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SOME INFORMATIONAL PROPERTIES OF PREPOSITIONS*

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CONTENTS

0. This article sketches out in some detail the treatment of English prepositions within an operator-grammar as outlined in several recent papers by Harris.[1] The first section, drawing from these works, serves to provide a general theoretical orientation to the grammar as a mathematical characterization of the information-bearing structure of natural language. In the second, the operator-argument status of a number of English prepositions is noted and the reductional strategies involved in accounting for their various occurrences discussed.

1.0. An Outline. Three relations are essential to the theory. The first is the partial order among words with respect to their entry into a sentence. That is, every sequence of words formed as a result of an operator entering into a position in respect to its arguments (in English, after the first argument) is a sentence. Thus, in

Harold's taking the car entails Mary's walking

entails is an operator (written O_{oo}: the subscripts indicate the ordered arguments) having as arguments two words which are operators in turn, those arguments being *take* (written O_{nn}) and *walk* (O_n). The operator *take* has as its arguments *Harold, the car* and *walk* has as its sole argument *Mary: take* forms a sentence out of two *Ns; walk* preceded by *N* forms a sentence. The sentence can

be written out as: *entail* > *(take* > *Harold, the car; walk* > *Mary)* where '>' is to be read 'operates on'[2] or 'is a later entry on'. Each word is seen to have particular ordered word sets, one of whose members must be that word's immediately prior entry; such sets are referred to as the argument (or entry) requirement for the word.

Classification of words in respect to argument-demand thus distinguishes: elementary arguments (*N*) – words with a null argument requirement:

e.g., chair, horse, John

elementary operators (*O*n. . .n) – words with an argument-requirement consisting only of some number of elementary arguments:

e.g., sleep (O_n) *Mary slept*
young (O_n) *Sylvia is young*
buy (O_{nn}) *Francis bought groceries*
put (O_{nnn}) *Natasha put the coat on the rack*

non-elementary operators (*O*. .o. .) – words whose argument requirement includes at least one operator:

e.g., slow (O_o) *The second movement is slow*
probable (O_o) *That they will intervene is probable*
surprise (O_{on}) *That Gielgud won the award surprised Chris*
suppose (O_{no}) *Alex supposed the winter would be a long one*
cause (O_{oo}) *Martha's restless sleep caused Henry to awaken*

In English (and presumably many other languages) a number of words and affixes occur which are neither operators nor arguments, *i.e.*, have no entry status. These indicate that another word in the sentence has operator status (*e.g., that, -ing, whether, to*) or carry the operator.[3]

The second relation is the likelihood-ordering of each given n^{th} entering word in a sentence with respect to the various $n\text{-}1^{th}$. For example, *sleep*, an O_n (an operator with an *N* argument) can normally occur with *the baby, Rosa* in its argument position, occurs with low likelihood with *the plant, the sea,* and exceptionally low likelihood with *vacuum.* The normal likelihood for a given argument or operator is called its selection. Particular inequalities of likelihood (discussed further below) serve as the groundwork of the last crucial rela-

tion, the reductions, which are physical changes in the shape of particular words which carry especially low information upon entry into a sentence. The first two relations determine the structure of the base (see below). All of the remaining sentences are obtainable via established reductions, which are generally optional and introduce restrictions into the grammar. Together these relations suffice for the compostion and analysis of sentences.

1.1. As a Mathematical Characterization of Language Structure.

Aside from the intrinsic methodological value that attaches to a mathematical characterization of language, *i.e.*, as a control on the analysis and as a guide to research programs, its prime theoretical interest lies in establishing such mathematical properties which not only permit analysis but which further specify, in a reasonably precise fashion, those criteria delimiting the structure of a possible natural language, or, with appropriate restrictions, delimiting a system as language-like in certain respects. This distinguishes the program from those which attempt to set out the relation of natural language to a spectrum of language-like systems via general restrictions which circumscribe the properties of language.

This is made possible in several ways. Considering first the base, it is seen that the objects participating in the entry-order relation are defined entirely in terms of that order. Moreover, as each word has a unique likelihood gradation of entering as an operator (argument) in respect to those words in a given argument-position (operator-position) under (above) it, that gradation suffices to distinguish among words. Since no appeal is made either to phonemic constitution of the words or their meaning, it follows that the entities involved and their structure may be taken as a mathematical object. The set of discourses, *i.e.*, those sequences satisfying the argument-requirement relation, is then a particular interpretation of the structure. Reduction of a word (sequence) occurs at its entry or upon the entry of the immediate operator on it (the conditions for the reductions being stateable a priori), making possible a decision procedure for sentence composition and analysis.[4]

1.2. As an Informational Characterization of Language Structure.

1.21. The Point of View. Language is only one of several vehicles of meaning found in human purposive activity (others being music, mathematics, and the like). These vehicles each have a structure closely related to the meanings that they bear. Grammar, as set out here, relates to that portion of semantics with a

determinate structure, *i.e.*, information. The principle involved is one of giving a unitary account of language. That is, it is not a matter of determining (in any sense of priority) the syntax of a given language and then locating its points of linkage with semantics over and above it (much in the same way that language change is not something over and above language structure but a product of it). Rather the question is one of characterizing language such that the syntactic elements and operations depicted are seen to correlate in a regular fashion with the information borne by language.

The concept of information employed here (still to be worked out in its full form) is partially explicated in terms of redundancy as set out in Harris 1968. The descriptive principle at work is outlined in the following passage:

> The fact that particular kinds and amounts of redundancy are essential parts of language structure makes it important that a description of language should not add its own redundancy to the picture. A theory of language should not contain elements of wide combinability and then specify which combinations are language. It should contain elements of just such combinability as appears in the language itself.
>
> (p. 12, fn. 16)

Elimination of redundancy is thus achieved by defining elements of wider combinability (cf. Harris 1968: 11-16). Still, there are restrictions, those 'summarized' in the dependence between operator and argument and the inequalities of likelihood between various operators and arguments. If there were none such, obviously no information could be distinguished. However, with the isolation and localization of those elements which are maximally unrestricted in terms of combination, the grammar which emerges is seen to have a transparent relation to the informational contribution of the elements in their entry order and the operations upon them. Of course there are limitations on the applications of these methods; this, related to the fact that we are not dealing with a system bearing fixed codified meanings nor yet a well-organized scientific sublanguage, but rather one which is open, *i.e.*, extendable by the usage of speakers (cf. Harris 1968: 172, 188, 200)

1.22. Within the Grammar. The base is a sublanguage closed with respect to entry-order and containing all the information borne by language. Most of the sentences in the base are simply sentences before the application of reductions. Some are reconstructions from reduced sentences. These reconstructions, marked †, are often marginally acceptable, though they must be admitted as grammatically possible, if not actually attested, since (and this is crucial) they

are required to satisfy entry relations among words. In terms of interpretation, base sentences have the rather simple structure of nested predications, where an operator 'says something about' its arguments.

The consequences of these properties of the base are several. Intrinsic philosophical interest accrues to the base as a linguistic illustration of the Fregean semantic principle that the meaning of a sentence is a function of the meaning of its words and their mode of composition. In addition, the entry-order system invites a more detailed comparison with such categorical grammars as have been developed in the philosophical tradition of Husserl 1928 and Leśniewski 1929. The abstract mathematical character of the system permits construction of various language-like systems and provides the basis for further comparison of natural language with other semiotic systems. Moreover, the close correspondence between syntactic elements and operations and information lends support to the foundational notion that natural language's primary functional role is the social transmission of information.

A key feature of natural language which distinguishes it from mathematical systems is the different likelihoods which each word in a given entry class has in respect to its prior or next entering word. More precisely, we are speaking of various inequalities of likelihood as estimated by speakers of the language. These inequalities of likelihood of arguments for each operator and vice versa serve to distinguish every operator word and its meaning. Whereas likelihood itself is imprecise and liable to fluctuate rapidly, the inequalities in their gross grades (exceptionally high likelihood, high likelihood, normal likelihood, *etc.*) are rather stable. A result of major significance for the theory is that the statement of these inequalities need only be for those holding between an operator and its immediate arguments.[5] Of note here are those situations wherein particular likelihood conditions permit the application of reductions.

Reductions are changes in the physical shape or relative position of words made upon their entry into a sentence. All of the reductions take place on words which contribute little or no information to the sentence. Moreover, a necessary condition on reductions is that they preserve the likelihood-inequalities obtaining among the operators and arguments of a sentence. Thus, reductions hold constant the informational content of the sentence, *i.e.*, are paraphrastic.

As stated above, reductions are applied in those situations where particular likelihood conditions obtain. In the case of favored high likelihood, the entering word is often reduced to zero. Thus, in *I expect John* what has been zeroed is *to be here* as the favored second argument of *expect* ('appropriate' zeroing). Other cases in which favored high likelihood motivates particular

reductions are seen in the formation of compound nouns, *e.g., milkman* ← *man who has particularly to do with milk* and the zeroing of *wh-* pronouns as in *the man who is coming tomorrow* → *the man coming tomorrow.* Related to high likelihood are instances of repetitional reduction. Such reductions occur in particular positions where a given occurence of a word is the "same" word or refers to the same things as another word occurrence, *e.g.,* the reduction in *Vikas played clavier and Stephanie flugelhorn.*

As the theory starts off with free words and not bound morphemes, the bulk of the affixes are formed as reductions of operators with broad selection, *i.e.*, normal likelihood in respect to exceptionally many arguments. For instance, the *-ly* affix is reduced from *in an X form* (where *X* is an adjective).

Of special importance is the reduction via relative clause by which all modifiers in English are obtained. This is achieved by considering semicolon intonation an O_{00} operator between a primary and a secondary sentence, *e.g., Reggie had a grand season last year; Reggie is an outstanding competitor.* Under semicolon intonation, a word in S_2 which is the 'same as' a word in S_1, may be reduced to a *wh-* pronoun, *which, who, etc.* Here 'same as' generally alludes to a relation between words with the same selection or to, in some cases (notably, for proper names and count nouns), words with the same designate. The sameness relation is stated in an appended metalinguistic sentence: '*X* in S_1 is same as *Y* in S_2'. The sentence above thus emerges as: *Reggie, (who is) an outstanding competitor, had a grand season last year.*[6]

2.0. Problems with Prepositions. Introduction. Grammatical analysis has persistently been plagued by the occurrence of prepositions in a wide variety of syntactic environments. Correspondingly, grammarians have often tried to assimilate prepositions in various ways, proposing them as adjuncts to a verb or have sought to subsume their annoying peculiarity in an inclusive 'throw-away' class of syntactic oddities ('particles', 'adverbs'). In any event, the net result has usually been to deny prepositions an independent status in the grammar. Approaches such as these are, after all, readily understandable. The extremely broad and general meanings featured by prepositions place few apparent restrictions on their situational occurrence: nearly every thing or event can be prepositionally related to some other thing or event. Prepositions can occur with 'objects': *He ran on the road* or without: *He is out.* They may occur as sharing the object (complement) of an adjoining verb: *There is little reason to regret or rejoice at his death*; as forming a unitary semantic relation with the verb: *He looked at me, He waited for the dawn of day*, or a non-unitary one:

He sat under a tree, He played in the garden. They can be juxtaposed to form complex *PPN* phrases in certain ways: *He looked up on the roof*, but not in others: **He looked on up the roof.* And *PN* phrases, like relative clauses, can be theoretically concatenated almost without limit: *The man in the subway with the brown hat near the door on the right by the man reading a newspaper to the left of the woman. . .*

Any complete analysis of the informational and other properties of these forms must come to terms with the wide variety of functional roles prepositions play in any system of grammatical description. Under the present analysis we distinguish occurrences of prepositions in the following manner: a) as operators, *on* in *Every morning John runs ten kilometers on the highway*; b) as argument indicators: *on* in *I can no longer rely on you*; c) as "frozen forms": *on* in *He took on a too formidable opponent.* About c) we have very little to say. Many of these occur as what traditional grammar has called "verb particles (citing evidence of non-separability, *e.g.*, **On he took a formidable opponent*) on the basis of the non-compositional or idiomatic semantic modification induced by the union of the verb and preposition. In principle we suppose that this usage is derivable from regular usage as in a) and b) on the grounds that there rarely seems to be a clear cut difference distinguishing idiomatic from other usage and that there apparently are infinite shades and nuances in between.[7] Because of these idiomatic properties, however, intermediate steps, where at all reconstructable, often seem forced or otherwise unnatural.

Returning to the difference between prepositions occurring as operators and as argument indicators, consider the difficulties involved in giving a unitary account of the word *to* based on the following contexts:

a. *John gave the book to Mary*
b. *To the man in the street, Bush is the candidate of powerful Eastern financial interests*
c. *Even compared to Reagan, Bush is hardly less of a conservative*
d. *Though he was exhausted, John listened to her story*
e. *Election year politics brought the world to the brink of nuclear holocaust*
f. *As he was about to leave, the phone rang*
g. *Waldheim went to Berlin and then to Paris*

In (a-e) *to* may be viewed as part of the residue in English of a now-extinct inflectional system of case endings, here marking the presence of the dative

case. Thus in (a) *to* is an argument-indicator which serves to distinguish *Mary* as an argument under the operator *give* which takes three *N* arguments (*John, book, Mary*). Similarly, in (b) *to* indicates that *man* is an argument of a zeroed O_{nno} operator (*seems, appears*) on (*It, man, S*). In (c) *to* again indicates that *Reagan* is an argument under the O_{nnn} operator *compare* on (*I/We, Bush, Reagan*). That *to* is an argument indicator in (d) and (e) is perhaps not immediately transparent, but may be seen by the non-occurrence of the operators *listen* (O_{nn}), *bring* (O_{nnn}) without *to* (which may subsequently be zeroed as in *John listened quietly*) indicating the final *N* argument: **John listens music, *Sally brought wine the party*. As historically the infinitive was an inflected noun derived from a verb, so the infinitival *to* in (f) need not be posited as a separate form but again may be viewed as the remnant of a dative case marker (*i.e.* as an operator equivalent to the dative) which originally carried the meaning 'in order to' (Harris, in press, §2.045). Finally, (g) shows a 'genuine' prepositional, *i.e.*, no longer merely a case marker, occurrence of *to*: apparently, this is the result of *to* spreading from its origin as a dative case indicator to new cases (here accusative) and situations. (For an opposing view, see Jespersen 1924:186-7). Much research remains to be done on the extent to which prepositions may be considered derivate of original case marking systems (for some discussion, see Visser 1963-1973 *passim* and Wackernagel 1928: 153-248).

2.1 Prepositions as Argument Indicators. As suggested in Harris (in press, chap. 2) argument indicators, among which are included in many of their occurrences, the prepositions *of, on, to, for,* and *by* as well as others, are basically of two kinds. Those of the first type arise in that some operators always impose a particular preposition between them and their second argument (*i.e.*, the operator does not normally occur without its argument indicator which may, however, have been zeroed, *e.g., John gave Bill the book* ← *John gave the book to Bill*). Thus, in *I rely on John, rely* is an O_{nn} operator whose object (second argument) is *John* and *on* is a required indicator of second argument status under *rely*. That *on* is here an argument indicator rather than O_{on} resides in the fact that it is always required when *rely* enters a sentence, even when *on* may be separable as in the interrogative: **Whom can I rely*? but *On whom can I rely*? (*Whom can I rely on*?). Similarly, in *The glass is full of milk, full* is an O_{nn} operator, *milk* its second argument and *of* is the required indicator of second argument status under *full*. Since we also say *The glass is full* or *He said he was full* with *full* an apparent O_n, we have to say in such cases, the second arguments of *full* together with its argument indicator have been zeroed:

the glass is full of something. He said he was full (of food). As always, the test as to whether a given occurrence of a preposition is an operator (O_{on}, O_{o}, O_{oo}, *etc*) or an argument indicator lies in determining if the previously entering operator (usually but not always a verb) can regularly occur (under normal intonation, *etc.*) without the preposition also being present, even as a zeroing. In general, we have found it advantageous to make the further claim that, unless the operator indeed requires a specific preposition (or a sole variant) as an argument indicator, that occurence of the preposition should be taken as a genuine operator.[8] For example, *represent* often appears as an O_{nnn} operator with a prepositional argument indicator of its third *N* argument: *Green represents the district in Washington.* But as we also have *Green represents a time when life was less complex to his followers, Green represents the University at the conference*, we take this as demonstrating that *represent* is actually O_{nn} while the various prepositions occur as O_{on}.

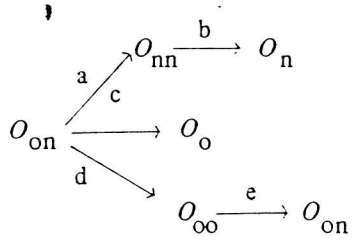
Argument indicators arise in a different way in the more complex situation when an operator (or a sentence) becomes an argument of a further (second-order) operator. In such cases, the argument indicator may be a special word, *e.g., that, whether*, or a preposition or it may be an affix, *e.g., -ing*, signalling the change in status of the operator-cum-argument. Thus, *that* in *That generals crave military appropriations is predictable, -ing* in *Generals craving military appropriations is predictable*, indicate that *crave*, together with its arguments (which in our example is the sentence) *Generals crave military appropriations*, is the argument of the O_{o} operator *predictable*. Other forms of the *-ing* argument indicator under a higher operator bring the argument indicators *by, of,* on the subject and on the object, respectively: *Craving of military appropriations by generals is predictable.* As will be noted below, certain reductions are often accompanied by the presence of a particular preposition as an indicator of the changed status of an operator, *e.g.*, many nominalizations carry *of: the cause of the accident*, passivization or passive-like nominalization, *by: the prisoner's acquittal by the judge.*

2.2. Below an account will be given of these and some other facets of prepositional life within the framework of the entry-order grammar sketched above. When occurring as operators, thirty-six prepositions are shown to belong to one of two argument-requirement classes in the base and the various established reductions are indicated which enable the prepositions to 'spread' from the base position to 'apparent' occurrences in quite distinct syntactic environments. Finally, several hypotheses of a semantic or informational nature are

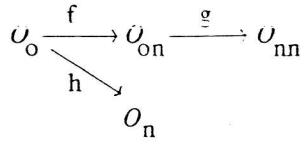
put forward regarding the nature of the syntactic classification.

The bulk of the prepositions examined are O_{on} operators (Table I), a finding which agrees with the familiar characterization of prepositions in traditional grammars as mediating between a verb and its object. Another, smaller, group are O_o operators (Table II) with correspondingly different informational properties. The reductional path or 'spread' of the O_{on} and O_o prepositions can be represented schematically as:

I)



II)



These diagrams are intuitively interpretable as follows:

I) A preposition which is O_{on} in the base has O_{nn} occurrence upon zeroing (a) of an appropriate (for the notion of appropriateness, see below) operator which is the first argument of the later entering prepositional operator. The O_{nn} occurrence of the O_{nn} preposition is seen to result from the fact that the *N* argument of the appropriate lower operator remains in place (*i.e.*, is phonemically present) lending the preposition the 'apparent' status of an operator with two *N* arguments, *i.e.*, O_{nn}. From an O_{nn} occurence, an O_n occurrence may be derived by zeroing (b) the second (*N*) argument; or, O_{on} may spread directly to O_o via zeroing (c) of its second argument; or, finally, from O_{on} an O_{oo} occurrence results after zeroing (d) of the second argument from which, in turn, a further O_{on} occurrence can be derived following a reduction (e) which nominalizes or zeros the second argument.[9]

II) A preposition which is O_o in the base spreads to O_{on} occurrence through zeroing (f) of some operator whose noun argument remains; from apparent O_{on} position an apparent O_{nn} position may be derived following zeroing (g)

of the O argument; or, O_o upon zeroing of its argument (h) may spread to O_n.

To make concrete the schematic representation and description of these reductions from base form occurrence to the various 'apparent' occurrences, corresponding examples are given below.[10]

a) *He saw many dead trees about* (= O_{nn}) *the shore of the lake* ← *He saw many dead trees present/located about* (= O_{on}) *the shore of the lake*

b) *He saw many dead trees about* (= O_n) ← *He saw many dead trees about* (= O_{nn}) *here/ a place* ← *present/located about* (= O_{on}) *here/ a place*

c) *The books and papers scattered about* (= O_o) *belong to John* ← *The books and papers scattered about* (= O_{on}) *here/ a place belong to John*

d) *John wrote another chapter before* (= O_{oo}) *he fell asleep* ← *John wrote another chapter; John's writing was during/throughout a period which occurred before* (= O_{on}) *a time which was when he fell asleep*

e) *John runs before* (= O_{on}) *breakfast* ← *John runs; John's running happens/occurs before* (= O_{oo}) *his eating breakfast* ← *John's running happens at/during a time which occurs before* (= O_{on}) *a time which is that of his eating breakfast.*

f) *Desmond climbed up* (= O_{on}) *the ladder* ← *Desmond climbed up* (= O_o) *along* (= O_{on}) *the ladder*

g) *We took the road up* (= O_{nn}) *the hill* ← *We took the road; The (course of) the road extending along* (= O_{on}) *the hill is up(wards)* (= O_o)

h) *The book is up* (= O_n) *on the top shelf* ← *The book is present on* (= O_{on}) *the top shelf which is located up(wards)* (= O_o)

We use the following notational abbreviations and terminology: Z_{ap}: appropriate zeroing, *i.e.*, the reduction to zero (phonemic shape) of an appropriate word under a higher operator (later entry). Appropriateness is defined in terms of high-likelihood of cooccurrence; as such, a zeroed appropriate word (or member of a very small class of appropriate words) is readily recoverable from its local environment (is 'felt' to be present) by native English speakers.

Z_{indef}: indefinite zeroing (a special case of appropriate zeroing); the reduction to zero of an N belonging to the small class of indefinites in English: *thing,*

something, a place, a point, a period, a moment, a time, etc.

Z_{rep}: repetitional zeroing; the reduction of repeated words to zero

O: operator (here, ambiguous as to type)

$\bar{N}$: primitive noun (having no argument requirement), *e.g.*, the indefinites noted above.

N: noun which is not primitive (*e.g.*, *fact* = O_o, *father* = O_{nn}) or is the product of nominalization or other reductions.

S^{nom}: nominalized sentence, the result of a later entry operating upon that sentence.

In the tables, the abbreviation given within the different boxes characterize the type of reduction involved. For example, 'Z_{ap} O + Z_{ap} O_{on} + Z_{ap} N / Z_{indef} $\bar{N}$' indicates that three zeroings have occurred: the first, an appropriate zeroing of an operator of unspecified type; the second, an appropriate zeroing of an operator of type O_{on}; the third, either the zeroing of an indefinite $\bar{N}$ or appropriate zeroing of an N.

2.21. The following tabular arrangement provides a relatively detailed outline of the argument-requirement status of thirty-six English prepositions and the reductions involved in deriving their various occurrences. The horizontal headings at the top of the columns chart the reductions from base argument (entry) requirement.

TABLE I – GROUP 1

O_{on}	$O_{on} \rightarrow O_{nn}$	$O_{nn} \rightarrow O_{n}$	$O_{on} \rightarrow O_{o}$
about	*He saw many dead trees about the edge of the lake* ← (*located, present*) *about* *She wrote a book about her mother* ← (*concerned*) *about* $Z_{ap}\,O$	*There was nobody about to do the dirty work* ← (*present*) *about* (*here, a place*) $Z_{ap}\,O + Z_{indef}\,\bar{N}$	*Desmond tossed and rolled about restlessly* ← *about* (*a place*) $Z_{indef}\,\bar{N}$
across	*John knows the man across the the street* ← (*present, standing, located*) *across* $Z_{ap}\,O$	*He took the first boat across this morning* ← (*going, sailing*) *across* (*indefinite body of water*) $Z_{ap}\,O + Z_{ap}\,N$	*Jan skated across to see if she could help* ← *across* (*the ice, surface*) $Z_{ap}\,N$
above	*The party camped a mile above the valley* ← (*extending, going*) *above* $Z_{ap}\,O$	*Tom moved to the apartment above* ← (*located, situated*) *above* (*here, there*) $Z_{ap}\,O + Z_{indef}\,\bar{N}$	*He climbed above to the lookout* ← *above* (*here, a place*) $Z_{indef}\,\bar{N}$
against	*He always swims the river against the current* ← (*going*) *against* *He sat in the chair against the wall* ← (*present, placed*) *against* $Z_{ap}\,O$	*Apparently, the votes against were miscounted* ← *votes* (*cast, placed*) *against* (*the issue*) $Z_{ap}\,O + Z_{ap}\,N$	*They were sure to vote against if they had the chance* ← *against* (*the issue, proposal*) $Z_{ap}\,N$

TABLE I – GROUP 1

O_{on}	$O_{on} \rightarrow O_{nn}$	$O_{nn} \rightarrow O_{n}$	$O_{on} \rightarrow O_{o}$
along	*The party stopped at an inn along the highway* ← *(located, situated) along* *There were birch trees planted at various intervals along the road* ← (extending, going) along $Z_{ap}\,O$	*The Don only invited Zerlina along* ← *(to come, go) along (the way)* $Z_{ap}\,O + Z_{ap}\,N$	*We were asked to come along but we refused* ← *along (the way)* $Z_{ap}\,N$
among	*They were only relaxed when they were among friends* ← *(present) among* $Z_{ap}\,O$	*Does not occur in this reduction*	*Does not occur in this reduction*
at	*I found John at the corner* ← *(present, located) at* $Z_{ap}\,O$	*Does not occur in this reduction*	*Does not occur in this reduction*
behind	*The folder was behind the bookcase* ← *(located, situated) behind* $Z_{ap}\,O$	*John lives in the house behind* ← *(located, situated) behind (here, there)* $Z_{ap}\,O + Z_{indef}\,\bar{N}$	*I don't want to look behind* ← *behind (something, me)* $Z_{indef}\,\bar{N}/Z_{ap}\,N$

TABLE I – GROUP 1

O_{on}	$O_{on} \rightarrow O_{nn}$	$O_{1n} \rightarrow O_{n}$	$O_{on} \rightarrow O_{o}$
below	*The ore was three miles below the surface* ← *(extending, going) below* $Z_{ap}\,O$	*The temperature was thirty degrees below* ← *(extending, going) below (the freezing point)* $Z_{ap}\,O + Z_{ap}\,N$	*John heard something, stirring below* ← *below (him, the place)* $Z_{ap}\,N/Z_{indef}\,\bar{N}$
beneath	*Water beneath the pier was brackish* ← *(present, located) beneath* $Z_{ap}\,O$	*The fields beneath looked fertile* ← *(located) beneath (here, there)* $Z_{ap}\,O + Z_{indef}\,\bar{N}$	*He works in the office located beneath* ← *beneath (here)* $Z_{indef}\,\bar{N}$
around	*John patronizes the restaurant around the corner* ← *(located) around* $Z_{ap}O$	*There are not many good books around to read* ← *(present, around (here)* $Z_{ap}\,O + Z_{indef}\,\bar{N}$	*Mary ran out to have a look around* ← *around (here, a place)* $Z_{indef}\,\bar{N}$
beside	*Gerard broke the lamp beside the chair* ← *(located) beside* $Z_{ap}\,O$	*He threw the book on the table beside and ran from the room* ← *(standing present) beside (him)* $Z_{ap}\,O + Z_{ap}\,N$	*He stood beside but said nothing* ← *beside (someone)* $Z_{indef}\,\bar{N}$

TABLE I – GROUP 1

O_{on}	$O_{on} \rightarrow O_{nn}$	$O_{nn} \rightarrow O_{n}$	$O_{on} \rightarrow O_{o}$
by	*The loutish crowd by the library are not students* *← (present, located) by* $Z_{ap}\,O$	*John directed the traffic by* *← (to move, to pass) by (him, a place)* $Z_{ap}\,O + Z_{ap}\,N/Z_{indef}\,\bar{N}$	*A butter knife whizzed by causing much consternation* *← by (here, a place, someone)* $Z_{indef}\,\bar{N}$
for	*The member for Yorkshire intends to speak* *← (present, standing) for* $Z_{ap}\,O$	*Does not occur in this reduction*	*Does not occur in this reduction*
from	*Politicians from Washington want to be trusted* *← (coming) from* $Z_{ap}\,O$	*Does not occur in this reduction*	*Does not occur in this reduction*
in	*Standley made a fortune in lawn furniture* *← (dealing) in* $Z_{ap}\,O$	*Jean followed the reporter in* *← (going) in (= into) (a place* $Z_{ap}\,O + Z_{indef}\,\bar{N}$	*He went in and was never seen again* *← in (= into) (a place)* $Z_{indef}\,\bar{N}$

TABLE I – GROUP 1

O_{on}	$O_{on} \rightarrow O_{nn}$	$O_{nn} \rightarrow O_{n}$	$O_{on} \rightarrow O_{o}$
near	*Max lives in the building near the greengrocer* *← (located) near* $Z_{ap}\,O$	*A nervous steward gathered the passengers near* *← (present) near (him)* $Z_{ap}\,O + Z_{ap}\,N$	*Mary, brave, girl, came near for a closer look* *← near (something)* $Z_{indef}\,\bar{N}$
of	*Raging fires burned within a mile of the city* *← (going, coming) of (= from)* $Z_{ap}\,O$	*Does not occur in this reduction*	*Does not occur in this reduction*
off	*The large painting is hanging a bit off center* *← (located, going) off (= from)* $Z_{ap}\,O$	*A burly conductor threw the drunkard off* *← off (the train, bus, vehicle)* $Z_{ap}\,N$	*Max dares you to jump off* *← off = from (here, a place)* $Z_{indef}\,\bar{N}$
on	*He made several remarks on possible applications of this method* *← (touching) on (= regarding)* $Z_{ap}\,O$	*Helen left the lid on too long* *← (present) on (the pot, something)* $Z_{ap}\,O + Z_{ap}\,N/Z_{indef}\,\bar{N}$	*By the time Horowitz came on the audience was nearly riotous* *← on (stage)* $Z_{ap}\,N$

TABLE I – GROUP 1

O_{on}	$O_{on} \rightarrow O_{nn}$	$O_{nn} \rightarrow O_{n}$	$O_{on} \rightarrow O_{o}$
over	*A man over there will tell you where to go* ← *(located, standing) over* $Z_{ap}\,O$	*Many disturbed people are over in the Pentagon* *(present) over (there)* $Z_{ap} + Z_{indef}\bar{N}$	*The soup is boiling over* ← *over (the side of the pot)* $Z_{ap}\,N$
past	*The rapids began a mile past the waterfall* ← *(located, going, moving) past* $Z_{ap}\,O$	*Jean-Paul chased the fox past and into the road* ← *(running, going) past (here)* $Z_{ap}\,O + Z_{indef}\,\bar{N}$	*The motorcade swept past without slowing down* ← *past (here, a place)* $Z_{indef}\,\bar{N}$
through	*Our trip through Wisconsin was disastrous* *(going, passing) through* $Z_{ap}\,O$	*At customs, only Fidel was able to bring his cigars through* ← *(coming, going) through (the checkpoint, barrier)* $Z_{ap}\,O + Z_{ap}\,N$	*No one could get help through to the trapped miners* ← *through (a barrier, a passage)* $Z_{ap}\,N$
to	*He stood with his face to the wind* ← *(exposed, present) to* $Z_{ap}\,O$	*A passing physician brought the victim to* ← *(coming) to (consciousness)* $Z_{ap}\,O + Z_{ap}\,N$	*When John came to it was evening* ← *came to (consciousness)* $Z_{ap}\,N$
with	*He bought several old books with color plates* ← *(containing) with (= containing)* $Z_{ap}\,O$	*Does not occur in this reduction*	*Does not occur in this reduction*

TABLE I – GROUP 2

O_{on}	$O_{on} \rightarrow O_{nn}$	$O_{on} \rightarrow O_{nn} \rightarrow O_{n}$	$O_{on} \rightarrow O_{o}$
before	*He is before me in line* *← (present/standing) before* $Z_{ap}\,O$	*Does not occur in this reduction*	*He has visited us before* *← visited us (at a time occurring) before (a time/the present time)* $Z_{indef}\,\bar{N} + Z_{ap}\,O$
after	*The library is after the physics building* *← (located) after* $Z_{ap}\,O$	*Does not occur in this reduction*	*The rest of the family came after* *← came (at a time occurring) after (the time when X came)* $Z_{indef}\,\bar{N} + Z_{ap}\,O + Z_{rep}$
during	*The attack during the day failed ← The attack failed; said attack (occurred) during the day* $Z_{ap}\,O$	*Does not occur in this reduction*	*Does not occur in this reduction*
since	*All this snow is since Monday* *← (has occurred/fallen) since* $Z_{ap}\,O$	*Does not occur in this reduction*	*He has written trashy novels since* *← since (a time/moment when ...)* $Z_{indef}\,\bar{N} + Z_{rep}$
until	*The lecture is until four* *← (extends/lasts) until four* $Z_{ap}\,O$	*Does not occur in this reduction*	*Does not occur in this reduction*
throughout	*The growing season is throughout the month of June* *← (occurs/extends) throughout* $Z_{ap}\,O$	*There are large fir trees throughout ← (present) throughout (a place/here)* $Z_{ap}\,O + Z_{indef}\,N$	*The play was dull troughout* *← throughout (the period/course of its performance)* $Z_{indef}\,\bar{N}/\,Z_{ap}\,N$

TABLE I – GROUP 2

O_{on}	$O_{on} \rightarrow O_{on}$	$O_{on} \rightarrow O_{\infty} \rightarrow O_{on}$
before	*Henry James wrote The Bostonians before he wrote The Ambassadors* ← *(in a period occurring) before (the period when) he wrote The Ambassadors* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N}$	*John had too many drinks before dinner* ← *before (his eating) dinner* ← *(in the period occurring) before (the period of)* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O$
after	*Nilsson came back after she paid her taxes* ← *(at a time occurring) after (the time when) she paid her taxes* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N}$	*John moved to Canada after the election* ← *after (people's) electing (someone)* ← *(in a period occurring) after (the time of)* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N} + S^{\text{nom}}$
during	*The appointee became visibly hostile during the Senator's questioning* ← *(at a time occurring) during (the period of) the Senator's questioning* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N}$	*The messenger arrived during breakfast* ← *during (one's/people's eating) breakfast* ← *(at a moment occurring) during (the period of)* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N} + S^{\text{nom}}$
since	*John loves to gamble since he won the lottery* ← *(in the period extending) since (the time when) he won the lottery* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N}$	*He has been miserable since the war* ← *since the war (occurred/began/ended)* ← *(in the period extending) since (the time when)* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O$
until	*They waited in the car until the rain stopped* ← *(for a period lasting) until (the time/moment when) the rain stopped* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N}$	*This train makes no stops until Richmond* ← *until (it stops at) Richmond* ← *(in the period extending) until (the time when)* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N} + Z_{\text{rep}}$
through-out	*The band played throughout the prime minister's speech* ← *(for a period extending) throughout (the period of) the prime minister's speech* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N}$	*The interruptions occurred throughout the recital* ← *throughout (someone's) reciting (something)* ← *(in a period extending) throughout (the period of)* $Z_{\text{indef}}\overline{N} + Z_{\text{ap}}\ O + Z_{\text{indef}}\overline{N} + S^{\text{nom}}$

TABLE II

O_o	$O_o \rightarrow O_{on}$	$O_{on} \rightarrow O_{nn}$	$O_o \rightarrow O_n$
up	*John climbed up the ladder* ← *up (along, on)* $Z_{ap}O_{on}$	*We took the road up the hill* ← *(leading, going) up (on, along) the hill* $Z_{ap}O + Z_{ap}O_{on}$	*The book is up on the top shelf* ← *(located) up* $Z_{ap}O$
down	*Bill sailed down the river* ← *down (along) the river* $Z_{ap}O_{on}$	*Our office is down this way* ← *(located) down (along)* $Z_{ap}O + Z_{ap}O_{on}$	*Clio took the train down to Washington* ← *(going) down* $Z_{ap}O$
away	*Homer kicked away the snarling dog* ← *away (from him)* $Z_{ap}O_{on} + Z_{ap}N$	*He left the car away a mile* ← *(coming, going) away (from here)* $Z_{ap}O + Z_{ap}O_{on} + Z_{indef}\bar{N}$	*Einstein lived several blocks away* ← *(going) away (from here)* $Z_{ap}O + Z_{ap}O_{on} + Z_{indef}\bar{N}$
back	*The police pushed back the demonstrators* ← *pushed the demonstrators which was (going, coming) back (from something)* $Z_{ap}O + Z_{ap}O_{on} + Z_{indef}\bar{N}$	*John moved the table back an inch* ← *(coming, going) an inch back (from something)* $Z_{ap}O + Z_{ap}O_{on} + Z_{indef}\bar{N}$	*Don Octavio held the vengeful lover back* ← *back (from someone, something)* $Z_{ap}O_{on} \neq Z_{indef}\bar{N}$
out	*Walter stared out the window* ← *out (from) the window* $Z_{ap}O_{on}$	*Jean drove the car out the garage and into the street* ← *(going, coming) out (from)* $Z_{ap}O + Z_{ap}O_{on}$	*He is out* ← *he (has gone, went) out* $Z_{ap}O$

2.3. Analysis of Data.

2.31. "Weak" and "Strong" Appropriate Zeroing.

The chart reveals that appropriate zeroing of either an *O* or an *N* can be further analyzed into two distinct types which we shall, for the purposes of the discussion here, call "weak" and "strong" (suggestive of the specificity of informational content of the zeroed entity). The former, which is extremely common, is the process by which a zeroed *O* or *N* is recoverable only from the relational informational content of the preposition. As such, the informational contribution made to the sentence by the zeroed word is of the most general and least specific kind, as is indicated by the classes of appropriate operators to be described below (*present, located, going, extending, occurring, etc.*) and by the $\bar{N}$ zeroings under indefinite appropriate zeroing (*a place, here, someone, a period, a moment, etc.*). Thus, in *The loutish crowd by the library are not students* we maintain a non-specific operator such as *present* or *located* has been zeroed purely on the basis of the relational information carried in the preposition *by*. If the sentence had been *The loutish crowd from the library are not students* we should similarly want to say that the non-specific operator is *coming* or the like on the grounds of the different relational information carried by the preposition *from*. In both cases, however, the point is the same: a word of quite general informational content can undergo zeroing because its contribution is still "felt" to be present in the later prepositional entry.

In contrast, what we term "strong" appropriate zeroing characterizes the process by which a specific word or words may be zeroed as the highly favored cooccurrent(s) of other words (in addition to the preposition) remaining in the sentence. For example, in *The conductor threw the drunkard off*, the specific (non-indefinite) *train* or *bus* can be said to have been zeroed due to their favored cooccurrence with *conductor* and *off*. This process is also at work in *By the time Horowitz came on the audience was nearly riotous* where the specific *N stage* is recoverable in the unreduced source as the favored cooccurent of *audience, on* and presumably *Horowitz*. Likewise, since one of the meanings of *for* is that of indicating extent or duration, in *He attended no lectures for a year* we can say that the structure of the sentence in the base is *S; which was for a period (extending, lasting) for a year* where all of the modifier save the last *PN* has been zeroed as informationally redundant. Since likelihood of cooccurrence is most naturally thought of as relative frequency of conjoined occurrence, the regularities involved in "strong" zeroing are not of a determinant nature but only statistical, to which additional determinacy

is added by extra-sentential or discourse relations. Thus in *The pilot brought the aircraft down smoothly* we should normally expect *on the runway* as zero-able from *pilot, brought, aircraft,* and *down* but in certain discourse environments we also have *on the water, to treetop level, etc.*

2.32. O_{on} ("Weak") Appropriate Zeroing. Several distinct subclassifications can be made on the basis of the kind of appropriately zeroed operator in the various reductions. These reductions (zeroings) are of a limited number of operator words which fall roughly into three classes. The classes serve, after a fashion, as semantic (or: informational) partitions of the O_{on} prepositions. These classes can in turn be grouped according to whether the relevant meanings are primarily positional or directional (Group 1) or temporal (Group 2). Of course, no claim is made as to the uniqueness of the particular operators chosen here; rather, they should be viewed as representative of a (fuzzy) class of words having the same general informational properties.

2.321. Within Group 1, we distinguish appropriate operators that have a prevalently durative aspect: { *present, located, standing, situated, made, consisting, exposed, touching* }. The O_{on} prepositions which zero operators in this class are all characterized by a strong positional or spatially relational sense: *about, among, at, behind, beneath, around, near, beside, on, over, for, with.* This is what may be expected because the durative or spatially relational information borne by the zeroed operator is already contained in the favored cooccurrent (preposition), which means that the condition for zeroing – high likelihood and consequently low informational content with respect to the favored cooccurrent – is met.

Separate from these is a second class of zeroed operators: { *going, coming, leading, extending, moving, passing, dealing* } . These are selected by other O_{on} prepositions: *off, through, from.* The informational partition effected here is one indicating displacement, directional motion or (partially overlapping with the first class) positional relation. In addition, there are O_{on} prepositions which can zero operators in either class: *across, along, against, above, below, by, beyond, in, of, past, for, to.* Thus these can have both a durative, positional sense as well as a non- (or: less-) durative directional sense, as can be seen in the mild ambiguity of such sentences as *The fence beyond the last line of trees is down* where we can, for most purposes, posit an operator from either of the above classes *(present/located) beyond* or *(leading/extending) beyond.*

2.322. The Group 2 prepositions *before, after, during, since, until, throughout* are distinguished by their ability to permit zeroing of an operator with a temporal meaning. For some, *before, after, throughout*, indication of temporality is not a required aspect of their zeroed operator for these may as well occur in environments determining appropriate operators with positional, spatially relational or directional meanings: *He is before me in line ← (present/standing) before; The president's limousine is after the governor's ← (located/coming/goes) after; The papers throughout the study are John's ← (present/scattered) throughout.* On the other hand, *during, since,* and *until* have, in their non-metaphorical usage, extremely high likelihood of occurring with temporal operators. As a result, the class of appropriate verbs here is restricted to those bearing a temporal aspect {*occurs, endures, lasts*}. Among these we also include *extends*, as a time may be thought of as extending in relation to another time.

2.33. Appropriate Zeroing in $O_{on} \rightarrow O_{nn} \rightarrow O_n$ and $O_{on} \rightarrow O_o$ The former reduction is, as indicated, actually a two-step operation: the first is the zeroing of an appropriate operator yielding occurrence as as apparent O_{nn}; the second is the zeroing of the second N argument, resulting in an apparent O_n. This process is represented by the notation '$Z_{ap}\ O + Z_{indef}\ \bar{N} \,/\, Z_{ap}\ N$'. Where the second zeroing is $Z_{ap}\ N$ as in *A burly conductor threw the drunkard off*, we have *off* as a non-adjacent modifier of the verb *threw: threw the drunkard which was off* (= 'from') *the train.* In each of these reductions where an appropriate N has been zeroed, the words remaining in the sentence (strictly: those retaining phonemic shape) which permit the appropriate zeroing (as favored cooccurrents) have been indicated by heavy type. Notably, a number of Group 1 O_{on} do not spread to O_n from O_{nn} nor do they spread from O_{on} to O_o, *i.e.*, $O_{nn} \not\rightarrow O_n$ and $O_{on} \not\rightarrow O_o$: *among, at, for, from, of, with.* The failure to undergo these reductions involving the second N argument suggests that the prepositions here require an informationally specific noun as second argument rather than an indefinite $\bar{N}$ which, ***per contra***, would be a likely candidate for zeroing. Indeed, the fact that these prepositions occur in sentence initial position in response to an interrogative further illustrates that they serve to introduce specific rather than indefinite (*i.e.*, minimal) information: *Where were the peaches? Among the apples and oranges* but not *Among the things; Where is John? At his office* but not *At a place.* The inclusion of *of* and *for* in this group is attested by the fact, seen below (§ 3.1.), that they usually occur as argument indicators of higher operator with the result that only the highly specific zeroing of that operator is permitted.

Of the Group 2 O_{on}, only *throughout* has been found to undergo reduction of the second N argument ($O_{nn} \rightarrow O_n$). It also occurs in O_o position where it is frequently observed to exhibit a predictably adverbial meaning: 'totally', 'completely', 'entirely', a quite natural contraction from *throughout a period/course: The administration contains scoundrels throughout.* That the other O_{on} in this group do not occur in O_n position (and *during, until* also do not occur in O_o position) can be taken an indicative of their strong selectional preference to occur as temporal conjunctions of full-fledged sentences or between sentences and nominalized sentences (§ 2.34.). *Before* and *after* occur as O_o in virtue of their ability to have an indefinite $\bar{N}$ as second argument but only if the first conjunct is a sentence referring to an event occurring in relation to (*before/after*) some otherwise unspecified time: *He has come before (the present time/now). Since* has restricted occurrence as O_o in discourse environments which permit repetitional zeroing of a sentence referring to some event X described previously in the discourse. *Since*, usually occurring here as *ever since*, thus serves as introducing a time in the indefinite past when the event X, described by repetitionally zeroed S_2, took place with attendant consequences described in S_1: *And so he has been happy ever since ← since a time when X (occurred).*

2.34 Appropriate Zeroing in $O_{on} \rightarrow O_{oo}$ and $O_{on} \rightarrow O_{oo} \rightarrow O_{on}$. The temporal character of the Group 2 O_{on} is clearly demonstrated in these reductions in which the indefinite $\bar{N}$ *a period, a moment, a time* are zeroed. Intuitively, occurrence as O_{oo} implies the functional role of a conjunction linking two sentences and, in fact, *before, after, since* and *until* widely occur as conjoining two sentences. The mechanism enabling these O_{on} to occur as bi-sentential conjunctions is seen in the reduction $O_{on} \rightarrow O_{oo}$ where zeroings are all of the form *(at/in a period/time* V_{ap}*)* O_{on} *(the time/moment/period when)* where V_{ap} is some aspectually appropriate verb (*occurs, lasts, extends*). The O_{on} together with its arguments is brought into conjunctional position as a *wh-* modifier from its source in an appended sentence: *Henry James wrote The Bostonians; his writing The Bostonians happened at a time; Henry James wrote The Ambassadors; his writing The Ambassadors happened at a time; prior time occurred before penult time → Henry James wrote The Bostonians at a time which occurred (→ occurring) before the time at which (→ when) he wrote The Ambassadors → Henry James wrote The Bostonians before he wrote The Ambassadors,* where *when* pronouns the relative *at which.*

Similarly, the mechanism of modifiers introduced by *wh-* permits a return

to apparent O_{on} position from O_{oo} in the reductional path $O_{on} \rightarrow O_{oo} \rightarrow O_{on}$. As a result, reduced forms (sentence nominalizations, non-primitive N) can appear as N second arguments to these temporal O_{on}: *throughout the day* ← *throughout a period, said period is that which is day(light); during the questioning* ← *during a period which was of someone's questioning someone; since the war* ← *since a period, said period is of that which is war*, with *that which is* → *the* (see below). The question may arise: why are these O_{on} occurrences derived by means of *wh-* on the indefinite $\bar{N}$ *moment, period, time* rather than taking the apparent N arguments (*day, questioning, war*) as primitive without any attendant reductions? Detailed justification would require an extended account of relative-clause formation as well as a meta-theoretical defense of the "regularizing" function played, within the grammar as a whole, by occurrences of indefinites, subsequently zeroed (*cf.* Harris, in press § 5.12.) For present purposes we may note the following: 1) In many cases, the morphology of the apparent N argument clearly indicates that it is the product of a reduction: *questioning* ← *someone's questioning someone.* 2) The N arguments in such occurrences are (semantically speaking) 'definite', a fact often evidenced by the presence of the definite article, whereas these O_{on} have favored selection to indefinite $\bar{N}$. Properties of the definite article in its various occurrences are most adequately explained within the present framework by taking it as the product of a reduction: *that which is N* → *the N* (Harris, in press, § 5.36). Given the source of the definite article in a relative clause, we should expect and, indeed do find, that the various non-primitive N occurring in this position (*i.e.*, as apparent N second argument to O_{on}) do not occur, except as nonce forms, as only indefinitely specified *N, a war, a breakfast: *He arrived* O_{on} *a breakfast* with O_{on} = *before, after, during, since, until, throughout.* Thus, the N in this position arises only via a relative clause modifier of a zeroed indefinite *N a time, a period, a moment.*

Among the temporal O_{on}, *before, after* occupy a special position in the grammar in so far as tense, with its attendant properties and complexities, is derived from their zeroable occurrence (Harris, in press, chapter 6). Accordingly, *before, after* have only minimal restrictions (largely imposed by discourse requirements) on occurrence: they can conjoin full sentences, nominalized sentences (*John's leaving before the final singing of the chorus occasioned much envious speculation*), reduced forms (*The election after the war was predictable*) or any combination thereof.

The aspectual character of the remaining termporal O_{on} varies considerably. *During* and *throughout* do not occur as bi-sentential conjunctions but can link

a sentence and a nominalized form: *The appointee became visibly hostile during the Senators' questioning* but not **The appointee became visibly hostile during the Senators questioned him.* This restriction accords with the intuitive semantic requirement of *during, throughout* that the temporal extent of the event described in S_1 be (usually properly) included within the duration of the event described in S_2. Here, the restriction is not one imposed on the class of V_{ap} in S_2 but rather that the nominalized form of S_2 insures even non-durative V in S_2 can be interpreted as indicating an event or action which may be iterated over time: *Claudia jumped during John's sneezing* and even *He was injured during the explosion*, where the most natural interpretation is that the explosion was not a momentaneous event but a series of events. Notice that in those instances, *e.g., John wept throughout breakfast*, where S_2 position is occupied only by a reduced form, the aspectual properties of the sentential source are retained by the surviving apparent N. Thus the interpretation of *breakfast* as an event extending (enduring) over a period can be explained by the presence of a durative V_{ap} operator, subsequently zeroed, in the sentential source: *throughout a period which was of one's eating breakfast → throughout breakfast.* That an (apparent) N can bear aspectual meaning – whereas aspect is normally thought of as accruing only to an operator's occurrence in a sentence – is again evidence for its sentential source (see above).

Since, meaning 'from' or 'after' (a time when) rather than 'because', has preferred selection to durative or iterative V in S_1 as in *He has complained since he arrived*, but it can also conjoin sentences with non-durative V: *He died since she left.* Occurring as O_{oo}, *since* is often interpretable in a causative sense, leading to ambiguity: *He exercises every morning since his doctor told him he was overweight, John lived in Manhattan since he had money* with *since* ambiguous between the meaning 'because' and the temporal meaning 'from' (a time when). In other O_{oo} occurrences, *since* can only be interpreted as 'because': *The glass was brittle since it broke.* Still, the temporal meaning is not unrelated to the non-temporal, causative one and syntactically we can posit a common source (*cf.* Harris, in press, § 6.16.). In this case, *since* meaning 'from (the time when)' can be thought of as extending into the (prescientific) causative meaning by what we may call a postulate of speaker's evidence: the occurrence of one event after another often (*vide* David Hume) provides grounds for saying that the latter is the cause of (or: is evidence for) the former. In other words, *since* the latter occurred, the former occurred. In *John lived in Manhattan since he had money*, the intent of the speaker is clearly that John's having or acquiring money is a prior condition to John's living in Manhattan.

Until, like *since*, has preferred selection to the indefinite $\bar{N}$ *a moment* as second argument as opposed to the more durational *a period, a time*. Consequently, both *until* and *since* have preferred selection to non-durative V in S_2 and to durative or iterative V in S_1: *The bells rang until the villagers were gathered together ← for a period extending until a moment at which. . .; He's been composing since yesterday ← for a period extending since a moment which occurred yesterday.*[11] *Since*, occurring as an O_{oo} and, by that fact, able to bear the meaning 'because', can violate this preference: *He slept since she slept.* But even if V in S_2 is durative, *until* retains its selection to the indefinite $\bar{N}$: *She sang softly until the child slept ← for a time extending until the moment when the child slept* (← *went to sleep*). Where S_2 is a reduced form indicating an event of considerable temporal extent, *e.g., the war*, the selectional preference to the indefinite $\bar{N}$ may be abrogated but non-durative V in S_2 is retained (although in zeroed form): *John has been despondent since the war ← for a time extending since the period when the war occurred.* Alternatively, we may view the meaning here as not primarily to the war conceived of as having considerable temporal extent but rather to a specific point in the course of the war (an endpoint or some interior one), thus preserving the preferred selection: ← *since the moment when the war began/ended/intensified, etc.*

2.35. O_o Appropriate Zeroing. In a number of cases in which O_o prepositions occur in O_{on} position (Column I) or in positions into which O_{on} have spread, *i.e.*, O_{nn} (Column II), it would fit the classification proposed as well as the requirement of paraphrase to say that an appropriate O_{on} preposition (sometimes with its N argument, for indefinite $\bar{N}$) has been zeroed. Thus in *Bill sailed down the river* where *down* (O_o) appears in O_{on} position, one would take the appropriately zeroed O_{on} preposition to be *along*. The matter of justifying the zeroing in this case and others like it finds support in that the class of N arguments with which *along* occurs with high acceptability are nouns denoting "objects of considerable extent" (*e.g., river, tree, pole, driveway*; with somewhat less acceptability, *lamp, pen, book*). Note that even in the somewhat anomalous *He looked up the lamp*, the zeroing of *along* is felt in the favored interpretation of *the lamp* as something having considerable vertical extension (*e.g., streetlamp*). Some common appropriate O_{on} zeroings of the O_o prepositions are as follows – *up: ran, climbed, looked up the tree* (zeroings *along*), *went up the elevator* (*in, on*), *ran, leaped up the stairs* (*on, over*), *drive up New England* (*through*), *The index is up a point ← up past one point to the next point; down*: (generally as above); *away*: commonly zeroing *from* as in

move, take, walk away. This zeroing is usually found to involve the indefinite $\bar{N}$ argument of *from* or a pronoun argument which is understood to have the same referent as the subject, information which is so trivially understood as to not merit explicit mention: *They moved away last year, Take away the prisoner!, Sally ran away into the night ← away from here, a place* as well as *Homer kicked away the snarling dog ← away (from him).* Also, *back*: commonly zeroing *from* but also *to*, as in *The youth raced back home; out:* zeroing *of* (meaning 'from') or *from* as in *Donna Elvira stormed out the door.*

There is also a widespread and familar zeroing of certain O_{on} (and their accompanying indefinites, if present) indicating extent or duration of time or a process. While this zeroing is not limited to, nor really dependent on, occurrence with the various O_o, nevertheless, under certain verbs (*came, left, stayed, remained, etc.*) it quite frequently accompanies the O_o, lending them the appearance of occurring as O_{on}: *He came back Thursday* (zeroing *on*), *He stayed away a week ← (for a period extending, lasting) a week, The landlord wants us out Wednesday ← (by) Wednesday, Jason remained out a year ← (for a period extending, lasting) a year.*

2.36. Further Remarks. The data collected here suggest that the various argument-demand requirements and reductions partition the prepositions into several semantic classes. Group 1 O_{on} have a broadly positional or locational (more durative) sense, Group 2 O_{on} have temporal meanings and the O_o bear a broadly directional (less durative) sense.

Within the group of O_{on} prepositions which have been distinguished as having a primary positional (directional) sense, a number frequently occur as well in clearly temporal usage: *in the morning, in June; at 5 o'clock; on Wednesday; about midnight; around the middle of next week; by tomorrow; near closing time; past departure time; through 1979, through the night, etc.* In light of these occurrences, it would seem reasonable to suppose these prepositions have as well a primitive temporal sense. However, in line with an informational characterization of prepositions stated in terms of the above and similar reductions, it is preferable to maintain the concrete sense as primary while "explicating" the temporal usage through reductions which show a plausible course for the extension of meaning. There is some evidence that this approach is correct. The range of time-indicating $\bar{N}$ arguments with which several of these prepositions can occur in their temporal meaning is selectionally quite restricted: **on 5 o'clock; *in midnight, *in next week; *at June, *at summer, *at 1980* (although one can say *The calendar stopped at 1980*, presumably reduced from *at the date*

which was 1980); **through 5 o'clock*. The restrictions on occurrence indicate selectional preference for appropriately scaled temporal *N* words, where appropriateness is seen to stem from the gross likelihood relations of these O_{on} to *N* arguments when occurring with their primary concrete meanings. For example, *at* in its concrete meaning has high likelihood of occurring with (zeroable) indefinite second argument *a point, a place*. Thus in *My appointment is at 5 o'clock*, we can posit a source preserving the prefered selection and hence the primacy of the concrete meaning: ← *My appointment is located/situated at a point which is 5 o'clock* (= *5 on the clock*), whereas *?Their journey to India was at 1979* because of the semantic anomaly – and consequently low likelihood – of a source: ← *at a point which is 1979*.

Additional evidence that the concrete, positional meaning for these O_{on} is primary comes from many of their occurrences as apparent O_{nn} with temporal meaning, as in the last example or in *Their estimated arrival is around midnight*, *The contract is through 1980*, where the zeroed appropriate verb – *located, present, extends* – may be taken as that appropriate to occurrences of these prepositions in their concrete usage. Whether all temporal occurrences of Group 1 O_{on} may be derived in this way is admittedly an open question and, in fact, the occurrence of the Group 1 *in, at* in the unreduced source of the Group 2 O_{on}, *i.e.*, as in the schema

S_1 *in a period, at a time* V_{ap} O_{on} *a moment/period/time when* S_2

seems more genuinely metaphoric. But, given the present unrefined method of exhibiting metaphoric extension of meaning (§ 3.4), these metaphoric occurrences can be "accounted for" only via a vicious regress through the Group 2 O_{on}, *e.g.*, S_1 *during/throughout a period as in something's being in something*, clearly an unsatisfactory solution.

The O_o show a marked contrast to the O_{on} in that, although they do co-occur with some durative verbs (*remain, fly, grow, keep, work, live, make, lay, sing, carry, argue*), they cannot co-occur with a rather sizeable class of durative verbs: *subscribe, maintain, forgive, recognize, perform, judge, graze, stress, establish, have, suffer, permit, issue, express, strain, consider, intend, desire, prepare, intrigue, evade, revere, contemplate, study, extol, intensify, detest, adore, conceive, know, imagine, place, inhabit, contest, renew, contain, need, survive, modify, compete, restore, conceal, participate, want, ponder, position, sleep, relate, publish, destroy, possess, understand, provide, protect,* etc.

Additional evidence for the semantic classification of O_o prepositions as less durative is provided by data which show that most O_o are readily extended

into verbal occurrences. Thus we have: *He downed three brandy and sodas, Henry backed the car into the garage, All the liberal candidates are backing the trade embargo, He upped the motion.* These arise from appropriate zeroing of a lower verbal operator argument of the preposition and affixing to it an operator indicator *-ed, -s, -ing* which carries the tense of the zeroed verb. *He drank down → He downed; He drove the car back → He backed the car.*

The verbal extension of the O_O may be even more sharply characterized by their occurence in exclamatory remarks: *Up the Queen!* (British English); *Down the Hatch!, Up the ladder, you rascall!, Away with all tyrants, Out! Now!, Back the Equal Rights Amendment!.* Correspondingly, we find that the O_{On} prepositions as more durative, do not show the same facility to occur verbally: **He acrossed the street. *He fromed. . . , *He withed. . . .* Moreover, the O_{On} cannot occur alone as exclamations: **About your business!, ?Along with you!, *Among the prisoners with you!, *Near the end of the highway!.* We do have, however, *Off with his head!* and *On with the show!* whose occurrence depends crucially on the fact of the $O_{On}O_{On}$ combination. An exception to the non-verbality of the O_{On}'s is *near: The train neared the station. Near* is further distinguished (together with *over*) by the fact that it forms an adverb with *-ly.*

3.0. Further reductions

3.1. Special Appropriate Zeroing. It may be noted that within the class of Group 1 O_{On} prepositions, there is a class (*for, of, to, by*) whose members, in many of their uses, do not easily spread to new cooccurrent environments via the chain of reductions characterized in the table above, but do spread via other 'special' appropriate zeroings (to be described below). By a 'special' zeroing we refer to a process which permits zeroing of a higher operator (later entry), which is quite specific to a given context, on the basis of the informational content of words remaining in the sentence. These facts are apparently related in the following way: a) that these prepositions do not spread via the stated chain of reductions is attributable to the fact that they regularly occur as (semantically) informationally-weak argument indicators to higher operators (verb). Their primary role is thus merely to "point out" an argument for some (semantically) informationally-stronger higher operator. Here, as with all zeroing, the tacit assumption is that the ability of a word to spread to new cooccurrent environments, *i.e.*, to permit a zeroing of a neighboring word or words, is purely a function of the information carried by the surviving word

or words vis-a-vis the zeroed entities such that the result of the zeroing operation preserves (up to local synonomy) informational content. The failure to spread can be seen, then, as following from this rather limited informational/semantic status and the fact that the higher operator requires the presence of its arguments (and correspondingly of its argument indicators). (Some examples: *allow for, thank for, free of, clear of, afraid of, rid of, full of, compare to, similar to, adjacent to, according to, previous to, attach to, lunge at, swear at*). b) Nevertheless, although these particular prepositions do not normally allow zeroing according to the stated reductions, they do in fact permit zeroing of certain of their operators to which they stand as argument indicators. That an argument indicator can carry sufficient informational weight vis-a-vis its operator to permit zeroing of that operator appears aberrant in view of the observation above that argument indicators generally have low-informational content. Why is this? In some cases, the zeroing of a higher operator (later entry) seems to depend as well upon information already present in the sentence (thus independent of its indicator which is imposed upon the entry of the operator) in words which stand as arguments (usually the first) to the zeroed operator. For example, in *John loves a poem in German*, the zeroed *written* is recoverable from *poem* (which is something which is written), *German*, and *written*'s argument indicator *in* (something which is written is almost always written in a particular language). Compare *John read a poem by Goethe*, where in English we hardly say *a poem made by Goethe* but rather *a poem written by Goethe*. In other cases, however, zeroing of a higher operator is allowed without reference to the information contained in its arguments. In *We bought a book for John, suitable* or *intended (for)* seems to be recoverable on the basis of the informational weight of the argument indicator *for* alone. Apparently, we must recognize the fact that argument indicators have, in certain situations, the special property of allowing their operator to (go to) zero, a reduction made possible either in tandem with one or more of the arguments of the operator or which may be carried out solely by the argument indicator. Just how widespread this phenomenon is and some of the restrictions on its occurrence are indicated in §§ 3.11. - 3.13.

3.11. Special Zeroings: *for*

This is a book for John ← *intended, suitable for (X intend(s) this book for John)*
The governor denied the condemned man's plea for mercy ← *asking, begging for*
He is for Kennedy ← *voting, rooting, pushing for*
The melons are three for a dollar ← *in exchange for*
We reserved a table for two ← *set for* (we do not say *a table made for two)*
John bought a car for racing ← *built for, indended for*
John did a favor for Sally ← *acting for, intended for*
The member for the fifth district spoke ← *standing for*
This room is for rent ← *available for someone's renting it*

A noteable fact about these reductions is that several of the contexts only determine a rather wide margin of appropriateness for the zeroed operator. As a result, the various possibilities for the zeroed appropriate operator may not be synonymous, even locally; *e.g.*, a book intended for John may not be suitable for John while a car intended for racing may not have been built for that express purpose. Also we have occurrences of *for* where we cannot point to any particular operator which has been zeroed but can only say that *for* goes proxy for, or exists as a variant, of other words or constructions:

John is unusually intelligent for a sociologist ← *considering that John is a sociologist*
It is extremely sultry for this time of the year ← *considering, allowing for*
The family always goes out for a walk after Sunday lunch ← *for the purpose of*

It may not be readily apparent, independent of further textual considerations, which operator or type of operator has been zeroed, giving rise to ambiguities. For example, in *The police ticketed the limousine for the governor*, one possible meaning is that the limousine is intended for the governor's use while another plausible reading is that the police ticketed the limousine at the governor's behest (*acting for* the governor). A third less likely possibility is that the police ticketed the limousine in lieu of the governor's doing so him-

self, *i.e.*, they acted *in place of* the governor rather than *for him*. (Compare: *The coach sent Jenkins in the game for Jones*).

Another, rather more complicated case of special zeroing occurs in *The children wanted a court for volleyball* which presumably arises from *The children wanted a court suitable, available, for the children to play volleyball* → *The children wanted a court suitable for playing volleyball* → *The children wanted a court for volleyball*. In this instance, *for* is, so to speak, doing double duty: as an argument indicator of *suitable*, *for* permits *suitable, available*, to zero, and as an argument indicator of *play* (indicating the first *N* argument, *children*) in the infinitival form *for children to play volleyball*, it permits zeroing of *play* along with the other argument indicator in the infinitival mood, *to*. A related example is *His point is important enough for special treatment* presumably reduced from *for his point to call for special treatment* where *for* serves as an argument-indicator in the infinitival matrix and as the remaining indicator of the zeroed verb *call*.

3.12. *of*. Many *of*-occurrences are as an argument indicator showing the argument position of a noun (or nominalized verb) to its operator. *Of* occurs as an argument indicator both in unreduced forms. *E.g.*, *full of, certain of, father of*, and as the product of nominalization: *the cause of, mixture of, etc.* The various uses and their sources are briefly surveyed below.

With O_{nno} verbs: *tell, inform, admonish, warn, advise, accuse, convict*. In *Robert told of his travelling in Peru, of . . . -ing* are indicators imposed by the operator *told* on the sentence *He travelled in Peru*. In certain factive constructions, *e.g.*, † *I accuse him that he cheated*, the language has developed in such a way as to prefer the *of . . . -ing* nominalization in spite of its generally different aspectual properties.

With O_{nn} verbs: *made of, consists of, composed of, possessed of*. As will be seen, zeroing in this class is quite widespread.

With O_{nn} nouns: *father of, widow of, president of, chief of, professor of*.

With O_{nn} adjectives and classifier nouns: *full of, lack of, clear of, sure of, certain of, kind of, case of, type of, form of, shape of*.

With O_{no} adjectives: *afraid of, ashamed of, tired of, capable of*.

With O_{no} verbs: *know of, think of, dream of*. Again, occurrence here is as a variant of *that*. It must be noted that there is another *know* in English (corresponding to Gr. *kennen*, Fr. *connaître*) which is O_{nn}, *e.g.*, *John knows Mary* or *John knows of Mary*, where *of* is not an argument indicator but is an O_{on} on *know, Mary*.

In several of its uses, *of* retains the approximate meaning *from* or *away from*, which is its original sense: *He nearly perished of hunger.* This *of* can zero an appropriate verb of movement or motion: *The Cossacks came within a mile of the city walls* ← *a mile reaching/extending from the city walls; The Duke of Gloucester*, or (the now antiquated) *a man of London* ← *coming from.*

In its so-called attributive use, *of* as in *a sonata of Haydn, a man of tact*, is an argument indicator to a verb which has been zeroed under the process of appropriate zeroing described in section 3.1. Thus, these are reductions of *a sonata attributed of (to) Haydn* or *a sonata which is due to Haydn, a man possessed of tact.* This is also the case with the compositional *of: a distance of over 700 yards* ← *consisting of over 700 yards, John slept on a bed of nails* ← *made of, consisting of nails.* This usage with *make* has been carried over into figurative or metaphorical speech: *make the most of, make a fool of, make the best of, etc.* Again in certain situations of restricted selection, ambiguities can arise via this process, *e.g., a pot of gold* can be either *a pot full of gold* or *a pot made of gold* or (conceivably) both. (Compare: *a pot of soup* ↛ *a pot made of soup*).

The partitive *of* arises as an argument indicator in just the same way: *The garden is behind the corner of the house* ← *behind the corner (which is) part of the house, i.e., of* permits zeroing of its operator, *part.* A use which seems quite closely related is that in *John climed over the wall of the park.* But we can hardly maintain that the source here is something like *John climbed over the wall-part of the park* so that we have to say that a more specific operator, appropriate to *wall* and *park*, has been zeroed, *e.g., bounding, limiting* → *boundary, limit.*

The classifier *of* is also an argument indicator to a zeroed operator; thus *a crime of treason* ← *treason is a species (kind, case) of crime*, a usage which is quite similar to certain uses of *of* to express possession, *That is a book of his* ← *That is a book of his books* ← *that is a book member of his books*, but not to others where *of* is an appropriate paraphrase of *has: the house of my father* ← *my father has a house.* In still other occurrences where possession is expressed, *of* is an O_{on} operator which has *'s* as a variant and which means *belongs to: The book is John's* ← *The book is of John (The book belongs to John).* These various possessive *of*'s serve to distinguish the two distinct interpretations of *that book of his*, viz., 'he wrote that book' (member of his books) and 'he owns that book'.

There is also a strong *of* which is O_{on} meaning approximately, *regarding* or *pertaining to: breakfast of champions, a history of Japan, the origin of the*

species. Finally, we note that *of* as argument indicator is a frequent accompaniment of various nominalizations, *e.g.*, with *-ing: He teaches math → his teaching of math*, and many others, *e.g., He explained the problem → his explanation of the problem, He betrayed the secret → his betrayal of the secret, He managed the firm → His management of the firm, X caused the accident → X was the cause of the accident.*[12]

3.13. *by.* A familiar use of *by* is in the passive where it occurs as a so-called "agentive" for the "logical subject" (*i.e.*, the subject in, should there be one, the active form) of the sentence: *e.g., Manhattanites disapprove of dogs, Dogs are disapproved of by Manhattanites.* Unlike previous transformational analyses, in the present theory the passive is not seen as the result of a transformation *sui generis* but rather as the logical product of several successive reductions whose physical components are subject-object "permutation," *is . . . en*, and *by* before the permuted original subject.[14] Reduced to these essentials, it becomes clear that the *by* of the passive is nothing other than a resultant (*i.e.*, an argument indicator) from a variant nominalization of the sentence. Thus *Manhattanites' disapproval of dogs* exists as well as *The disapproval of dogs by Manhattanites.*

Among the most common special zeroings of this *by* are: *made by, composed by, created by, etc.* as in *The painting is by Raphael, The C minor symphony by Beethoven.* This *by* also carries the meaning of *by means of, V-ing by means of: John went the entire distance by boat ← travelling, going by means of, Reading by candlelight is tiring to the eyes ← One's reading things by means of candlelight. . . , The only way to learn some things is by experience ← by means of one's experiencing them.* There is also the meaning *by virtue of, by the fact of: He is an Englishman by birth ← by the fact of his being born in England* or *Of English parents, etc. By* occurs as a variant in certain comparative constructions: *He is taller by three inches, Our team won by three goals ← Our team won the match; the degree of our winning was our teams' scoring goals which were more by two than the other teams' scoring goals*, where *more by two than* is a variant of *two more than. By* also has several 'frozen' forms which carry the meaning of an expanded construction: *We advanced slowly step by step ← with one step by the side of another step, The workmen wanted a board ten feet by two feet ← ten feet in length by the side of two feet in width.*

3.2. Repetitional Zeroing. Repetitional zeroing operates with respect to the

prepositions in the same grammatical situations and under the same conditions as in the rest of the grammar. Thus, there is parallel zeroing under *and* and *or*: *Bees swarmed among the roses and the tulips* (zeroing *Bees swarmed among*), *You can collect signatures at the square or the bus terminal* (zeroing *You can collect signatures at*). Under certain conjunctions there is end-zeroing: *He jogged across the field and up* (zeroing *He jogged up (along) the field), We ran across the street just before the truck came through* (zeroing *the street*), which is only marginally acceptable if at all, with other conjunctions, *e.g.*, with *or* in many situations: **Jan ran across the street or over.* Acceptability in these cases becomes greater if the force of the conjunction is strengthened: *He either had to go around the fence or over.* These reductions, in conjunction with the zeroings treated above, carry the prepositions into a wide range of positions in the sentence. A brief survey follows with special attention given to parallel-zeroing.

3.21. With parallel-zeroing, when two occurrences of a word (and any modifiers provided they are the same) are under *and, or,* the second occurrence of the word (along with its modifiers) is zeroable. Thus there is zeroing of the operator *fishes* in *Harald fishes by the brook and Knut on the lake.* The preposition may also be zeroed as in *Frank mused about the election and other mockeries.* The operation of parallel-zeroing appears indifferent as to whether the occurrence of the preposition is as an argument indicator or as an operator. As an argument indicator, *on* has been zeroed in *Sally was accustomed to rely on Thomas as well as Jan,* while as an operator in *Plaster fell on the table and the floor.* There are instances in which the requirement of parallel entry-order positions for zeroing is apparently violated. In *Isaac swam down and across the pool, down* is an O_0 and *across* an O_{on}. This violation is only apparent, however, as it can be seen that an O_{on} (*along* is perhaps most favored) has been zeroed as appropriate (*Isaac swam down along the pool*), preserving the requirement.

The requirement that the two words share the same chain of modifiers for zeroing explains why in *Sally met Sidney by the train station near the stockyards in Chicago and Sarah in Detroit,* only *Sally met* and not by *by the train station near the stockyards* has been zeroed. But in *Sally met Sidney and Sarah by the train station near the stockyards in Chicago*, the entire chain of modifiers has been zeroed. Parallel zeroing in conjunction with appropriate zeroing has already been noted (*i.e.*, in *Isaac swam down along the pool*); a different combination can be seen in *There was a chair behind and a book on the old*

table where an appropriate operator (located, present) zeroed in the first conjunct, has undergone parallel zeroing in the second.

Zeroing is stylistically preferred when *and* is on two sentences that, except for their order, are identical: *e.g., The wheel turned around and the wheel turned around → The wheel turned around and around.* The sense of repeated action is preserved in the reduced form (in fact, it seems given an additional emphasis). Conjoined occurrences of the same preposition are regularly found with *around, on, over,* (among the O_{on}) and *up, down* (among the O_{o}): *Nilsson sang on and on, We went over and over the example, The rocket shot up and up, He rode down and down the canyon looking for an exit.* Such sentences appear to be severely restricted. Thus, a plural *N* subject, a mass noun, or quantifier is ordinarily required with *by and by: The tanks rolled by and by emitting great oily clouds of diesel fumes, The parade passed by and by without apparent end,* but not in *The plane flew by and by without landing.*

3.22. End zeroing refers to the zeroing of the final sequence of words, typically in the second sentence. Under *and*, the prepositions investigated fall into two groups. The first comprises those pairs of prepositions which permit both parallel and end zeroing. There are two subclasses; one in which the prepositions can occur in either order (though there may be a favored ordering), the other in which there is only one order of occurrence. In the first subclass are the pairs *up/across, down/across, above/below, up/down: Richard chased him up the field and across, The tugboat sailed across the river and down, The gulls flew above the clouds and below, The trail went high up into the mountains and down.* In the second subclass are *on/below, up/over, up/past: Submarines travel on the surface and below, Jan climbed up the fence and over, The express roared up the tracks and past, etc.* The second group comprises those pairs of prepositions which permit end zeroing to the exclusion of parallel zeroing: *to/up, to/down, across/back, up/back, down/back.* Examples: *He ran to the stairs and up, across the street and back, to the store and back (← back from the store).* End zeroing also occurs under *or: The passengers were assembling on the deck or just below* and other conjunctions: *He tiptoed across just before the bridge collapsed,* with end zeroing in the first sentence.

3.3. *He decided on the boat.* In some cases, it is not readily apparent on purely syntactic grounds whether a given occurrence of a preposition is as an argument indicator or as an operator, a situation complicated by the fact that different 'words' (here, operators) are found to share the same phonemic shape.

Corresponding to this uncertainty is the related question of whether any zeroings have occurred, and if so, what and where. To take a well-known example, the ambiguity in *He decided on the boat* has its source in the fact that *on* can be given two quite distinct paraphrases: 'He decided the matter/question while he was present on the boat' as opposed to 'He decided on (= regarding, concerning) the matter/question of the boat'. Since this and similar examples have long circulated through the literature without adequate explanation[14] it may be worthwhile to pay some attention to the syntactic source of this ambiguity.

Within the framework assumed here, there are several possibilities. One is that *on* in *decide on* is an argument indicator imposed by *decide* as it operates on the sentence which is its second argument in the same way that *on*, in *rely on*, is the argument indicator imposed by *rely* on its second argument. But this leads to an undesirable result, namely, that whereas *rely* always occurs with *on* (thus substantiating the claim that *on* is its argument indicator, see § 2.1.), *decide* assuredly does not. And, in accordance with our methodological maxim of avoiding class cleavage (§ 1.22.), we do not want to say that the language contains two verbs *decide*, one occurring with an argument indicator and one without. Rather, there is only one *decide*, an O_{no}, whose second argument is a sentence referring to a time different from that of the operator (or to some relatively 'timeless' state of affairs): *John decided to take the train, He decided that the climate was too dry for grapes to grow, The jury decided that John was innocent, He decided that John is a fool.*

Another possibility is that there are two operators *on*. Consider the following pairs of sentences: 1a. *He decided to run for office*, 1b. *He made a decision to run for office*; 2a. *He decided on running for office*, 2b. *He made a decision on running for office*. In 1a. and 1b. the course of action incumbent upon his decision is that he will run for office; we shall say that these sentences permit only a positive interpretation (as to his future course of action). However, a negative interpretation can be forced upon 2a. (perhaps sharpened with pause between *decide* and *on*) and is clearly evident in 2b. In other words, 2b. and, to a lesser extent 2a., have the interpretation 'he decided ***whether or not*** to run for office'. The presence of *on* in the sentences of 2 yields an interpretation which introduces an element of semantic uncertainty, missing in the sentences of 1, as to the nature of the decision. Our task therefore is to explain why the argumented sentence following *decide on* carries the (zeroed) argument indicator *whether ... or* while the argumented sentence following *decide* clearly does not (*He decided to go* cannot be taken to be reduced from *He decided whether*

or not to go but from *He decided for him to go, i.e., He decided that he will go.*

Notice that this implicational ambiguity (either *to V* or *not to V*) can be adduced in *He decided on the boat* under the interpretation 'He decided regarding the matter/question of the boat' where *matter/question* is an O_O classifier of the sentential argument of *decide*, imposing the argument indicator *whether. . . or* on that sentence: *a matter/question is whether for him to* V_{ap} *the boat* (with V_{ap} some verb appropriate to the discourse, *e.g. take, buy, sell, etc.*). If we suppose the relevant derivation is: i) *He decided something; something is on a matter/question; a matter/question is whether for him to* V_{ap} *the boat* → ii) *He decided on a matter/question whether to* V_{ap} *the boat* → iii) *He decided on V-ing the boat* → iv) *He decided on the boat*, there are two observations of interest. The first is that *on* (step iii) imposes *-ing* on the sentence substituted for the sentence classifier *matter/question*. We can find support for this analysis in the historically attested derivation of the so-called 'progressive' tense in English from a PS^{nom} source (as given by Harris, in press, chapter 6): *The house was a-building* (1393 OED) ← *The house was on one's building of it*, where *on* has the meaning 'in the process of'. Whether these are in fact occurrences of the same *on* but with two meanings is not entirely a pseudo-question because the meanings involved are apparently quite unrelated. Yet from what must have been its widespread occurrence in the progressive, we can easily imagine *on* spreading to similar (O_{OO}) environments where new (or: different) semantic relations had to be expressed. However, there is a plausible course of metaphoric extension (see § 3.4) of O_{OO} *on* meaning 'concerning, regarding' from a source which is O_{On} as, *e.g.*, in *Margaret wrote a book; said book (exists) on something as in said book's touching, bearing on something; something is the matter of the Risorgimento* → *Margaret wrote a book bearing on the matter of the Risorgimento* → *Margaret wrote a book on the Risorgimento.* Pending some such account of the extension in meaning of the O_{OO} *on* ('in the process of'), this means that at the cost of maintaining that the language contains two distinct words *on*, we have avoided the counterintuitive claim that there are two verbs *decide.*

A second observation regards the zeroing of the O_O operator *matter/question* in the reduction ii) → iii) where, notably, the argument indicator *whether. . .or* is also zeroed (**He decided on whether V-ing the boat*). Here we must take into consideration that there is no requirement that once an argument indicator has been imposed by an operator on its argumented sentence it must be phonemically retained under further operators on that operator-argument pair when the prior operator reduces to phonemic zero shape: *John phoned, John's*

phoning continued, John phoned all night (*continue* → ϕ). Yet the informational presence of *whether. . .or* is still 'felt' in iii) and iv) because each admits of opposing construals (positive or negative) as to the course of action to be adopted. That is, *He decided on the boat* (= iv) implies either 'He decided to V_{ap} the boat' or 'He decided not to V_{ap} the boat'.

3.4. Metaphor. Due to their quite general meanings, many prepositions can be extended into a wide variety of metaphorical usage: *e.g., He is above cheating, – an expert on trout-fishing, – on to her tricks, – for legalized gambling, – beyond redemption, – a coward at heart; an idea off the top of my head; a conversation over his head; He ran till near exhaustion; She imitates her mother in hating her father; John lives in sin, – from day to day, etc.* Traditionally, accounting for metaphoric usage has been a formidable obstacle for categorically-based grammars as the metaphorical occurrence of a word may lend it a highly abstract meaning permitting it to enter into quite different syntactic and co-occurrent environments (*i.e.* showing differences in argument-requirement and cooccurrent range) from those sanctioned by more concrete applications of the word. An advantage of the present grammar is that many cases of metaphorical usage can be seen to be derived, in specifiable ways, from non-metaphorical usage via reductions which preserve base categorical status (argument-requirement). For O_{on} prepositions, these reductions are found to consist chiefly in two kinds of reductional paths, viz., (1) $O_{on} \rightarrow O_{no}$ and (2) $O_{on} \rightarrow O_{oo}$; for the O_o, we find $O_o \rightarrow O_n$.

The sample derivations given below are intended only to convey the flavor of a possible treatment of metaphor within the confines of the grammar. $O_{on} \rightarrow O_{no}$: *Henry is above cheating* ← *Henry is present (exists) in a manner which is related to a cheating manner as in one's being above something* where *above* is O_{on}. $O_{on} \rightarrow O_{oo}$: *John and Mary are intelligent beside being good looking* ← *John and Mary are intelligent in addition to being good looking, which is as something being present beside something* ← *John and Mary are intelligent; John and Mary are good looking; their intelligence is (exists) beside (by the side of* = in addition to*) their good looks* where *beside* is O_{on}. $O_o \rightarrow O_n$: *He is up on biochemistry* ← *He is informed on* (= about) *biochemistry as in one's being up* (= dominate) *on something.*

With few exceptions, the O_{on} exhibit a strong tendency to spread to metaphoric usage via a process of reduction: the zeroing of an appropriate operator (verb or classifier) and/or the zeroing of an indefinite primitive $\bar{N}$. It may be surmised that the metaphoric productivity of the O_{on} stems from a ready semantic transition from concrete locational/positional meanings to abstract

positional ones. Of the four O_{on} for which no metaphoric extension was found, *of* and *to*, it may be assumed, exist primarily as argument indicators for a higher operator rather than as operator in their own right. *With* and *among* were also found not to readily admit of metaphoric extension.

Though the O_{on} are highly metaphoric, the O_o and O_{oo} are not. As might be predicted from the argument-requirement, the O_o readily form a lexical unit with the verb and consequently give rise to much idiomatic usage. A check of several listings of verb-particle combinations reveals that the vast majority of prepositions which serve as particles are O_o (*out, back, away, up, down*).[15] The productivity of the O_o for this construction is attributable to the entry requirement for these words which indicates that they have selection only to the verb. The resulting verbal idioms do pattern, albeit roughly, along semantic lines. Most notable in this regard is *up* which has the peculiar property of losing its literal directional meaning and of taking on a completive aspectual meaning with a wide range of verbs: *broke up, shut up, give up, dreamed up, let up, bring up* (= raise), *finish up*, etc. *Away* similarly (though not as productively) exhibits a purely aspectual meaning as an intensive or iterative: *writing away, chop away, sang away, kissed away, plugged away*, etc. *Out* is still less productive, but shows an opaque aspectual meaning in such forms as *fit out (a ship), help out, work out a solution, hold out, wear out*, etc.

Unlike operators and argument indicators in certain situations, prepositions occurring as particles can only rarely zero the verb to which they are structurally related, this being presumably a consequence of the fact that the informational unit composed of verb and preposition is non-compositional with the meaning of the verb correspondingly aspectually modified and therefore not recoverable. The few exceptions to this rule seem to be only with *up* and *down* which, as indicated above (§ 2.36), have verbal extension. Thus *Gus gulped down three glassfuls → Gus downed three glassfuls; In 1980, the Transit Authority raised the fare up → In 1980, the Transit Authority upped the fare.*

4.0. A characterization of the informational contribution made to the sentence by prepositions can be given on the basis of the three relations of argument requirement (or: entry requirement), cooccurrence and the attendant notion of likelihood, and reduction (the reduction to zero of the phonemic shape of a word or words). Working in this fashion, it can be demonstrated that the wide range of sentence positions in which the various prepositions occur are, in large part, derivable via specifiable and attested reductions from just two separate categorical requirements in the base (the set of kernel sentences). Corresponding

to these requirements and operations are the informational properties of prepositions which, together with the prepositional cooccurrents, determine in a regular manner the various reductions involved. In addition, the non-operator (*i.e.*, argument indicator) status of many preportional occurrences were shown to result from other processes (e.g., nominalizations) at work within the language that have an independent justification within the grammar.

While we have touched on a few of the less well-understood facets of prepositional usage, there are a number of areas which require further investigation. Among them we note the following: the manner(s) by which metaphoric occurrences of the prepositions may be obtained from their primary meanings; the detailed selectional properties of prepositions in verb-particle constructions, in particular with regard to aspectual character; the role of certain prepositions, *e.g., over, under, up, down,* in *PV* verbal compounds (generally expressing loose comparisons): *overcome, understate, upgrade, downplay, etc.* Finally, there remains the problem posed by the extension of these methods to other English prepositions. The authors would welcome any comments on or criticism of the results presented.

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NOTES

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1) See references.

2) Paraphrasing '$>$' as 'operates on' is adopted here only as a convenience. Strictly speaking, it is misleading to do so as 'operates on' is not a relation which meets the requirement of transitivity imposed by the partial ordering.

3) A number of prepositions have dual status in this regard, *i.e.*, they serve both as argument-indicators and as operators (see below).

4) Harris 1979.

5) This delimits sharply the notion of 'environment'. A more precise characterization of likehood may further research into dialect variation, syntactic-semantic change, *etc.*

6) Detailed discussion of relative clause formation may be found in Harris, in press, chapter 3.

7) *cf.* A.S. Kroch 1979. Bolinger 1971:98 sketches a plausible course for the extension of meaning of *up*: "The primitive directional meaning was probably modified to the aspectual one by the direction that most physical acts of completion take. When a glass is filled, the level moves up toward the eye of the viewer; when a flow is suddenly checked the level rises. This associates *up* with completion and with arrest, and also with the notion of closing a gap between the eye of the viewer and the thing viewed..."

8) Harris 1974 and 1976c.

9) Note that since we can, from O_{on} base form, derive O_{on} occurrences in reduced forms, mere occurrence as O_{on} is not a sufficient diagnostic for the assertion that the operator occurs in an unreduced environment.

10) The appearance of the relative pronouns in derivations follows from the role of the relative clause within the current system in the introduction of all modifiers in English. See § 1.22.

11) The preference for V_1 to be durative is evidenced by the acceptable *He didn't leave until ten o'clock* alongside **He left until ten o'clock*. This may be explained in terms of the durativity imposed by the negative, which has its source in the metalinguistic performative, *I deny*. *Cf.* Harris, in press, § 7.12.

12) Strictly speaking, the "reductions" here are only suggestive. The affixes *-tion, -al, -ment, etc.*, are derived from the further reduction of free-standing operators. *cf.* Harris, in press, Chapter 5.

13) For details, see Harris, in press, 8.4., where difficulties with treating the passive as a unary transformation are adumbrated. There the case is made that what appears as subject-object permutation is actually the result of the object in a sentence occcurring as the subject of an entering verb operating on that sentence.

14) *Cf.* Chomsky 1976 101, where an account is given in terms of subcategorization schemata which purport to explain the "close construction" of the prepositional phrase to the verb, *i.e.*, the apparent ungrammaticality resulting from permuting to sentence initial position: *On the boat he decided* meaning 'He chose the boat'. The deviance claimed here seems to us a matter of low likelihood rather than (as follows from Chomsky's account) a violation of the argument requirements of the words involved, *i.e.*, zero likelihood. Note that Chomsky's glossing of *He decided on the boat* as 'He chose the boat' is not entirely accurate. *Chose* is a closer paraphrase of *decided* than of *decided on: Edward VIII decided/chose to abdicate the throne; Edward VIII decided on/?? chose abdicating the throne.* It is just this distinction between *decide* and *decide on* that is relevant to an account of the ambiguity in question. See below. Note also that since appropriate zeroing is not licensed by the generative constraint on "recoverability of deletion" (deletion only under "structural identity" or "non-distinctness"), variation in patterns of complement structure are therefore 'explained' by means of subcategorization shemata which have to be listed either among the base rules or in the lexicon but which, in fact, only describe apparent syntactic environments, *i.e.*, reduced forms. Dropping this constraint can be shown to be a necessary step for any adequate specification of the information borne by language.

15) Fraser 1976: Appendix A, 70-102; Pelli 1976: 147-153.

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Bruce -
The prepositions paper is largely an extension of what is said in GEMP -- the points of interest are in the details, regarding, for instance, appropriate zeroing, repetitional zeroing (e.g., the remarks on "on and on", "around and about"), and the suggestions made anent metaphor. I still find some aspects of the introduction nice in setting the stage and making some familiar points (I'd be interested in your impression). To save time - you might take the tables on faith, referring to them only for illustration, if need be.

Just sent off the proofs of chapters 4 and 5 to Paul. I've made you a copy and as soon as I get a copy of chapters 1-3 from Tom (hopefully by mid-week) will send off the set. There's plenty of mark-up, at least in chs. 4-5, but I believe it's comprehensible (in some sense of the term !). Thanks for the extracts.

Michael
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