

The Syntax and Semantics of English Prepositional Phrases

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For just over twenty years now, I have been an admirer of Fred Sommer's work in the logic of natural language, especially as summarized extensively in his 1982 book of this title. Before I knew many details about Fred's work, I wrote in the 1970s Suppes and Macken (1978), and Suppes (1979a, 1979b, 1981). All four of these earlier articles of mine, the first one with Elizabeth Macken, concentrated on the elimination of variables entirely in semantics, and also on a semantics that was organized to reflect directly the structure of natural English, not the structure of first-order logic. My agreement with Fred on these matters could not be more complete.

In this early work of my own and in Fred's well-known book (1982), as well as his more recent textbook on logic (Sommers and Englebretsen 2000), there is really no systematic semantical treatment of prepositional phrases, yet prepositional phrases carry considerable load in expressing our cognitive ideas about space and time and many other kinds of relations between ourselves and objects. In various places, Fred occasionally uses a verb phrase that contains a prepositional phrase modifying, in the ordinary grammatical sense, the main verb. But in his analysis of canonical sentences, he would simply treat this as a verb phrase and not analyze it into parts, for example, in the verb phrase, *lived among the heathen*—not that this is one of his examples. I can also equally well cite such unanalyzed complex predicates of my own in my logic text (Suppes 1957/1999).

There are some fundamental reasons for shying away from a detailed analysis of prepositional phrases. I pointed out a central difficulty in the final two paragraphs of Suppes (1979b). Here is the simple example I tried to analyze:

John is pouring water in the pitcher.

This is an ordinary sentence that certainly has a clear meaning. But when we analyze it in terms of the usual formal logic of relations and operations on relations, as exemplified in the 1979 article cited, and which certainly appears in work by many other people as well, the ordinary logic ends up with the inference that John is in the pitcher, which is clearly not meant to be a valid consequence of the sentence. The difficulty is that the prepositional phrase locates the action denoted by the main verb phrase and does not spatially locate where the subject of the sentence is, that is, where *John* is. So, if we try to analyze this sentence in terms of just the natural context-free semantics for noun phrases, verb phrases and the obvious extension of a verb phrase to prepositional phrases, we cannot get out of this difficulty. It is clear that the models used must be made richer in structure than arbitrary relational structures, which is the workhorse of the model theory ordinarily associated with the semantics of context-free languages. This applies as well to the extended relation algebras I have introduced in several articles and that are characterized in (1979b).

A very general response to what I have written is that we could certainly provide adequate logical machinery by going beyond relation structures or the extended relation algebras I considered earlier by introducing an unbounded set-theoretical hierarchy of the sort much used by Montague. But this is really not the point of the focus I want to bring to the table here. What I said in the earlier article I still hold to. I am not sure Fred would really agree with this point. I am skeptical of making any analytic-synthetic distinction in the use of prepositions, especially. So I regard, for example, prepositional phrases using the preposition *in* to be often making spatial claims, claims that are not logical at all, but much richer in character, for example, as in the sentence *The broom is in the next room*. So the real difficulty I want to consider here is that of understanding the subtlety of the correct use of such prepositions in English. I will not, in the discussion to be given here, undertake at all to give a formal treatment of their semantics, e.g., what is the logic of such phrases.

There is also another direction of analysis which I do not intend to entertain in any detail in this paper. This is in attempting to indicate, without a full formalism, what is the semantics of various spatial prepositions, especially *in* and *on*. In an earlier paper, Crangle and Suppes (1989), Colleen Crangle and I tried to spell out some of the intricate geometric and physical aspects of the usage of these prepositions. Some of the considerations we entered into there were of the following sort. Did the use of a given preposition or prepositional phrase implicitly imply a point of view, as when one says *The house you are looking for is to the left of the yellow one*? In many accounts, the correct interpretation of the preposition *to the left of* requires a point of view, for reasons that are obvious. Here is another kind of example. It is natural to think of many relations of *on* as being purely geometric, as when I say *The book is on the table*. But, on further reflection, it is obvious there is a physical concept of support implied that is not at all geometric in nature. It can, of course, be argued that we can eliminate the need for a separate concept of support by enriching Euclidean geometry with a restrictive notion of oriented verticality. So that, with Aristotle, we can meaningfully talk about *up* and *down*, but this is certainly not something we can accomplish in ordinary Euclidean geometry, for which no notion of *up*, *down* or *on* is invariant.

There is another usage of *on* in geometry that is appropriately invariant, and that is when we say that point *a* is *on* line *l*. The preposition *on*, especially, is a wonderful source of puzzles. We might be inclined, working through things in a purely mathematical way, to think that *on* should be transitive. But, in an ordinary sense, it is not. So, we can say *The table is on the floor* and we can also say *The book is on the table*, but it would be a mistake to say that the book is on the floor.

Still other kinds of examples require the introduction of space and time, not merely space. Here are some standard examples. *When you are going to school, walk in the shade. If you are smart, you will run under the bridge when the rain starts. The pencil is rolling on the table, can you catch it?* Well, Crangle and I certainly offered no general solution for this wilderness of cases. We did, I hope, make some progress in classification and clarification.

In this article, I want to do something else. I want to take note of how inadequate the ordinary purely grammatical classification of nouns and noun phrases can be in terms of their being objects of prepositions. We need a much finer classification than the ordinary grammatical one to eliminate nonsense. For example, we say, in a quite appropriate way, *The water is running in the bucket*, but we can't say, *The water is running in the minute*. In other words, *in* has a kind of spatial quality that, of course, can be used in a temporal fashion, but only in a special way. So,

for example, I can say *I will be home in five minutes*. But it sounds weird to say *I'll be home in the minute*.

Similar restrictions, devious in nature when all examples are considered, are needed for *on*. I can say *The books are on the table*, but it is nonsense to say, in a literal sense, *Five minutes are on the table*.

A different kind of problem is raised by the implied motion that is so often associated with the use of the preposition *into*. It is fine to say *He walked into the room*, but not *The book is into the table*, or even, perhaps, *He is into the room*, in contrast to, *He is in the room*. So, here we need a sense of motion under way or just completed. However, for many kinds of motion, if we have the right kind of verb, we can use *in*, as in the following example. *He is running in the water*, or, even more interesting, *He is turning the pages in the book*.

I give these many examples in the conviction that it is a responsibility of the full analysis of a language to exclude the nonsense examples from being accepted. I have been careful in formulating the last sentence not to say whether the strings that are not accepted, that I've been calling nonsense, are being rejected for grammatical or semantical reasons. My general view of such matters is that this is a mistake. We can't really draw a sharp line between the grammatical and the semantical, just as we cannot between the analytic and the synthetic. Not everyone agrees with this view. My purpose here, however, is not to argue for its correctness, but rather to point out how hard it is to exclude the nonsense sentences, whether one assigns them to the grammatical or semantical side of the fence.

Three obvious production or parsing context-free rules for prepositional phrases (PP) are the following.

- (1) PP → Prep + NP *Maria ran to the house,*

where *to the house* is the prepositional phrase, and *the house* is the noun phrase (NP). The noun phrase is referred to as the complement of the preposition. The second rule permits an adjective phrase (AdjP) to be a prepositional complement.

- (2) PP → Prep + AdjP *She worked for little, but liked it.*

However, "standardly" prepositional complements are noun phrases, and much more rarely adjective phrases. More common, but still not standard, are clausal complements of prepositions, with and without *that*.

- (3) PP → Prep + (*that*) + Clause. *I left before he did.*

Here the clause *he did* is the complement of the preposition *before*. The use of *that* is much more restricted, but here is an example, *I left provided that she stayed*.

But these three rules are only a small sample of the many required to chart the syntactic varieties of correct prepositional use. The new *Cambridge Grammar of the English Language* (2000) gives a wonderful detailed survey, without actually writing down formal rules. It would seem to be a good thing for someone to attempt, a matter I return to later.

The issue I want to turn to now is the important one of imposing restrictions on the range of rules. Violations of rules (2) and (3) are obvious, since very few adjective phrases can serve as prepositional complements and lots of clauses cannot. For example,

(4) **He ran to unsettled.*

(5) **She walked in very heavy.*

(6) **She left in he said he would.*

But such infelicities are easy to construct as well for prepositional complements that are noun phrases. Here are some examples using the familiar prepositions *on*, *in*, *into* and *at*.

(7) **She ran quietly on her ideas.*

in contrast to

(8) *She ran quietly on the empty street.*

(9) **He slept in his notebook.*

as opposed to

(10) *He wrote in his notebook.*

(11) **The pencil was into the box.*

as compared to

(12) *He put the pencil into the box.*

(13) **She stated her views at the room.*

in contrast to

(14) *She stated her views at the graveyard.*

That the starred expressions are ungrammatical is uncontroversial and obvious even for a liberal normative standard of usage. That is not the problem. The problem is restricting the grammatical production or parsing rules to rule out such usage, but permit the usage that is acceptable.

Before making any concrete suggestions, I want to state my general view that the task of giving nearly all the rules governing prepositional usage in standard written English is a difficult if not impossible task, as yet not really attempted by anyone, although some of the efforts at writing large computer-based grammars of English may in the not too distant future produce significant approximation.

In mentioning ‘rules’ I deliberately did not mention ‘grammatical’, for many would regard many of the additional rules needed as embodying semantical rather than grammatical

distinctions. I am, as already mentioned, skeptical of making this distinction precise and will not make an effort to do so in any detail in what follows.

It is commonly remarked that it is important that probably a majority of the most frequently used prepositions, such as the four just discussed, have an essential spatial or temporal character, often extended by spatial or temporal metaphors.

(15) *She searched in the oldest parts of the house,*

but as well

(16) *She searched in her oldest memories of him.*

The subtlety of what constitutes acceptable usage is well exemplified by the starred (13) and the proper (14). The preposition *at* most often has a spatial focus that marks the occurrence of some event at a given place. This spatial marking of place is implicit in (14), but not in (13). Why? Because the bare noun ‘*room*’ has a primary sense of being a container rather than a place to be, which is not the case for *graveyard*, although it is certainly acceptable to say:

(17) *Her mother was buried in the graveyard.*

These last examples suggest how we might begin to generate new and better rules by restrictions on the old one. So we replace (1) by

(1.1) Container → Container Prep + Container NP

and

(1.2) Place PP → Place Prep + Place NP

(The rules seem awkward when written with such repeated modifier words, but I will not abbreviate them because of their nonstandard character.) As sentences (14) and (17) illustrate, nouns such as *graveyard* have both a container and a place sense. Which sense is being used depends on the preposition being used, or, in some cases, on the sense of the preposition, which may be illustrated by again using *in*.

(18) *The balls were in two different places*

which I take, obviously, to be a case of *in* being used in the sense of place, as expressed in rule (1.2), but in the following in the sense of measure of a quality or property;

(19) (i) *They differ in temperature.*

(ii) *They differ in weight.*

(iii) *They differ in attitude about freedom.*

In the three examples under (19), (i) and (ii) differ in type of measure. Using the traditional distinctions, temperature is an intensive property and weight an extensive one, but this distinction does not seem to matter much to the use of *in*. Some might object that only qualitative

distinctions are actually needed for (19), but because I think it is important not to distinguish the kind of quality, extensive or intensive, referred to by the prepositional complement, I lump them together under measure. But I do mean to restrict measure to qualities that at least admit a comparative judgment about them. I also see that another terminology could be proposed, but I shall not examine the matter further here.

The preposition *in* can be used in all three senses introduced: container, place and measure. What about *on*? It does not easily have a sense of container, but certainly does of place, including not just spatial place, but also temporal place, as in

(20) *They burst on boiling.*

This example might also be interpreted as using *on* in the sense of measure, as in the similar

(21) *The pipes burst on freezing.*

But at least (20) and (21) seem to illustrate a singularity, or change of state, associated with the measurable property or quality.

These last two examples do move us toward another sense, that of movement, as in

(22) *She walked into the room.*

Movement generally implies change in both space and time. This is the first of the four senses introduced that *in* does not have, except in a very indirect way, as in:

(23) *She danced in one room and then another.*

Another sense of frequent use is that concerning causes, expressed by prepositions such as *because*, *because of*, *due to*, and *in spite of*. Note that *in spite of* takes as a complement a negative cause. (Intuitively a negative cause is a cause that tends to prevent an event or action from happening, as in

(24) *Mary saw Henry in spite of the advice of her parents.*

Of course, negative causes can also be successful in preventing an action:

(25) *Rosa did not go out because of the illness of her mother.*

For a formal analysis of negative causes, see Suppes (1970, p. 43.)

Also important is the sense of prepositions expressing goals, e.g., *to* and *straight to*, as in:

(26) *I ran to the shelter.*

(27) *I ran fast straight to the shelter.*

Prepositions used to express higher or more general goals fall under this sense also.

Without claiming that I have given a complete list of basic senses, I stop the enumeration. And, as should be obvious, I have stopped even sooner the elaboration of syntactic expressions for prepositions, which is, fortunately, explored rather thoroughly in Huddleston and Pullum (2002).

Huddleston and Pullum describe many complex prepositions, which syntactically means those using several words, such as *in spite of*, *in front of*, *with reference to*, *for the sake of*—note the occurrences of familiar simple prepositions beginning and ending these complex prepositions.

Linguists tend to classify lexical categories as open or closed. Noun phrases are open because there is in English no obvious fixed finite bound to their number. But prepositions, simple and complex, taken together, form a closed class. On the other hand, the total number of prepositions, even just those that are uncontroversial, seems to be very large. As far as I know, no one has as yet attempted anything like a complete enumeration of just those that seem intuitively widely acceptable.

Perhaps as essential would be an agreed upon, more or less complete list of what I have called senses, which in many cases correspond to what in traditional philosophy have been called categories. Certainly, it seems to me, such a modern list, which was only begun here, can no longer be claimed to have the privileged epistemological or ontological status of the categories, as proposed by such philosophers as Aristotle or Kant, and those who have been more or less their followers on this matter. But taken more pragmatically, many of the distinctions introduced by Aristotle in *The Categories* can be useful to the kind of analysis begun here.

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