

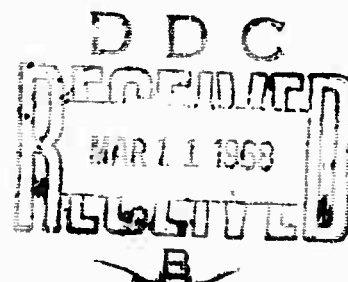
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SOME DISCUSSION AND EXTENSION OF MANFRED BIERWISCH'S  
WORK ON GERMAN ADJECTIVALS

Paul Teller

Contract No. F19628-68-C-0125  
Project No. 8668  
Task No. 866800  
Work Unit No. 86680001



Scientific Report No. 3

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30 November 1967

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Contract Monitor: Hans Zschirnt  
Data Sciences Laboratory

Prepared for:

AIR FORCE CAMBRIDGE RESEARCH LABORATORIES  
OFFICE OF AEROSPACE RESEARCH  
UNITED STATES AIR FORCE  
BEDFORD, MASSACHUSETTS

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## INTRODUCTION

This article presents some discussion, criticism, and extension of Manfred Bierwisch's recent paper, "Some Semantic Universals of German Adjectivals" (1). Bierwisch draws conclusions about the structure of semantic theory as the result of his attempt to analyze the meaning of selected words and expressions. Correspondingly, the present paper will separate into two parts: (1) an extension of Bierwisch's study of semantic theory, and (2) further analysis of particular expressions. In Part I I will present certain difficulties that arise from Bierwisch's restructuring of semantic theory along with suggestions for dealing with these difficulties. In Part II I will present the analysis of some words and expressions related to those that Bierwisch has examined. My analysis will use many of the semantic markers he has proposed as well as others that I have found necessary to add. These examples are further evidence of the usefulness of the semantic markers Bierwisch introduced.\*

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\* Of necessity, a thorough understanding of the present paper will require a thorough familiarity with Bierwisch's work on the part of the reader. Furthermore, all my statements will concern semantics in English rather than German. Most of Bierwisch's examples and analyses seem to have close counterparts in English, so many of the claims I will make about English should be equally valid for German. But, in general, I will not examine the question of whether the two languages require different treatment. Some of the examples treated in Part II will be peculiar to English.

## PART I

In this first part I will deal with the difficulties posed by the role Bierwisch assigns to dependency structures in semantic theory. Both Katz (see, for example, Katz and Postal, An Integrated Theory, Section 2.2) and Bierwisch take the position that the analysis of an expression's meaning is given by a number of formal objects called readings of the expression. Each reading represents a specific sense of the expression. The readings of morphemes are given in a lexicon; the readings of an expression composed of two or more sub-expressions (morphemes or larger units) are derived as a compositional function of the sub-expressions' readings. This process of putting readings together is called amalgamation of readings and is performed by rules called projection rules. Readings are composed of primitive elements, that is, elements which are undefined in the theory, called primitive semantic markers. Readings which are composed of primitive semantic markers are sometimes referred to as complex or composite semantic markers. It is generally agreed that a semantic marker will not be an unordered set of other semantic markers, but will have structure of some sort (c.f. Bierwisch, pp. 22-23 and references cited there).

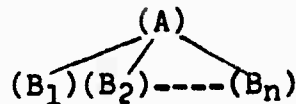
In developing the readings for physical objects and the associated spatial adjectives, Bierwisch notes that some markers seem to be naturally subordinate to others in a manner amenable to representation in a tree structure notation (section 3.3). This fact leads him to introduce "dependency structures" as the means of representing the readings and stating the rules governing amalgamation. A dependency structure, or "dependency tree", is built up with a single relation, "YdX", read, "X depends on Y". If Y and Z depend on X no relevance is put on the order of Y and Z in their X-dependence. Finally, unlike a phrase marker, the terms

which label the nodes of a dependency tree do not divide into terminal and non-terminal symbols. Thus, the terminal symbols are not, as they are in phrase markers, the objects classified by the non-terminal symbols.

The cases which Bierwisch describes by saying the semantic marker X is dependent on the semantic marker Y include more than one conceptual relation between the concepts which those markers represent. In Bierwisch's example of "Schrank" (p. 19) the marker (+rigid) is given as dependent on the marker (physical object). (+rigid) is to be interpreted as further characterizing or specifying the property (physical object) with the property (+rigid). (3 space) depends on (physical object) so as to further characterize it with the property of three dimensionality. However, the markers dominated by (3 space) further characterize (3 space) in terms of different conceptual relations by selectively characterizing different parts, namely the three component dimensions represented by (3 space). For example, (+ vert) selectively characterizes one dimension on the basis of its spatial orientation, whereas (+ rigid) indicates a general physical property of the whole object. In general, if X depends on Y, X is understood as further characterizing Y in a way that reflects different conceptual relations. But the formalism of the dependency relation itself does not capture such differences; they are made specific only by the intended interpretations of the markers X and Y. Since the further characterization involved is not made explicit by the dependency relation we lose nothing by generalizing one step further: to say marker X depends on marker Y is just to say that X bears some direct relation to Y, where the relation is specified by the interpretation of X and Y. The effect of representing X as dependent on Y and as not (directly) dependent on another marker, say Z, is to represent X as having a direct relation in its interpretation to Y and not to Z.

A dependency tree in this sense is a very minimal sort of structuring. It can easily be seen that the dependency notation is an alternative and equivalent notation to the bracketing used in previous discussions of semantic theory, as for example in the many examples of structured readings Katz gives in "Recent Issues in Semantic Theory". This correspondence of notations can be indicated by introducing the following convention for representing dependency structures: Markers  $(B_1), (B_2), \dots, (B_n)$  listed in a bracket are interpreted as being directly dependent on the marker immediately to the left of the bracket.

Thus  $(A) ((B_1), (B_2), \dots, (B_n))$  represents the tree



$(A), (B_1), \dots, (B_n)$  may each be either a primitive or a complex marker. Despite the simplicity, any relation can be indicated, but in both notations at the expense of putting the burden of representing the particular relation on the interpretation of the markers.

Since dependency trees and bracketing are equivalent notations for indicating that there is some direct relation of one marker to another, there is no theoretical issue here any more than there is an issue in the question of whether phrase structure in syntax is to be represented by trees or by bracketing. Thus we may use either dependency structures or bracketing as a means of representing the structure of a complex semantic marker like (physical object). However Bierwisch does create a theoretical issue by attempting to use dependency structures to eliminate selection restrictions from semantic theory. We shall now argue that this application of dependency structures has to be rejected.

## THE STATUS OF SELECTION RESTRICTIONS

On Katz's view, the analysis of the meaning of an expression must be broken down into two parts. The first gives the conceptual content or meaning content proper. A second list of markers, the selection restriction, gives the markers that a second expression must have in order to be amalgamated with the first.\* In Bierwisch's presentation, dependency structures seem to make this distinction unnecessary. A dependency structure is said to serve both these functions. The same structure which specifies the meaning content of an expression, R, restricts the range of readings with which amalgamation is possible to just those whose structures have a place where the structure R "fits in" in accord with a given list of dependency matching rules. For example, if the dependency structure (A)-(B) is part of the lexical entry for an adjective, then the semantic marker (B) acts as a selection restriction if the adjective modifies a noun with the semantic marker (C) which is antonymous to (B)\*\*; and (B) is injected into any dependency structure with which (A)-(B) is compatible (according to Bierwisch's dependency structure matching rules), for example (A)-(G)-(H).

There are several difficulties with this new device. It may be argued that the determination of conceptual content and restriction of combination of concepts are two clearly different characteristics of meaning. Semantic theory ought to make the distinction explicit. Thus we do not usually think it part of the conceptual content of the word "colorful" that it applies to

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\*For a full description of selection restrictions see, for example, Katz and Postal, An Integrated Theory of Linguistic Descriptions, p. 15.

\*\*This involves a dependency satisfaction rule which Bierwisch needs but does not state, to be discussed below.

physical objects but not, say, to emotions. It might be replied that the distinction can be called into question because many cases are not as clear as "colorful". For example, verticality of a principle axis is clearly part of the conceptual content of "high", and the amalgamation of "high" and "cigarette" is blocked just because the one principle axis of a cigarette is normally not vertical\*. The conclusion seems to be that amalgamation is blocked here precisely because the conceptual contents of the two words are incompatible. An impression of this sort seems to be one of Bierwisch's motivations for restructuring semantic theory.

Take another example: "elderly idea" is anomalous because "elderly" is used only of persons. But is it part of the conceptual content of "elderly" to be a person just as it is part of its conceptual content to be old? Or do the concepts of being a person and being old enter in different ways into the meaning of "elderly"? If our intuitions are not clear on this question we need some independent argument by which to choose between the two proposed methods of dealing with selection restriction. The following observations will provide such an argument and also will help to clarify what underlies the felt difference between selective and content determining aspects of meaning.

It will be seen that the dependency structure method loses the distinction between anomalous and contradictory phrases because in any adequate formulation of the method either contradictory phrases are classified as anomalous or anomalous phrases are classified as contradictory. For the dependency structure method to perform its desired function an additional rule, not stated by

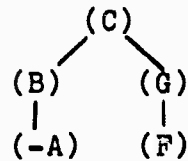
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\*The advocate of selection restrictions can retort that in this special case, some form of (vert) is used in the selection restriction and in the list of semantic markers. We will see below how this can be done.

Bierwisch, on the matching of dependency structures must be added:

Two dependency structures,  $D_1$  and  $D_2$  do not match if when  $D_1$  is mapped into  $D_2$  any branch has antonymous markers.

For example, let (+A) and (-A) be antonymous markers. Then (B)(+A) does not match either (B)(-A) or



If this rule is not included we could, for example, map (1 space)(+vert) onto any branch starting with (1 space)\* including the branch (1 space)(+main)(-vert) of "cigarette". This would make "high cigarette" contradictory instead of anomalous. The same goes for "long tower" and "long pole which is a high pole". On the other hand, if the rule is admitted in general form most, if not all phrases which should be marked as contradictory will turn out not to have readings and be marked anomalous.

We can show pretty clearly that the loss of contradictory readings (upon adoption of the new rule) results from the failure to employ some distinction tantamount to a distinction between selection restrictions and the semantic markers determining conceptual content of a reading. The intuitive distinction between a contradictory phrase (e.g. "female uncle") and an anomalous or meaningless phrase (e.g., "sleepy table") is that the first express incompatible conceptual components whereas the second does not express any concept at all. This distinction between contradiction and anomaly is to be reflected in the theory by amalgamating

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\*Presumably, (1 space) will never depend on (+vert).

antonymous markers in the one case and by blocking amalgamation in the other. But with the dependency structure mechanism, augmented by the rule I have described above, both cases are lumped together under anomaly; and contradictory expressions are not given readings.

This state of affairs is unacceptable. We must count as inadequate a semantic theory which cannot differentiate between contradictory and non-contradictory readings (in the present case because contradictory readings cannot arise). This distinction, which some may argue is unclear or unimportant, is not alone at stake; the analysis of analytic expressions (the denial of a contradiction) and, in turn, logical entailment is inseparably connected to the identification of contradictory readings (cf. Katz, Analyticity and Contradiction in Natural Languages).

Since semantic theory cannot dispense with the classification of contradictory readings, a proponent of the dependency structure method might make the move of rejecting my additional rule and arguing that phrases such as "high cigarette" and "long tower" are contradictory, as they would be marked by the original form of the dependency structure method, and not anomalous. After all, such a person might argue, by "something long" we understand something not vertical, so by "long tower" we understand something vertical and not vertical, i.e. a contradiction.

This argument, that "long tower" should be counted as contradictory, is not without force; but it shows too much. "Sleepy idea" can be shown to be contradictory in the same way. From the point of view of the selection restriction advocate, the fallacy in the foregoing argument probably is to be found in the statement, "by 'something long' we understand something not vertical." This is so, but only because the marker (-vert) is pulled out of the selection restriction of "long" by the action of the pro-form

"something" (For a description of this effect of pro-forms, see Katz and Postal, An Integrated Theory, on the definition of (selector), p. 83).

A more powerful heuristic argument a dependency structure advocate could use might go like this: "Long" is predicable of the sorts of things of which a tower is an example (shaped, physical objects), so "long" is meaningfully predicable of "tower". In terms of selection restrictions the selection restriction of "long" will be  $\langle(\text{physical object}) \wedge (\text{shaped})\rangle$ . But "sleepy" is not predicable of the sorts of things of which an idea is an example. Again in terms of selection restriction, the selection restriction of "sleepy" will be something like  $\langle(\text{animal}) \wedge \dots\rangle$ , and (animal) will not be found among the semantic markers of "idea". Since predications like "long tower" are meaningful but somehow wrong or vacuous, they are best counted as contradictory.

Though seductive, this argument is not conclusive, for although "long" is meaningfully predicable of most shaped, physical objects it does not follow that it is meaningfully predicable of all. In terms of selection restrictions, the characterization of the selection restriction of "long" as  $\langle(\text{physical object}) (\text{shaped})\rangle$  is incomplete. How the selection restriction must be extended will be discussed shortly.

There are powerful positive arguments for rejecting the attempt to save the dependency structure by allowing phrases such as "long tower" to be marked as contradictory instead of anomalous. For example, in such a theory, without my added rule, "This box is long, wide, and high." would have a (contradictory) reading in which "long", "high", and "wide" would all characterize the same dimension. In fact, ignoring any ambiguity of the words involved, this expression would have no less than five readings,

four of which (those for which two of the adjective characterize a single branch) would be contradictory. This conflicts with our intuition that the sentence has a single reading, that is, that it has a single unambiguous and non-contradictory sense (again, if we discount ambiguity of the individual words). When we also take into account the ambiguity of constituent sub-expressions of a sentence the classification of anomalous expressions as contradictory becomes still more objectionable. In most examples of sentences containing several ambiguous words, there are far fewer possible interpretations of the sentence than the number of readings that would arise if we were to permit the amalgamation of each reading of each ambiguous word with the remaining constituents of the sentence. For example, "deposit" as a verb is at least three ways ambiguous; "check" as a noun is at least eleven ways ambiguous; and "bank" as a noun, is at least six ways ambiguous. If some amalgamations are not prevented, we would have at least 198 readings for "He deposited the check in the bank". In fact, this sentence has far fewer possible interpretations (though more than one would guess at first glance). To give a sample of readings which are excluded, we can interpret "deposit" as giving something as security or in partial payment, "bank" as a pile or slope, and "check" as any one of its eleven (or more) readings.

By way of contrast, we should compare the above example with a sentence which has more than one sense at least one of which is contradictory. Such a case can be found in the sentence "Some bachelors are female." Here there is a sense in which femaleness is predicated of unmarried adult males. But another of its senses expresses the trivial truth that there are some ex-coeds. When we compare the ambiguity in such an example with the purported ambiguity of the previous example it becomes immediately

clear that what would be taken as contradictory senses in Bierwisch's theory are not senses of the sentence at all. To take them as genuine senses would make the extraordinary claim that the sentence given in the previous example would be marked as 198 ways ambiguous.

We have to conclude that a semantic theory must retain the concept of anomalous expressions, expressions for which the amalgamation of readings of constituent expressions is blocked. Of course, the concept of anomaly is not entirely given up in the theory as presented by Bierwisch; many amalgamations may still be blocked by the dependency matching rules which are given in his paper. However, we have seen that the rules he states are inadequate for the examples he considers, and there is no a priori reason to suppose that other kinds of examples (such as the analysis of a full sentence like "He deposited the check in the bank.") can be handled in a natural and non ad hoc manner in his system.

So far we have seen that semantic theory is inadequate if selection restrictions are rejected, whether or not one includes the additional rule which is required to make dependency structures operate as Bierwisch intended. If the rule is included, contradictory readings cannot arise, with the result that the analysis of contradiction, analyticity, and entailment is no longer possible. If we omit the rule, many, perhaps all amalgamations which should be blocked are permitted by the theory, giving an inadequate analysis of anomaly and ambiguity. These difficulties make the old concept of selection restriction very desirable; but we cannot clearly opt for it without showing that the special problems of selection arising from spatial adjectives, for which the dependency structure mechanism was designed, can be handled as well by selection restrictions.

An immediate problem is to deal with the function of (+vert) in "high". (+vert) must appear in the list of semantic markers which characterize the conceptual content of "high" because "pole" is not marked (+vert) but "high pole" is. Furthermore, ( $\bar{+}$ vert) must somehow be used in the selection restriction of "high" so that "high cigarette" is marked as anomalous and "high tower" is given a reading. However, we cannot simply list (+vert) in the selection restriction for then "high pole" would not receive its desired reading. Listing (-vert) is clearly no help either. The desired restriction is that (+vert) be present in the modified word, as in the case of "tower", or that neither (+vert) nor (-vert) be present, as in "pole". That is, the condition of amalgamation has to be that (-vert) not be among the semantic markers of the word modified. We may mark this by writing ( $\overline{-vert}$ ) in the selection restriction of "high"\*. In general, if (A) is a semantic marker, ( $\overline{A}$ ) can appear in a selection restriction and will be read, "not A". It is interpreted by blocking amalgamation of a phrases  $P_1$  having selection restriction  $\langle \dots \overline{(A)} \dots \rangle$  only if (A) does appear among the semantic markers of the phrase  $P_2$  with which  $P_1$  is to be amalgamated.\*\*

Although not common, one can find other examples of this form of selection restriction. Consider:

sincere behavior  
sincere statement  
\*sincere twitch

An action which, by virtue of the meaning of its name, is not intentional cannot be characterized as sincere, as in the example of "sincere twitch". Thus we must put something in the selection restriction of "sincere" to block amalgamation of "sincere" with

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\*Of course this is a partial description of the selection restriction. More will be filled in later.

\*\*This construction has already been described by Katz in The Philosophy of Language. p. 160.

words which have the semantic marker (-intentional). But this could not be accomplished by putting the marker (+intentional) in the selection restriction of "sincere", for then "sincere behavior" would be anomalous. So the selection restriction of "sincere" must be of the form  $\langle \dots \overline{(-intentional)} \dots \rangle$ . In addition, "sincere" must have (+intentional) in its list of semantic markers because behavior is not always intentional, but sincere behavior, by virtue of the meaning of the word, is. The situation is completely analogous to that of "high" and ( $\pm$ vert).

It must be admitted that the function of markers of the form  $\overline{(K)}$  in a selection restriction only redoes what dependency structures did in a more elegant way. In a dependency structure, one listing of (K) had the effect both of (K) on the list of semantic markers determining conceptual content, and also as  $\overline{(A/(K))}$  in the selection restriction, where  $A/(-)$  is the antonymy operator which picks out the markers antonymous to the marker entered as the argument in  $(-)$  (See Katz, Philosophy of Language, p. 199). This is because the presence of (K) in a dependency structure blocks amalgamation only if (K'), antonymous with (K), is present in a second dependency structure to be amalgamated. It is regrettable that the dependency structure method runs into so many difficulties; in any case, the attempt to use it has brought to light evidence for the need to employ markers of the form  $\overline{(K)}$  in selection restrictions.

We have been considering the question whether the selective function of dependency structures can be accomplished using the old form of selection restrictions. One special construction for selection restrictions has been seen to be necessary for this task. A second problem requires a more radical solution. As used up to this time, selection restrictions effect the process of amalgamation only by giving conditions, in terms of the presence or absence of individual markers, under which amalgamation may take place.

However, there is also a question of the placement of a marker when amalgamation occurs; when an object such as a car or pole is characterized as high, a (+pol) marker and in some cases (e.g. for "pole") a (+vert) marker must be injected into a dependency structure below the most superficial level. For example, suppose we need to represent amalgamation of the marker (W) with the complex marker

$$R \stackrel{\text{def}}{=} ( (A)( (B), (C) ) )$$

to get

$$( (A)( (B), (C), (W) ) )$$

The only way suggested by Katz to determine the point within the structure of a marker at which another marker or set of markers should be embedded by the operation of projection rules is to permanently mark R with a categorized variable, V, at the place where (W) may be injected and to add a projection rule which substitutes (W) just in case (W) is the reading of a constituent that bears the grammatical relation in terms of which V is categorized. (See Katz on injection of readings for subject and objects into the reading for a verb - Philosophy of Language, p. 170 and on the readings of relative size adjectives in "Recent Issues..", p. 186-7.) But such an analysis enormously complicates the readings which are in question. Consider the reading for "pole": the (+max) dimension of "pole" can be characterized as (+pol), (-pol), (+vert), and (-vert). The other two dimensions can also be characterized together as (+pol) and (-pol). This already requires six categorized variables and the final number is likely to be much larger when other conditions, not yet studied, are taken into account (e.g. "slanted pole"). For each of these categorized variables there must be a special substitution convention. Perhaps the number of variables could be reduced by using one variable for ( $\pm$  vert) and one for ( $\pm$ pole), however the total is still at least three and the corresponding substitution conventions would be a

little more complex. In the case of other objects (e.g. box) variables would have to be included on every branch for (+max) and possibly for other markers.

This displeasing complexity leads one to suspect that some simplifying regularity is being missed. If some method could be found to characterize in terms of other parts of the reading in a simple and uniform way the place where markers such as ( $\pm$ vert) and ( $\pm$ pol) are to be inserted the categorized variables would be evidently superfluous. This was just the effect of Bierwisch's dependency structure method. The location for insertion of a marker (W) was identified by the matching of the structure of the reading,  $R_1$ , into which (W) is to be inserted and the reading,  $R_2$ , of which (W) is a part. The dependency structure method wonderfully simplifies the problem of amalgamation of structured readings, but fails to make the necessary distinction between selective restriction and conceptual content components of meaning. The selection restriction method performs this second task but fails to give a pleasing solution to the first problem.

A solution to this impasse can be found by examining a little more carefully the current status of selection restrictions. In the original presentation of the concept (cf. Katz and Fodor) the only kind of reading described consisted of an unstructured list of semantic markers and a selection restriction which gave a boolean condition stating which markers had to be in the unstructured list of markers of a second reading in order for amalgamation of the two readings to take place. But now, the conceptual content of a reading is no longer given by an unstructured list, but by a dependency structure. Consequently, it is no longer possible to describe the restrictions on the amalgamation of readings by simply stating in the selection restriction what markers must be present or absent in a second reading to be amalgamated; for the second reading will (in general) not have an unordered set of markers, but a collection of markers

tied together in some specific structure. For the moment, let us take "high" as a paradigm; when discussing the selection restriction of "high" earlier, we concluded that the required condition on the modified head, R, with which "high" is to be amalgamated is that R should not have the marker (-vert).<sup>\*</sup> But this is insufficient; the requirement cannot be that (-vert) not appear anywhere in the structure. (-vert) might be used in some way irrelevant to the application of "high", as for example, in describing the orientation of an axis instead of its length (see the section below on "put" "lay" and "stand"). Rather we must require that (-vert) not appear in some specific place in the structure of R. Examining cases such as "high cigarette" and "high floor" one can see that it is only the axes of R which must not be characterized as (-vert). Furthermore, "high" cannot be amalgamated with R unless R is characterized as having at least one axis. Lastly, only a (+main) axis can be characterized by "high". A high pole is one whose (+main) axis is of great extreme, not one which is oriented horizontally and is very thick. The full requirement is now that R have an axis marked (+main) and that at least one such axis not be also characterized as (-vert) if "high" is to apply. These facts can be represented in the theory by giving the selection restriction of "high" as

<(1 space) (+main) (-vert)>

and interpreting it as requiring R to have a sub-structure which agrees with(that is to say, exactly matches) the structure given in the selection restriction. Generalizing from this example suggests that selection restrictions should be interpreted as giving a restriction on the structure of a reading R to be

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<sup>\*</sup>To simplify the analysis, we will restrict R to be a noun naming a rigid physical object.

amalgamated by listing a dependency sub-tree which must exactly match a sub-tree of R. The new matching rule should be identical to that of Bierwisch (statement (37) p. 27) with the last clause, "in case  $Z_i$  and  $Z_j$  are in T" left out. The effect of this change is to require all the elements of a dependency structure to appear in a sub-tree which it exactly matches.

However, we have still not fully described the processes of amalgamation of two dependency structure readings, P and R. We have seen that P will have the form  $M \langle SR \rangle$ , where M, the conceptual content, and SR, the selection restriction, are both dependency structures; amalgamation takes place on the condition that SR exactly matches a sub-tree of R. But where in the structure of R will M be inserted? It cannot, in general, be just anywhere, or at the most superficial level; in the case of the reading of "high" M will be  $(+pol)(+vert)$ , which must be inserted on a  $(1 \text{ space})(+main)$  branch which is not also marked with  $(-vert)$ . But now we note that, at least in the case of "high", the place of insertion of M can be easily characterized in terms of the selection restriction  $\langle (1 \text{ space})(+main)(\overline{-vert}) \rangle$ .  $(+pol)(+vert)$  must be inserted on just the sort of branch characterized by the selection restriction of "high". This can be indicated by writing the selection restriction as

$$\langle (1 \text{ space})(+main)(\overline{-vert}) * \rangle$$

where \* is a dummy marker indicating the point of insertion in a structure.

The full interpretation of a selection restriction can now be given as:

- 1) a reading  $M \langle SR_1 \rangle$  is amalgamated with a reading  $R \langle SR_2 \rangle$  just in case  $SR_1$  matches a sub-tree of R. Of course, in determining the matching, the dummy marker \* is treated as null.
- 2) In case there is such a match, M is inserted into R at the place indicated by the dummy marker \* in  $SR_1$ .

We may hope that selection restrictions can be given purely on the basis of describing the restrictions on amalgamating readings. When this is possible (as in the one example given so far) the information describing the place of insertion comes essentially free, requiring only the placement of the one dummy symbol \* at one place in the selection restriction, and removing the necessity of weighting down the semantic description with a multitude of categorized variables and special insertion rules.

It is important to note that my proposal is really little more than Bierwisch's dependency rule reinterpreted to preserve the distinction between selection restrictions and conceptual content. A dependency rule (p. 27-28) had the form  $M[D]$ , where  $M$ , the modification and  $D$ , the domain, are dependency structures and  $D$  contains in its structure the dummy element, \*. Amalgamation with a structure  $R$  is effected when  $D$  matches a sub-structure of  $R$  and  $M$  is inserted at the location in that structure marked by \*. But the machinery I have presented is the same as Bierwisch's, after  $D$  has been reinterpreted as the selection restriction and the necessary adjustments have been made to accommodate such a reinterpretation.

So far I have illustrated the proposal with only one example. And likely enough it will turn out that the necessary structural information will not always be available in the selection restriction, viewing the selection restriction, as before, as a device for determining the compatibility of readings. The insertion of subject and object readings into the reading of a verb will clearly need dummy variables in the verb's reading. But, as Katz has observed (in conversation) the need of a special projection rule for each of these dummy variables can be eliminated by a single general projection rule for all categorized variables which says that a reading of a constituent is substituted for a categorized variable  $V^G$  just in case the constituent bears the grammatical relation  $G$  to the constituent in whose reading  $V^G$  occurs.

Having two types of machinery for locating one reading within another, the question naturally arises what considerations are involved in the choice to use one of these types of machinery rather than the other in the treatment of a given case. We can make a suggestion as to what some of these considerations are. The use of categorized variables has the advantage of locating the position in the reading in which another will be embedded. The advantage of having such a position marker is clear in the following kinds of cases: First, where the reading contains two or more embedding positions and where the readings to be embedded in one or another of these positions can have the same selection restriction. Second, categorized variables are needed where the reading into which another reading is embedded contributes semantic markers to the reading embedded in it. An example of this situation can be found in Katz's treatment of "chase" in The Philosophy of Language, p. 167. On this analysis the reading for the subject in the expression "X chases Y" is modified by the meaning of the verb, "chase", to indicate that X is moving at a fast rate. And third, categorized variables are needed where there is a selection restriction in a reading governing the readings which may be embedded in it and where the absence of a reading to embed requires that the unfilled position be filled with the selection restriction on that position. For example "Mary bought a book from X" is anomalous when the reading substituted for X does not fall into the category of persons or social organizations. So the categorized variable marking the place of insertion of the indirect object must be governed with a selection restriction of the form  $\langle(\text{human})\vee(\text{organization})\rangle$ . At the same time when the indirect object is omitted, as in "Mary bought a book." it is understood that the agent bought the book from a person or organization. This fact can now be represented by stipulating that when a categorized variable has not been replaced

by a reading, when all amalgamations have been completed, the reading (or readings) in the selection restriction replace the categorized variable. It is easy to find any number of examples showing the need of this stipulation\*.

It is also quite likely that the treatment of adjectives such as "big" and "old" as relative to the lowest semantic category of the modified head (cf. Katz, "Recent Issues" pp. 186-8) will require categorized variables and corresponding special rules. But we may hope that in most other instances of the modifier - head relation the information which must be in the selection restriction to determine compatibility of readings will also suffice to characterize the place of insertion of one reading into another. This can be illustrated by examples which have already been discussed in the literature.

(1) Perhaps the simplest case is that of a modifier and head which are each described by an unordered set of semantic markers, along the lines of the original Katz and Fodor presentation (cf. Katz and Fodor, "Structure of a Semantic Theory"). The two readings are amalgamated by simply taking the union of the two sets of markers; and such an amalgamation takes place just in case for each reading we have satisfaction of the selection restriction which specifies the markers the other readings must have. This can be taken to be the degenerate case of the system now being proposed, with both dependency structures in a reading being degenerate. The reading for the modifier would have the form  $(X)\langle((D_1), (D_2), \dots, (D_n)), * \rangle$  where  $X$  is the list of semantic markers to be amalgamated and  $(D_1), \dots, (D_n)$  are the semantic markers which must be in the reading of the head. Other boolean combinations of markers in the selection restriction are permitted. In

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\*Details of this analysis are to appear in Katz's work on states and processes, now in progress.

the same way as the former kind of selection restriction used boolean combinations of markers, with the present concept of selection restrictions we may allow boolean combinations of dependency structures. Thus  $(X) \langle (D_1) \vee (D_2), * \rangle$  has the same force as the disjunction of readings:  $(X) \langle (D_1), * \rangle$  or  $(X) \langle (D_2), * \rangle$ .

(2) Since the present interpretation of selection restrictions is a direct reinterpretation of Bierwisch's system, his examples with spatial adjectives carry over immediately. The example of "high" already described can be summarized in the reading  $(+pol)(+vert) \langle (1 \text{ space})(+main)(-vert)* \rangle$ . "Big" characterizes any set of (+main) dimensions and otherwise is not applicable. So the selection restriction must have the form  $\langle (n \text{ space})(+main) \rangle$ . The whole reading can be given as  $(+pol) \langle (n \text{ space})(+main)* \rangle$ . The other examples of spatial adjectives follow similarly.

(3) As a final example, consider the immediate simplification which the system being proposed effects in Katz's analysis of "good" (see Philosophy of Language, pp. 289-302). The reading suggested for "good" is  $(+) \langle (Eval_x( )) \rangle$ . When  $(+) \langle (Eval_x( )) \rangle$  is amalgamated with a reading  $(M_1) \dots (Eval_x(Y)) \dots (M_1) \langle SR \rangle$ , a special rule moves the (+) in the derived reading

$$(M_1) \dots (Eval_x(Y)) \dots (M_1), (+) \langle SR \rangle$$

to the evaluation marker, giving the final form as

$$(M_1) \dots ((+) Eval_x(Y)) \dots (M_1) \langle SR \rangle$$

However, if selection restrictions are being used to indicate the place of insertion we can give the definition of "good" as

$$(+) \langle *(Eval_x( )) \rangle.$$

The (+) will then be inserted at the right place on the basis of the single generally applicable projection rule, without any special rule for the definition in question.

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\*The problem being discussed here - at what place in the reading of the head the reading for the modifier, "big", should go - must not be confused with the separate problem of how the reading of "big" itself should be modified to relativize it to the lowest semantic category of the reading of a head. This is the problem mentioned by Bierwisch on page 10, to which Katz proposes a solution in "Recent Issues", pp. 186-8.

## PART II

In this part of the present paper I will attempt to extend Bierwisch's application of the semantic markers which he introduced in analyzing spatial adjectives.

## "ROOM", "BOARD", AND "LONG"

The words "room", "board", and "long" bring out some problems in the use of the markers (+max) and (-max). Bierwisch suggests (in effect) that the conceptual content of "long" be characterized with (+max) and the selection restriction with (-max). The first statement cannot be correct because it is perfectly proper and not contradictory to say of certain rooms that, "This room is wider than it is long," particularly if the room has an orientation, either inherently or with respect to observers. (e.g., a lecture hall or auditorium). But for many words, such as "board", the dimension characterized by "long" cannot be less than the one characterized by "wide". These facts can all be captured by putting (-second) in the selection restriction of "long" and characterizing the two main dimensions of "board", one with (+second) and the other with (-second)(not(-max)), where (not(-max)) is to be interpreted as characterizing the dimension as not less than any other.\* We need (not(-max)) instead of (+max) to be able to treat square boards. The word "rectangle" is treated in the same manner. By way of contrast, "knife", "road", and "oblong" will have their (+main) dimensions characterized by (+second) and (-second) (+max) respectively, since, for each of these words, the dimension characterized by long must be greater than the other (+main) dimension.

\*(not (-max)) must be considered as a different marker from (-max). If (-max) appeared outside a selection restriction, any (-max) inside a selection restriction would have the function of requiring (-max) to be present in a reading, instead of requiring (-max) not to be present in the reading.

"Board", "road", "knife", "oblong", and "auditorium" should all have their (-second) dimension characterized as (+inherent) since the fact that this dimension is characterized by long is not a context dependent property of these objects. "Room" is problematic in this respect, for sometimes which dimension is characterized by "long" depends on orientation with respect to observers, but sometimes the choice depends on inherent properties of the room, as when the room is a classroom or when observer orientation is not relevant (e.g., no one is in the room and the room has a maximal, nonvertical dimension). Perhaps this ambiguity can be captured by simply not marking the (-second) dimension of "room" with either (+observer) or (+inherent) or any complex marker built up from these two.

#### ORIENTATION OF POLARITIES

Bierwisch introduces a notion of orientation of antonymous pairs of adjectives, such as fast/slow or long/short, by noting that only the first members can be combined with phrases such as "twice as" or "half as". He takes as examples

twice as fast  
 \*half as slow  
 twice as long  
 \*half as short

Furthermore, this same polarity corresponds to the applicability of measure phrases. For example:

two feet long  
 \*two feet short

However, as Bierwisch himself notes, we do say "a thread twice as thin as a hair." What then is the relation of the phrases "twice as" and "half as" to such antonymous pairs of adjectives?

We seem to use "twice as thin" or "half as thin" when we are concerned with objects which are thin compared to the average of objects in their class. If this is the case we should

use "twice (half) as thick" for comparatively thick items; and surely, if we are comparing two big, thick boards we say, "This one is twice as thick as that one." in preference to "That one is half as thin as this one."

If this regularity for "thick" and "thin" is a real one, it would be surprising if the same did not hold for other adjectives of measurement. Indeed, we do use "half (twice) as slow" if we are talking about things which move very slowly, such as turtles, snails (which are slow for animals), or cars in a traffic jam (which are slow for cars). We can say that one newborn infant is twice as young as another. And it is, at least linguistically, perfectly appropriate to describe Jane's mini-skirt as twice as short as Mary's.

An alternative way of looking at the phenomena which Bierwisch points out in this connection is to say that expressions like "My car is twice as slow as your car" are not semantically anomalous; and in fact, "My car is twice as slow as your car" is synonymous with "My car is half as fast as your car." Rather, the oddity in the cases Bierwisch describes as anomalous might result from use of an expression when the quality or attribute which has been adopted as the subject of conversation is named by an expression antonymous to the one being used. This would be to treat the difference between cases in which cars are described as twice as slow or fast as other cars as the same type of difference that can be found in connection with the words "sweat" and "perspire" which are synonymous in the grammar but where the former is said of men and the latter of women.

Bierwisch asserts that measure phrases, such as "10 feet" and "4 yards", always take the member of an antonymous pair

characterized by the (+pol) marker. Thus:

10 feet long  
 \*10 feet short  
 4 years old  
 \*4 years young

But this is only the case for adjective pairs which determine a scale of measurement which admits of only positive measure from a zero point. For any adjective pair which determines a scale which admits of positive or negative measure from a zero point, the applicability of measure phrases is symmetric.

Thus:

4 hours early  
 4 hours late\*

#### "PUT", "PLACE", "SET", "LAY", AND "STAND"

I will use some of Bierwisch's markers in a sample investigation of several verbs having to do with the positioning of physical objects. I will not attempt full analysis of the verbs, but only treat questions relating to orientation. It is to be understood that the analyses are intended to hold only for literal applications to physical objects and do not always hold for derivative applications, for example to abstract objects, as in, "I put the question to him." or in "His interests were put before mine."

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\*Also

4 feet advanced  
 4 feet regressed  
 elevated 4 feet  
 depressed 4 feet  
 4 feet ahead/behind  
 4 feet above/below.

Since these phrases arise from structures quite different from the adjectives under consideration it is not clear to me whether or not they are real examples of the sort of scale with positive and negative measurement which the pair early/late exhibits.

In studying these verbs I have used the following heuristic tool: use the verb in a command, and then ask yourself what position of the object must result for the command to be correctly executed. Thus, a correct response to "Lay the book on the table" is to position the book with one of its covers on the table; any other positioning is a failure to execute the command. It is such a resultant position required by the meaning of the verb and exhibited by my tool that I wish to characterize in the analysis of these verbs.

This characterization will be accomplished by taking the reading for the object of the verb and adding semantic markers which describe the required position of the object. The reading thus derived describes (one element of) the terminal state of the process into which the verb is analysed. More formally, the terminal state in the analysis of the verb is (partially) characterized by the complex marker

$$( (Q(a))\langle SR \rangle (X_0))$$

where  $X_0$  is the categorized variable for the object, (a) is a semantic marker and  $(Q(a))$  is to be amalgamated by the usual rules with the reading put in for  $X_0$ , according to the selection restriction  $\langle SR \rangle$ . The reason for using the complex semantic marker  $(Q(a))$  instead of simply (a) is as follows. Certain axes of an object (say, that axis of a bottle which is normally vertical) will be characterized as having a certain orientation in the terminal state (e.g., horizontal, as in "Lay the bottle on the table."). Thus the (+vert) axis of the reading for "bottle" must be characterized, in the resultant reading, as having the orientation (-vert). But we cannot represent this by simply amalgamating (-vert) with (+vert), which would result in an unwanted contradictory reading. Rather, we must separate the markers indicating the relevant axis of the object and the characterization of the orientation of that axis. This separation

is accomplished by embedding, not (-vert), but (Q(-vert)) where Q can be thought of standing for "orientation."

Now, let us apply these devices to several verbs. "Put", I claim, is completely neutral with respect to resultant orientation. Consider

Put the knife  
 bottle  
 book  
 tablecloth  
 card  
 match box  
 coffin  
 pot  
 etc... on the table.

To position any of these objects in any orientation on the table is to correctly carry out the command. "Place" and "set" seem to me to be completely synonymous with "put" in this respect. This neutrality of final position can be indicated by simply omitting the marker

$$( ( (Q(a)) \langle (SR) \rangle ) (X_0) ).$$

Next consider "lay". The examples, except possibly for "match box" and "coffin", seem to indicate that the terminal position of the object must be one such that as many main dimensions as possible are horizontal. Thus "Lay the book..." shows that reference to a vertical dimension will not work and that sometimes we must require two main dimensions to be horizontal; for to position the book on its binding is not to carry out the command. In some cases we can only restrict one main dimension, since the object may have only one, as for "thread" and "bottle". The marker, as so far described, would look like this:

$$( ( (Q(-vert)), \langle ((n \leq 2 \text{ space}) (+main)*) \rangle ) (X_0) )$$

The marker (( n  $\leq$  2 space) (+main)) picks out an (n space) branch marked (+main) with n as large as possible  $\leq$  2. (A marker, (n space), (without the restriction  $\leq$  2) with the same convection is

already independently needed to handle "big" and "thick", as described by Bierwisch, p. 30.)

But "coffin" and "match box" seem to show this analysis insufficient; for all three of their axes are (+main), but to stand a coffin or match box on end is not to follow the command, "Lay the match box/coffin on the table." There seems to be the further requirement that a maximal dimension, if one occurs, must be positioned horizontally. We are faced with the further complication that match boxes and coffins do not have a maximal dimension by virtue of the meaning of the words. Consider, for example, a coffin shaped to hold the bodies of a man and wife; the container might well be of equal length and width. But, I claim, this complication is apparently only; the presence of a marker (+max) if in these expressions at all, arises by injection from contextual information as can be seen by considering what we would say or do in response to these commands if we imagine we had no idea from empirical information of how these objects are usually shaped.

This observation does not eliminate the problem of how to handle a (+max) marker when it does occur, for example, when its presence is made explicit in the linguistic context. Consider,

Lay the box which is three feet by one foot by one foot on the table.

To stand such a box on end is not to carry out the order. Furthermore, uses of "lay" in statements result in final readings in which the object either is characterized as having a maximal dimension positioned horizontally, or, more likely, is characterized as not having a maximal dimension positioned vertically. Thus, it follows logically from "John layed my box on the table.", that my box did not have a maximal dimension positioned vertically.

The requirements for orientation in the terminal state of "lay" can now be summed up as follows: If the object has one main dimension, it must be characterized as horizontal. If the

object has two or three main dimensions, two of these must be characterized as horizontal. If, in addition, one of the main dimensions is characterized as (+max), this dimension must be among those characterized as horizontal.\* This set of conditions can be represented in the selection restriction by a somewhat messy but straightforward Boolean combination. Let the complex marker  $(A \Rightarrow B)$  be defined by  $(\bar{A} \vee B)$ , for semantic markers A and B. Then the terminal condition is represent by

$$( (Q(-vert)) \langle ( (+max) \Rightarrow (n \leq 2 \text{ space})(+main)^*) \vee$$

$$( (+max) \Rightarrow (n \leq 2 \text{ space})(+main)^* (+max) ) \rangle (X_0))$$

The verb "stand" (as in "Stand the lamp in the corner."), appears to me to be entirely complementary to "lay" with respect to terminal orientation. If one stands something one orients it so that (i) a main dimension is oriented vertically. This covers cases such as "Stand the book on the table.", where there is no (+max) marker. And (ii), if an axis is marked (+max), it must be the one oriented vertically.\* Thus, "Stand the oblong shaped box on the table." is not carried out unless its maximal dimension is oriented vertically. The same sort of Boolean combination can represent this pair of conditions:

$$( (Q(+vert)) \langle ( (+max) \Rightarrow (1 \text{ space})(+main)^*) \vee$$

$$( (+max) \Rightarrow (1 \text{ space})(+main)^*(+max)) \rangle (X_0))$$

"HIGH", "TALL", AND "LOFTY"

I have not solved the problem of distinguishing between "high" and "tall", but my efforts have brought out several observations which may be worth noting.

\*It is very likely that, as a universal generalization, no (-main) dimension will be characterized as (+max). So we need not worry about this combination.

There seems to be a real temptation to try to get around the problem by the following argument: "High", it will be said, is not an adjective of extension like "long" and "wide", but of position, like "distant". Thus, when we characterize something as high, it is claimed that we are really saying that its top is at a high location.

This line of attack can be countered by showing that the use of "high" is ambiguous. It is important to become clearly aware of the two readings since confusing them leads to mistakes in all quarters.

The ambiguity is clearly exhibited in the following examples:

- (a) The cavern
- (b) room
- (c) table is high.

(a) can be true because the cavern is 100 feet from bottom to top or because, as a whole, it is located at elevation 10,000 feet in the Rocky Mountains. (b) can be true because the room is 15 feet from floor to ceiling or because it is located on the thirtieth floor of the Empire State Building. (c) can be true because the table has legs five feet in height or because it stands on a platform above the head of the speaker. The argument derives whatever plausibility it has by ignoring this ambiguity. On one reading, "high" is clearly analagous to "long" and not to "distant", and it is this reading which we would like to be able to distinguish from the reading for "tall".

As for attempts to separate "high" and "tall" semantically, several dictionaries suggest that things tend to be characterized as tall when they are thought of as growing or having grown, or when they are small in diameter compared to their height.

Thus:

tall man  
tree  
building  
grass

high mountain  
plateau  
curtain  
door

But there are counter examples:

*tall spire	high spire
geyser	geyser.

The words "post", "pole", and "tower" seem to me to provide clear counter examples, though people's intuitions for these words seem to vary a great deal. Particularly interesting is "tall growth" and "high growth", both of which seem to be correct, as in "His back yard is covered with a high/tall growth of weeds."

There are, however, some clear generalizations which seem to hold for "lofty" relative to "high." "Lofty" has the same ambiguity as "high." ("Lofty mountain," "eagle's lofty perch"). "Lofty", in its literal sense, means the same as high, except for indicating a more extreme degree.

"Lofty" sorts with "high", with one exception: "lofty is not used to characterize interior dimensions of an object. Thus,

lofty room  
cavern  
chamber,

unambiguously means one located, as a whole, at a great height and cannot mean "very high," where "high" has the reading analogous to "long" and "wide". This contrast with "high" can be easily marked by adding to the selection restriction of "high" the complex marker ( $\overline{+int}$ ) where (+int) is the marker suggested by Bierwisch in his attempt to analyze the meaning of "deep", as in "deep cabinet", by marking the notion of an interior dimension.\*

#### "WIDE" AND "BROAD"

"Wide" and "broad" seem to be interchangeable with two exceptions:

Only "wide" is used to characterize interior dimensions.

\*Bierwisch's notation corresponding to my (+int) is (-plain).

Thus:

wide tunnel  
room  
doorway

\*broad tunnel  
room  
doorway.

We immediately have another use of ( $\overline{+int}$ ). Just as with "high" and "lofty" the reading of "broad" will differ from that of "wide" by the presence of the marker ( $\overline{+int}$ ) in the selection restriction of "broad".

The second generalization is that "broad" never takes a measured phrase:

\*two inches broad.

I have not been able to formalize this regularity in a non-ad hoc manner, though the analogy with "lofty" is suggestive, for "lofty" also does not take a measure phrase. One is tempted by the following speculation: there may be some connection between the fact that the concepts corresponding to "broad" and "lofty" are incompatible with interior dimensions, and the conceptualization of measurement of an object's dimensions as being between or bounded by its sides or ends.

There is also the possibility that "broad" and "lofty" will be prevented from combining with measure phrases on syntactic grounds. The problem is probably best treated in the broader context of questions about measure phrases which must deal with anomalies such as

\*three pounds long  
\*two feet fast/early.

#### "BIG" AND "LARGE"

A simple case! These appear to me to be clearly synonymous; one dictionary suggests there is a difference in extremes indicated; but at best this is a stylistic variation, for consider,

I looked for something big, but found something large.  
I looked for something large, but found something big.

These seem to me to be clearly on the same footing and clearly contradictory. [For a description of the "but" test for the comparison of two phrases see Katz, "Some Remarks on Quine on Analyticity", pp. 47-50].

Another suggestion is that "little" indicates absolute size while "small" indicates size relative to the class in which the object falls. But again, the difference appears to be, at best, stylistic or connotational. For all examples of the following sort are contradictory.

I looked for a small orange but found a little orange.  
I looked for a little orange but found a small orange.

#### "TOP", "FRONT", AND "SIDE"

I will present an analysis of the meaning of the words "top", "bottom", "front", "back" and "side", taken as nouns. The concepts developed will then provide an analysis of the adjectival use of these words and will have an immediate application in describing the semantics of certain locative prepositions, such as "over", "under", "behind", etc.

Katz, Bierwisch, and others have defined nouns by specifying a defining property,  $P(Y)$ . Thus bachelor is defined by the composite property (male) (unmarried), etc. However, there is no defining concept or property "topness" independent of some physical object or spatial figure of which something is the top. Reference to "the top" must always be to the top of something. Thus, the concept required is really a relation,  $R(Y,X)$ , "Y is the top of X". The property "topness" can then be defined as  $(EX) (X \text{ is a physical object or spatial figure and } R(Y,X))$ . Since an object or figure generally has only one top, R can be thought of as a function which takes as its argument the concept of a given figure or physical object, and which then singles out the part of the object or figure which forms its top.

Consequently, in describing the defining property of "top" I will explicitly show the argument of this function. The same remarks hold for "bottom", "front", and "back". "Side" is a relation of the same sort, but is not a function since generally a thing may have more than one side.

Initially, let us restrict ourselves to "top". The top of something can be a surface (as for the top of a piano), a line or edge (the top of the windowpane), an upper portion of a vertically-oriented surface (e. g. "the figure in the top of the picture"), or a point, or upper segment of a vertically oriented line or thin object (the top of the flag pole). Common to all these cases is the concept of a part, or sub-figure, Y, of a figure, X, where Y is an extremal portion of X. Y is unspecified by the concept as to shape or dimensionality; it may be either the extreme limit of X (such as the point which forms the very top of a flag pole) or may be a more substantial portion of X (such as the uppermost two feet of a 50 foot flag pole). I will represent this concept by introducing the marker (ex prt (X)) (read "extremal part of X") as the first marker used in characterizing the meaning of "top".\* The marker (ex prt (X)) singles out a part or sub-figure of X which is then to be further characterized by other properties.

The top of an object is characterized by the object's vertical axis. Roughly speaking, the top lies in the plane which is perpendicular to the object's vertical axis. We will use (+vert) to represent this further characterization of (ex prt (X)) by letting (+vert) depend on (ex prt (X)), thereby indicating that

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\*The ambiguity illustrated in the flag pole example might be eliminated by specifying whether Y has dimensionality equal to or less than the dimensionality of X. But for the present analysis I will lay this refinement aside.

(+vert) further characterizes (ex prt (X)). In this way, we derive the complex marker ((ex prt (X))(+vert)). We could, of course, spell out in more detail in the representation the way (+vert) characterizes (ex prt (X)); but I shall simply take it to be part of the intended interpretation of (ex prt (X)) that a marker describing an axis and dependent on (ex prt (X)) is interpreted as determining the extremal part in question to be in a plane perpendicular to the axis.

There are, of course, two such planes; one giving the location of the top of X and the other giving the location of the bottom of X. These can be distinguished by using the fact that a (+vert) axis is not just a line or spatial orientation, but has a directional orientation as well, with the positive sense of direction pointing upward (see Bierwisch, Section 3.2). We need a pair of markers (+ext) and (-ext), read "plus extreme" and "minus extreme", to pick between the two extremes of the axis. We now have as the reading for top:

((ex prt (X))(+vert)(+ext))

and for bottom

((ex prt (X))(+vert)(-ext))

This is still not enough, for consider a bottle which is lying on its side. The instruction to touch the top of the bottle can be correctly interpreted in two-ways: (1) Touch the end of the bottle through which one pours its contents, (2) Touch the highest side of the bottle, i.e., the side which is now highest. The distinction depends on whether the vertical axis referred to in the definition of top is the axis which is normally vertical or the axis which happens to be vertical at the moment. I will mark this difference by introducing the marker (normal) which can be used to further characterize (+vert). We now have two definitions of "top", which corresponds to the cases (1) and (2) in the last example.

$top_1(X): ((ex\ prt\ X)\ ((+vert)(normal))(+ext))$

$top_2(X): ((ex\ prt\ X)\ (+vert)\ (+ext))$

A digression is needed here to explain why I am introducing a new marker, (normal), instead of using Bierwisch's (+inherent). In Bierwisch's analysis objects are defined as normally having certain characteristics by simply including the markers which represent those characteristics in the appropriate place in the definition. Thus, cigarette is defined as having its (+main) (+max) dimension normally in a horizontal orientation by marking the (+main)(+max) dimension as (-vert). Contrast the role of (-vert) in cigarette with the role of (+max) in, say, pole. The (+max) in pole must be further characterized as (+inherent); for if an object does not have a maximal dimension dimension, it is not a pole, whatever its orientation. A cigarette, however, can be oriented vertically and still be a cigarette; a cigarette balanced on end is just a cigarette in a funny orientation. However, in defining "top", we cannot differentiate between a normal vertical orientation and a vertical orientation of the moment by simply including or omitting the marker (+vert) because in both cases we need to refer to or single out a vertical orientation. If we were to omit (+vert) from the definition, we could not refer to a vertical axis, normal or otherwise. Furthermore, the normal vertical orientation referred to by  $top_1(X)$  is not just orientation which is normal by definition, but may be normal by facts about the world which have no direct relation to the meaning of the expression, X. For example, a bag or sack is thought of as normally oriented with its open end up. But this is by no means true by virtue of the meaning of the word "bag" as is shown by the acceptability of "long bag", as compared to the unacceptability of "\*long tower". But the differentiation between  $top_1(X)$  and  $top_2(X)$  holds for sack: think of a sack, filled with flour, and

lying on its side. The command, "Touch the top of the sack.", has the same ambiguity that it had for bottle. If this example is not convincing, the same evidence can be adduced from the phrase "inflated balloon". We see that, not only does (normal) seem to be necessary, but it must refer either to orientation as specified in the reading substituted for the parameter "X" or directly to orientation which is learned as normal for the object referred to by X.

The (+vert) which is not characterized as normal is to be interpreted as the vertical of perceptual space; thus, the top<sub>2</sub> of a bottle is that side which is at the moment uppermost. A few observations about the notion of perceptual space will help us understand why the meaning of "front" cannot be handled in exactly the same way as the meaning of "top". By perceptual space I mean the three dimensional space which we think of as associated with each person's perception. The vertical axis of an observer's perceptual space is the real vertical direction; the axis of depth, or primary non-vertical axis, is the direction in which he is facing, and his axis of width, or his secondary, non-vertical dimension is the direction from his left to right. The important fact here is that the vertical axis of all people's perceptual space coincides (If an observer is not himself oriented vertically, he nevertheless thinks of the direction of free fall as his vertical direction.) Thus, in giving the meaning of top, it was sufficient to specify the orientation of the object either as normal or as fixed by the immediate context. Given that the orientation is normal, that is, that the object is in a context in which it has its normal orientation, the vertical axis of the object as seen from the point of view of any observer in that context is the same. Consequently, it is not necessary to further specify the vertical axis as the vertical axis of some particular observer in the context. Similarly, as long as the

context is specified or fixed, one can refer to the vertical of that context as the vertical of any of its observers.

This simple fact becomes important when we notice that we cannot distinguish between the two non-vertical dimensions in the same easy way we can distinguish between vertical and horizontal. This is because the forward direction for one observer in a given context need not coincide with the forward direction of another observer in that same context. Consequently, in picking out the forward direction or axis of an object, we need to do more than refer to the forward direction of a specified orientation (normal or contextual). We must also specify: (1) with respect to whom is the orientation given, and (2) what is the special relation of that person to the object which specifies or picks out the orientation. These complications explain why we cannot define a  $\text{front}_1(X)$  and  $\text{front}_2(X)$  exactly analogously to the way we distinguish between  $\text{top}_1(X)$  and  $\text{top}_2(X)$ .

In giving the reading for "front" we again use  $(\text{ex prt } (X))$ ; for just as in the case of the top, the front is an extremal portion of the object in the same general sense which includes bounding points, edges, surfaces and segments of the object. For example, the front of an arrow can refer to the very tip, or to a whole forward portion of the arrow, say, the arrowhead. Just as in the case of "top", we take  $(\text{ex prt } (X))$  to be further specified by an axis with a sense of direction and an extreme on that axis. The axis is, first of all (-vert), (this will be qualified later on). The required (-vert) axis and its sense of direction is singled out by some further property indicated by (+prominent). So far, we have as a reading for "front":

$((\text{ex prt } (X)) (-\text{vert}) (+\text{prominent}) (+\text{ext}))$

In trying to determine the interpretation of (+prominent) I have found a great deal of variation from person to person as to

what sort of things have fronts. For example, when asked to describe the front of a typewriter, trumpet, telescope, or mirror, some people immediately picked out a part, while others found the request bizarre. Some people seemed to think that trumpets have fronts, typewriters do not, and so on. This might indicate that the meaning of "front" varies a great deal from person to person; it is to be hoped that such a variation can be described by variations in the content of the single marker (+prominent). It is also to be noted that in the case of objects for which a front is not well determined, special terms often arise to describe the part more clearly; for example, there is the bell of a trumpet, the viewing side of a mirror, the keyboard of a typewriter, and the business end of a gun.

One might try to interpret (+prominent) as "functionally prominent", that is, outstanding or attention catching by virtue of the function of the object. The function can be either the normal function or some special function specified by the context. This analysis seems to specify the correct side as the front for the sort of things which everyone will agree have fronts, and when "front" is used in this sense, hearers seem to interpret the word as intended; however, on this analysis of (+prominent) a great number of things are easily characterized as having a front which most people seem to feel do not (e.g., pencil, spoon, saw).

Instead of referring to general functional prominence we may try to list a more restricted set of characteristics which single out the axis. On this analysis, an axis is (+prominent) if,

(1) It is the axis of motion of the object, with the positive sense of the axis in the direction of motion. This gives the front of a car, and the front of a moving ball. Or

(2) It is the axis of vision of some specific observer facing the object (either a normal observer or some observer specified by context.) The sense of orientation is toward the

observer. This gives the front of a television set, the front of a house, and the front of a mirror, or

(3) It is the axis along which motion or vision proceeds through the object. Orientation is in the direction of motion or vision. This gives the front of a telescope, the front of a trumpet and the front of a fan or propellor.

This list is very unsatisfactory. In (2) the required observer in the case of normal orientation is still unspecified. Many people's use of front does not seem to conform to (3).

Whatever the correct interpretation of (+prominent) it must have the characteristic of being applicable to an object in different ways in different contexts, or even in the same context. The front of a desk is usually thought of as the side where the user sits. But if the desk is used for interviewing clients, say by a doctor or business man, the clients' side may also be thought of as the front. A house trailer has two normal fronts; one is the side by which it is pulled (hence, indicated by direction of normal motion). The other is the side with the door (or main door if there are two), and hence, the one faced by a normal observer. The provisional description of (+prominent) accounts for these cases of dual applicability of "front".

We distinguished between two meanings of "top" corresponding to whether or not the relevant axis was marked as (normal). In the case of "front" the relevant axis can be normal in two ways; (a) the (-vert) marker may be further characterized as normal; or (b) the (+prominent) marker may be further characterized as normal. These cases give rise to four combinations

	(-vert)	(+prominent)
Marked with (normal): (1)	yes	yes
(2)	no	yes
(3)	yes	no
(4)	no	no

"Front of the man" and "front of the radio" are examples of case (1). I cannot find an example for which (2) holds; this is to be expected, because if an axis or side is prominent by virtue of some normal function or property of the object, that same function or property will, in practice, lend a normal horizontal orientation to the object. Thus "gun" might fall in case (2), since it has a prominent axis; and there is nothing about this prominence which logically forces the axis to be normally (-vert). But in fact one generally shoots, roughly speaking, in a horizontal direction instead of up or down, so that the axis of the gun barrel comes to have its normal orientation in the plane.

A symmetrical, unlabeled bottle gives an example of case (3), and a brick an example of case (4)\*. In neither case can the object be described as having a front, even in very special situations. However, both (3) and (4) will be used in defining the prepositions "before", "in front of", "behind" and "in back of".

Since only case (1) corresponds to situations in which an object is characterized as having a front, we finally have as the definition for front(X):

((ex prt (X)) ((-vert)(normal)) ((+prominent)(normal)) (+ext))  
and for back(X):

((ex prt (X)) ((-vert) (normal))  
((+prominent) (normal)) (-ext))

For use in defining locative prepositions we give a function,  $\text{front}_p(X)$ , corresponding to case (3) and (4), but not to any English noun.  $\text{front}_p(X)$  is defined as

\*The fact that no axis of a brick is singled out as normal can be used to explain the oddity of "The brick is upside down", though one can, of course, turn a brick upside down, since this inversion is with respect not to a normal vertical axis, but the vertical axis singled out by the immediate context.

((ex prt (X)) ((-vert)(normal))(+prominent)(+ext)) or  
 ((ex prt (X)) ((-vert)(+prominent)(+ext))).

A function,  $\text{back}_p(X)$  is defined analogously, by changing (+ext) to (-ext).

#### "SIDES" AND "ENDS"

"The length of a thing (a car) is the distance between its ends", and "The car is as long as it is from end to end" are analytic. "The car is twice as long as it is from end to end" is contradictory.

These examples show that the end of something is to be defined as an extreme or limit portion of its dimension of length, that is, the dimension marked as (-second):

$\text{end}(X)$ : ((ex prt (X)) (-second))

Just as in the case of "top" and "front", the end may be the extreme portion (say the last foot of a twenty foot pole) or the bounding surface or point (e.g., the surface at the end of the pole).

We can similarly treat that meaning of side which is analogous to end. "The width of the board is the distance between its sides" is analytic. "The board is twice as wide as it is from side to side" is contradictory. In the same way as for "end" such examples show that we should define side (on one reading) as:

$\text{side}_1(X)$ : ((ex prt (X)) (+second))

The front of something may be a side or an end; for example, a house trailer has both a front end and a front side. The top can likewise be an end (top end of the bottle) or a side (top side of a desk). We can give possible readings for these expressions very simply in terms of the previous definitions (leaving out the marker (normal)).

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front end(X): ((ex prt (X)) (-second) (-vert)
              (+prominent) (+ext))
front side(X): ((ex prt (X)) (+second) (-vert)
              (+prominent) (ext))

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and similarly for "top end" and "top side".

"Side" has other possible interpretations. It may mean an extremal part which is not the top, bottom, front, or back (e.g., the sides of a car). This may be indicated by introducing (-prominent) as a companion marker to (+prominent). (-prominent) is interpreted as specifying an axis perpendicular to the (+prominent) axis. We then have as a reading for "side",

```
side2(X): ((ex prt(X)) (-vert) (-prominent))
```

I suspect that the same variations produced by further qualification by (normal) hold as in the case of "front", but the distinctions become so fine here that they are hard to check on an informal basis.

Next, "side" may be taken to indicate any of the actually vertical sides, as for example, the south, west, north, and east sides of a building. This is easily defined as side<sub>3</sub>:

```
((ex prt (X)) (-vert)).
```

This definition works for figures such as squares, hexagons, circles, and oblongs, but not for stars or ellipses. The feeling of inapplicability increases as the ellipsis becomes more elongated. This discrepancy may be eliminated by adding the restriction that the side not be zero dimensional (a point).

We now have:

```
side3(X): ((ex prt (X)) ((-vert), (not (0 space)) ) )
```

Finally, "side" may mean any side. This is just the concept (ex prt (X)) restricted not to be a point:

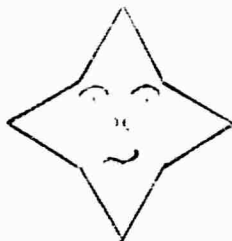
```
side4(X): ((ex prt (X)) ((not(0 space)) )
```

In this sense, a front, back, right, left, top, or bottom surface or edge may be a side (e. g., the six sides of a cube)\*

It is not clear to me how the readings for "front end", "front side", "top end", and "top side", arise. These expressions might themselves have lexical entries. They might be transformationally derived by a nominalizing transformation from structures corresponding to phrases such as "end at the front", etc. However, there is some question as to how well this transformational analysis works. "Corner store" means the same as "store at the corner", so that the first expression may arise transformationally from some structure corresponding to the second. But this relation fails for "corner car" and "car at the corner"; and "machine cat" and "cat at the machine."

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\* One may wonder why (not 0 space) is used for  $side_3(X)$  and  $side_4(X)$ , but for  $side_1(X)$  and  $side_2(X)$ . The decision was made on the consideration of examples such as the following. Consider a "star face" such as a child might draw:



It seems to me that the two lateral points of such a figure are correctly referred to as sides in the sense of  $side_2(X)$  (the sense of "side" which contrasts with front and back), but not in the sense of  $side_3(X)$  (any vertical side). However, such examples might be debated at length; and if I should turn out to be wrong, the necessary adjustments would be very easy to make.

Thirdly, "front" may be an adjectival modifier of "end" in "front end". On either of the last two suggestions, it is not at all clear that the derived reading for "front end", as amalgamated from the meanings of "front" and "end", will have just the form I have given above; though one would hope that such derived readings and the reading suggested here would be equivalent in practice.

#### "FRONT" AND "TOP" ADJECTIVES

When we refer to the top button, the top picture, or the top iron-thing, there is a presupposition in each case that there is more than one thing of the kind specified. There is an oddity in using any of these expressions if there is only one button, one picture, or one thing made out of iron in view, or admitted by the linguistic context. For example, there is something very wrong about the instruction "Push the top button on the board which has only one button".

Furthermore, something is presupposed about the configuration of the set of objects tacitly referred to by these expressions. If the set of buttons relevant to the context does not constitute a configuration which can be interpreted as having a top, the instruction, "Push the top button", cannot be interpreted. This would be the case for a horizontally oriented straight row of buttons.

Thus far, the adjectival reading for "front" in "front X" is seen to include as a presupposition that there be more than one X forming a configuration which has a top, and that X constitute the top of the configuration. Exactly analogous statements hold for "top".

However, complications are not at an end. In the case of several, parallel vertical rows of buttons the phrase "the top button" has no application. But "a top button" does. It means

on at least one interpretation, any one of the buttons in the top row. It may also mean any one of the buttons in any one of the top few rows (if there are enough rows). This second interpretation is not preferred, but can be brought out more clearly in the case of "front". Consider a movie theatre (theatre A) whose seats are divided by aisles into three sections or tiers. Theatre B has only one tier of seats. A man going to the theatre and having forgotten his glasses at home tells his friends he wants to sit in a front row. In the case of theatre A, he may mean he wants to sit in the first row of one of the three tiers. But if he is headed for theatre B, he means one of the first few rows.

These examples show that "top X" is not always a specific X which forms the top of the presupposed configuration, but may be a part or a member of a subconfiguration of X's which forms the top of the main configuration. Such an analysis will also work for "the top buttons". This phrase refers to a set, Y, of buttons. It is presupposed that there is a set, X, of buttons, that the configuration of Y forms the top of the configuration of X. "Some top buttons" refers to a subset Z of Y, where Z has more than one member.

Let  $P(X)$  represent the defining property of X, and let  $\text{conf}(U)$  stand for the configuration of the members of any collection U. Then the meaning of "top X" can be given as

$$\begin{aligned} \text{(a) Presupposition} \quad & (\exists Z) ((\forall z) (z \in Z \Rightarrow P(z))) \\ & (\exists Y) (Y \supseteq Z) \\ & \text{conf}(Y) = \text{the top}_1(\text{conf}(Z)) \end{aligned}$$

$$\text{(b) Defining property of X: } X \subseteq Y.$$

There are two definitions for "top X"; one for  $i=1$  and the other for  $i=2$ .

The determiner attached to the phrase "top X" further speci-

fies whether  $X=Y$ , whether  $X$  is a subset of  $Y$  with more than one member, whether  $X$  is a unit set of a single member of  $Y$ , or the unit set of the unique member of  $Y$ .

"Front  $X$ ", "back  $X$ ", and "bottom  $X$ " are defined analogously, by simply substituting the appropriate functions for  $top_1(X)$ .

#### USE OF "TOP", "FRONT", AND "SIDE" IN LOCATIVE PREPOSITIONS

In their strictly locative use, "before", "behind", "in front of",\* "in back of", "beside", "by", "above", "over", "on top of", "below", "beneath", and "under" each describes a spatial relation between objects, figures, or spatial locations. Such a spatial relation  $R(X,Y)$  can be analyzed, in part, in terms of parts, or sub-figures of  $Y$ , namely  $Y$ 's front, back, top, bottom and sides. These can be picked out using the functions and predicates previously defined. I will limit myself to listing the relevant functions and predicates together with a few remarks on the distinctions they make possible, and will not attempt to give the details of definitions of the prepositions themselves.

(1) "above", "over", "on top of", "below", "under", and "beneath":  $X$  is above  $Y$  if  $X$  is located in a volume the base of which is, roughly speaking, identical with the  $top_2$  of  $Y$ . For example, the lamp above a desk is located higher up in perceptual space than the uppermost side of the desk. Examples of this sort show that  $top_2(X)$  and  $bottom_2(X)$  are the relevant functions for these prepositions.  $top_1(X)$  and  $bottom_1(X)$  do not seem to enter in at all.

(2) "before", and "in front of". "in front of the car" is ambiguous: Aside from any special context it means located in front of the front fender of the car. But imagine a photographer who

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\*I am assuming that prepositional expressions such as "in front of" arise from a single formative.

stands fifteen feet away from the side of the car and asks his child to stand in front of the car to have his picture taken. The request is correctly fulfilled by standing before the side of the car which the photographer is facing. This is just the side specified by  $\text{front}_p(X)$ . On the first interpretation, the correct side is given by  $\text{front}(X)$ .

We already noted that a brick or bottle does not have a front. Yet something can be in front of a bottle or in front of a brick; in each case the relevant side is the one facing the speaker or relevant observer. This is just the side singled out by  $\text{front}_p(X)$ , with clause (2) operative in the definition of (+prominent). In the same way a ball does not have a front, but something can be in front of or cross in front of a moving ball. Again, the relevant side is selected by  $\text{front}_p(X)$ , this time with clause (1) of the definition of (+prominent) involved.

These observations show that there are two definitions of "in front of", one corresponding to a normal front side, the other corresponding to a "front" picked out by the context. It is likely that the two definitions will be identical, except that one will use  $\text{front}_p(X)$  where the other used  $\text{front}(X)$ .

It should also be noted that for an object, X, with a real front, Y can be in front of X and at the same time above or below X. For example, a flower can be said to be in front of a camera which is posed directly above it to take its picture. Or a star at the zenith can be in front of a telescope which is pointed at it. This is "in front of" defined with  $\text{front}(X)$ . Nothing can be in front of X in the sense using  $\text{front}_p(X)$  and at the same time be situated above or below X. This is because  $\text{front}_p(X)$  does not refer to the front of normal orientation, which, because it is singled out as a front in normal context, can actually be horizontal in a special context.  $\text{front}_p(X)$  refers to a side singled out in the immediate context and this is restricted to be

vertical in fact. And, indeed, when "in front of" can only be interpreted in the sense using  $\text{front}_p(X)$  as in "in front of the bottle" or "in front of the brick" nothing can be both in front of the thing (e.g., bottle or brick) and at the same time above or below it.

The same arguments can be made for "before".

(3) "behind" and "in back of" - Exactly analogous to (2).

(4) "beside" and "by": "Beside" and "by" are also ambiguous: the tree by or beside the house can be a tree in front of, behind, on the right side of, or on the left side of the house. But if John is said to sit by or beside Mary, usually he is not sitting in front of her or behind her. If I talk about a car by or beside my car, I am usually taken to mean a car which is not before or behind mine. Furthermore, the more restricted meaning of beside may contrast with the front and back sides (the right and left side of a liquor bar are also its ends) or may contrast with the ends, whether or not the ends are distinguished between front and back. Examples are, "By or beside the car" interpreted as on the left or right side of the car; and "By or beside the rope".

These distinctions can all be made using the predicates defined earlier:

$\text{side}_1(X)$ : an (ex prt (X)) has the property  $\text{side}_1(X)$  if it is a vertical side and not an end.

$\text{side}_2(X)$ : an (ex prt (X)) has the property  $\text{side}_2(X)$  if it is a vertical side which is not the front or back.

$\text{side}_3(X)$ : an (ex prt (X)) has the property  $\text{side}_3(X)$  just in case it is a vertical side.

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13. ABSTRACT This article presents some discussion, criticism, and extension of Manfred Bierwisch's recent paper, "Some Semantic Universals of German Adjectivals" (1). Bierwisch draws conclusions about the structure of semantic theory as the result of his attempt to analyze the meaning of selected words and expressions. Correspondingly, the present paper will separate into two parts: (1) an extension of Bierwisch's study of semantic theory, and (2) further analysis of particular expressions. In Part I, I will present certain difficulties that arise from Bierwisch's restructuring of semantic theory, along with suggestions for dealing with these difficulties. In Part II, I will present the analysis of some words and expressions related to those that Bierwisch has examined. My analysis will use many of the semantic markers he has proposed as well as others that I have found necessary to add. These examples are further evidence of the usefulness of the semantic markers Bierwisch introduced.			

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KEY WORDS

LINK A

LINK B

LINK C

ROLE

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