intent, and in whether the complement represents a question or an order.

One could easily write off these analyses of *try* and *ask* as legerdemain, mere virtuoso display; many steps along the way have been speculative and unsupported by the solid kind of data that was presented in earlier sections. It is certainly not clear that the descriptive power of the system is not being abused. However, I present these analyses so as to indicate directions in which research might be pursued, and to show the potential power of the theory. Only through such analysis can we ever hope to arrive at any real understanding of the semantics of complementation, one of the most vital problems of current linguistic research.

## 7. On Psychological Reality

This study has developed a fragment of the semantic description of English in terms of the theory of thematic relations. This fragment is observationally adequate in that it provides sentences with semantic representations that convey the correct information and that have the correct entailments. It meets criteria of descriptive adequacy in a number of ways.

Most important, it expresses the strong intuition that verbs are fundamentally the same in their various uses. The causative–noncausative relationship has long been a staple of linguistic description, but other relationships investigated here are relatively novel. The most significant is the relationship engendered by varying the locational parameter in the functions GO, STAY, and BE among the values Positional, Possessional, Possessional′, Identificational, and Circumstantial. Relationships are also created by substituting fully specified information for strictly subcategorized arguments and by entering strictly subcategorized arguments in different positions (such as the main function and the intent marker).

Further, the theory permits a succinct description of traditional intuitive terms such as *event*, *state of affairs*, *Agent*, and *Goal*. To the extent that these terms represent real generalizations, the theory is descriptively adequate.

The theory also meets criteria of descriptive adequacy with respect to the relationship between semantics and syntax. In particular, the dependence of complement type on semantic structure is an important part of the analysis: the bare infinitive complements of *make* and *let* correspond to direct causation; gerundive complements correspond to Circumstantial Locations, Goals, and possibly Sources; *to*-infinitives correspond to Circumstantial Goals and to intents. The direct object

of *force*-type verbs, previously justified on syntactic grounds and on the basis of semantic intuitions, has been given a semantic justification as the Theme of a Circumstantial function. More speculatively, a place has been found in the system for the relationships between ethical datives and Positional prepositions, and between benefactives and Possessional prepositions.

The most important advance in this analysis, however, is at the level of explanatory adequacy. Any choice of formalism automatically creates a valuation of possible descriptions, based on their relative simplicity within the formalism. A theory is explanatory when the empirically correct description is also most highly valued by the formalism. The crucial aspect of the theory of thematic relations, as has been emphasized, is its generalization of the functions GO, STAY, and BE across several modes of location. The formalism claims that the simplest verbs and the simplest inference rules are those that generalize across all the values of the locational parameter, leaving it maximally unspecified. Thus verbs like *be* and *keep* are claimed to be very simple, not very complex, on account of their wide variety of uses. From the choice of notation comes the proliferation of inferences based on extremely primitive physical principles, extending to Possessional and Identificational verbs in section 4, and most strikingly to Circumstantial verbs in section 5. In this last case, the assumption that being involved in a circumstance is a kind of location led to the automatic and natural account of a large variety of implicative verbs, perhaps the single most important particular result of this study. It can now be claimed that the implicative properties of verbs are not idiosyncratic meaning postulates or classificatory features, but the only possible consequence of the verbs' having the functional structure they do.

There have been other, minor, results in the domain of explanatory adequacy, of which I will mention only two. The analysis of implicative verbs depends on treating sentence negation and the negation meaning 'at a place other than' as identical. The notation has been chosen so that such identification is inevitable. Also, various selectional restrictions have followed automatically from the semantic analysis, for example the requirement of animateness on verbs of intent and the heretofore poorly understood relationship required between ethical datives and their associated clauses.

No matter how much internal coherence a semantic theory may have, of course, the ultimate test is whether it fits coherently into a theory of human psychology. For we are engaged in studying natural language, not abstract formal systems. And I believe that the theory of thematic relations, though it does not immediately imply a particular approach, has suggestive connections to some current trends in psychology.

I have already mentioned my conviction that the inference rules of section 4 are not simply means of formally manipulating semantic representations. Rather, in their Positional manifestations, they are fundamental principles involved in understanding the behavior of the physical world. As such they are certainly of an extralinguistic nature. The work of Piaget (e.g. 1947, 1970) has been concerned with the

development of this sort of understanding: the conservation of objects, their existence independent of perception, their combinatorial properties, and so forth. He emphasizes the nonlinguistic nature of these notions, showing how the child's ability to reason about and describe situations involving these notions develops later than his ability to put the notions to practical use.

Piaget inquires about the nature of logical reasoning, arguing that logic (in the logician's sense) is not the basis of thought, but only the final step in a long sequence of developmental stages of reasoning. The beginning of the sequence is the application of principles of conservation and identity to the perception and manipulation of the physical world; by gradual stages of abstraction, a child develops the ability to understand situations that he does not perceive completely and in which he is not directly involved. Finally, he learns to comprehend situations completely independent of the point of view of the observer and to generalize to abstract situations totally beyond experience, such as logical truths.

According to the theory of thematic relations, one crucial step in moving to abstract reasoning is recognizing a particular phenomenon as an instance of generalized Location. For example, understanding the full generality of complement verbs requires learning the concept of Circumstantial location, realizing that the principles of conservation and identity apply in the new domain. This is exactly the kind of learning process that Piaget describes in connection with other extensions of physical comprehension. In fact, the analysis of language may provide insight into where cognitive extensions of physical principles may be sought: surely the linguistic extensions are physically unmotivated, hence any account of why these and not other generalizations occur must bear on a theory of the structure of cognition.

The generalization of the physical and the abstract also plays an important role in current schools of psychotherapy such as gestalt therapy and bioenergetics. The most elaborate theoretical discussion I am aware of is in Perls (1947) and Perls, Hefferline, and Goodman (1951). At the risk of treating a large and complex work frivolously, I will attempt to describe briefly the germane points of Perls's theory. Perls points out numerous parallels in linguistic description between the process of meeting physical needs and that of meeting emotional and intellectual needs, for instance *digesting an idea, biting off more than one can chew, spitting out answers, feeling empty, swallowing a story whole* ("*I can't swallow that!*"), and so forth. More centrally, he discusses characteristic physical reactions to emotional and intellectual processes, in light of which the linguistic parallels are not at all surprising. For example, nonreceptivity toward a situation is often accompanied by clenching of the jaws as if not to let anything in; holding back feelings is accompanied by holding back breathing.

On such grounds, Perls argues that all spheres of human activity are governed by identical gestalt principles, the formation of figure–ground configurations in accordance with organismic needs. The apparently "metaphorical" extensions of

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# Remarks and Replies

## Avoiding Reference to Subject

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For generations, descriptions of natural language grammar have made use of notions like subject, direct object, and indirect object.[1] The character of these concepts and their exact role in linguistic theory can still not be said to be clear.[2] Nonetheless, it would be rash to imagine that grammatical description can dispense with them.

For some time it has been common to suggest that transformational grammar is in significant part a reconstruction of traditional grammar.[3] Despite this, within the theory of generative transformational grammar (TG) as understood by its original formulator, N. Chomsky, the following statement holds:

(1) No transformational rule can refer to notions like subject, etc.[4]

Some readers may doubt that (1) is a correct characterization of transformational theory.[5] Such doubts could be motivated by the following (cf. also footnote 8). Much of the actual descriptive work ostensibly done in a transformational framework ignores (1) and states rules violating the conditions that entail it.[6,7] This in-

[1] The construction of this article has greatly benefited from criticisms and suggestions by David Johnson, David Perlmutter, Stanley Peters, Warren Plath, Haj Ross, and several anonymous reviewers for *Linguistic Inquiry*. It would have been even worse without their help and probably better if I had taken more of their advice.

[2] For proposed theories in which these notions figure as the fundamental primitives of clause structure, cf. Perlmutter and Postal (to appear) and Johnson (1974a, 1974b, to appear).

[3] Cf. Chomsky (1964, 11, 15).

[4] The notation "subject, etc." will often serve as an abbreviation for "subject, direct object, and indirect object". The context makes it clear when this is intended.

[5] The validity of (1) was kindly verified by N. Chomsky, personal communication of November 28, 1974.

[6] The relevant conditions are those excluding quantificational statements from the formulations of the structural descriptions of transformations. Cf. the discussion of Lasnik and Fiengo's remarks in the text, as well as (6) and (7) below. Presumably, the trouble with (7) from this point of view is that it involves a statement of the form (i):

(i) There exists a constituent of the category $S$, $S_1$, such that terms 2 and 3 are all and only the immediate constituents of $S_1$.

This involves both universal and existential quantification.

[7] For only a few examples of "transformational" descriptions that violate these conditions, see the following works: Aissen (1974a, 345); Berman (1974, 10); Bresnan (1971, 266); Bresnan (1973, 278, 307, 327);