

Priorities in the Production of Prepositions

Joost Zwarts

Radboud University Nijmegen

P.O. Box 9103

6500 HD Nijmegen

The Netherlands

Joost.Zwarts@let.ru.nl

+31-24-3615871

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Abstract*

This paper studies the semantic interaction between pairs of closely related prepositions, like *in*, *on*, *over*, and *around*, in order to determine the priorities that determine the application of these prepositions to ambiguous situations. It is proposed that the division of labour between prepositions in such situations is strongly determined by stereotypical regularities in the way spatial notions like support, containment and superiority are related.

1. Introduction. When a speaker wants to express a spatial relation between two objects, a Figure and a Ground, she has to make a choice from an inventory of expressions, typically prepositions. One way of studying the semantics and pragmatics of prepositions is to focus on such choices and to look for the spatial (and other) factors that determine them. At first sight, this may seem like a simple research enterprise. After all, are prepositions not ways of directly labeling spatial relations: *in* names the relation of containment, *on* that of support, and similarly for other prepositions? The research on prepositions in the last couple of decades has demonstrated that this is in fact a far from simple matter. The choice between two prepositions for a particular spatial scene is typically the outcome of the interaction between quite complicated perceptual, geometric, pragmatic and conventional factors, as shown in the studies of Talmy (1983), Herskovits (1986), Vandeloise (1991), Regier (1995), Feist (2000), and Conventry and Garrod (2004), for example.

Consider, for example, a spatial trajectory that has the shape in Figure 1, partially enclosing a Ground.

INSERT FIGURE 1 ABOUT HERE

There are, *prima facie*, two prepositions competing for the description of this situation, *around* and *over*. The reason is that a path of this shape is among the usages of both of these prepositions (as shown in Schulze 1989,1993 for *around* and Lakoff 1987 and others for *over*). Without any further spatial information about the spatial scene we would tend to say that the path goes *around* the Ground, but when we know that the picture offers us a side view, then it is more natural to say that the path goes *over* the Ground. Why is this? What are the principles behind the competition between prepositions like *around* and *over*? Why do we have to use *over* when vertical orientation becomes salient? I will argue that it is more important or useful to express the vertical orientation of a path with respect to the Ground than its curvature. This is one of the *priorities* in the system of prepositions: *over* takes precedence over *around* on the basis of a deeper semantic ordering of vertical orientation and curved shape.

In this paper I will study a number of situations where two prepositions compete with each other for a particular meaning, but only one of the two is appropriate. This will reveal important principles for the semantics of prepositions. I will use the theoretical framework of Optimality Theory. The mapping from meanings (spatial relations) to forms (prepositions) is construed as an optimization process. Given a particular spatial relation, different prepositions present themselves as candidates, competing with each other. The winner of the competition, the optimal preposition, is that candidate that best satisfies a system of ranked constraints. Formulating the problem in this way will help us to make explicit which factors play a role in the production of prepositions and how these factors interact.

The next section will spell out my (Optimality-Theoretic) assumptions in somewhat more detail. After that I will go through a range of simple two-way competitions between prepositions and derive several spatial priorities. At the end of the paper I will tie these case

studies together to examine the origins of these priorities more closely and draw some general conclusions. I want to stress already at this point that we have to work here with a partial picture of preposition interactions, with very strong semantic idealizations and simplifications. But nevertheless, in this way we can hopefully see more clearly the semantic priorities that play a role in the production of prepositions and the implications that these priorities might have for the system and grammar of prepositions and other spatial markers.

2. Optimality Theory, production and lexicon. Optimality Theory is a theory about input-output mappings in natural language. It was first applied in phonology, to the mapping from underlying lexical forms to surface pronunciations, and later also to the syntax-semantics interface, in the mapping between form and meaning (Prince and Smolensky 1997, Blutner, de Hoop, and Hendriks 2005). The following elements of OT are important for this paper.

The input gives rise to a set of candidate outputs through some unrestricted generative mechanism (the generator GEN). These candidates compete with each other for being the output. There is a set of well-formedness constraints C_1, \dots, C_n applying to the candidates. Each of the candidates will typically violate some of the constraints, and there is usually no candidate that is perfect. The reason is that constraints can be in conflict with each other, imposing demands on the output that work in opposite directions. This conflict is resolved by ranking constraints with respect to each other, with higher constraints being more important for the output than lower constraints. The output is then the candidate that is *optimal*: i.e. that produces less violations for higher ranked constraints, roughly speaking.

Here is a simple and well-known example from OT syntax, the component that maps meanings to sentential forms. The appearance of the expletive subject *it* in the sentence *It rains* in English is analyzed as arising from the interaction of two general constraints (following Grimshaw and Samek-Lodovici 1998). FULL INTERPRETATION requires every

word to have an interpretation, a requirement that is violated by the non-referential (expletive) pronoun *it* here, which does not have an interpretation. SUBJECT states that a sentence always should have a subject, even if the verb does not project an external argument. In English, SUBJECT is ranked over FULL INTERPRETATION, which means that the output with an expletive pronoun wins the competition, as shown in the following tableau:

INSERT TABLE 1 ABOUT HERE

In this tableau the semantic input is informally represented as ‘It rains’. Below this input, two candidate outputs are given: *Rains* and *It rains*. The operation of the two constraints is given by two columns, with an asterisk indicating that an output is violated for a constraint. *It rains* is the optimal output: even though it violates the lower-ranked constraint FULL INTERPRETATION, it is still better than *Rains*, which violates the higher-ranked constraint SUBJECT. Switching the order of the constraints leads to an Italian-type language, in which subjects can be dropped.

In Optimality Theory faithfulness constraints play an important role. They require the output to reflect the input in certain respects. The more the output diverges from the input, the more faithfulness constraints are violated. In the above example, FULL INTERPRETATION is such a faithfulness constraint.

Most of the Optimality-Theoretic applications take a production perspective. The input of the optimization process is an underlying phonological form or a meaning, the output is a surface phonetic form or a syntactic structure, respectively. OT semantics, on the other hand, starts with a form or syntactic structure as an input and tries to define the optimal output interpretation for that (Hendriks and de Hoop 2001). Combinations of both perspectives are possible and lead to interesting enrichments of our views on linguistic well-

formedness (Blutner 2000). However, in this paper, I am only concerned with the mapping from an input meaning to an output form, like in OT syntax. Nevertheless, while OT syntax is primarily concerned with morphosyntactic issues of word order and inflection, the OT system that I have in mind here involves the problem of choosing the best word for describing a particular input meaning, a process prior to OT syntax. There are different ways to formulate this optimization process, depending on the kind of semantic framework one adopts.¹ I will make the following assumptions here, concerning the input meanings, the output words, and the constraints that determine the mapping from meanings to words.

First, in order to keep things simple and accessible, I will assume that the input for the OT mapping is some bundle of semantic features $[F_1, \dots, F_N]$ that characterizes what the input situation is like. What these features are like depends on the semantic domain; in the domain of prepositions we want to characterize a spatial relation and therefore we need features about direction, distance, reference frame, curvature of a path, force dynamics, etcetera. Alternatively (and ideally), we define a formal model of spatial meanings, on the basis of vector spaces, mereotopological regions or trajectories and draw spatial input meanings from such a model.² However, defining prepositional meanings in such models is not always straightforward, and providing and explaining the relevant definitions here would not be beneficial for the major focus of this paper. I will therefore work with very rough spatial features like SUPERIOR and SUPPORT, in spite of various sorts of justified criticism that could be raised against such features. I believe that the general points that I want to make about priorities and optimization in the prepositional domain are relatively independent of the issue of whether meanings are formulated in terms of primitive features, topological image-schemas or model-theoretic objects. So these capitalized features stand for the reader's favourite explicitation of spatial relations. The important thing is that we have some way to differentiate various spatial relations in the input in a sufficiently explicit way.

Second, the candidate outputs in a particular language are words from that language that expresses one or more of the input features. In this paper, we are only dealing with the English words *in*, *on*, *over*, *above*, and *around*. Each of these words is specified for at least one spatial feature. *On*, for instance, is specified as expressing the feature SUPPORT, while *above* carries the feature SUPERIOR. Prepositions are often polysemous, and therefore they may have different feature specifications for their different senses, as we will see in section 5 for *over* and *around*. In addition to the prototypical *around*_{CIRCLE}, we also find *around*_{HALF} and *around*_{QUARTER}. There might also be prepositions that combine different features, like *on top of*, which seems to be both SUPERIOR and SUPPORT at the same time, but I will not deal with such complex prepositions here. I am interested in the competition between prepositions for which one core meaning and maybe a few additional meanings can be identified.

Third, there is a faithfulness constraint FAITH(F_i) for every feature F_i , which is violated when F_i is part of the input but not reflected in the output. The output depends on the ranking between the various faithfulness constraints. Let us make more concrete what can happen with a simple abstract example, in which the input of the optimization process is the feature bundle [F,G]. In theory, there are three possible candidate words for this input: a word that expresses F ($word_F$), a word that expresses G ($word_G$) and a word that expresses both F and G ($word_{F,G}$), but in the concrete cases that I will discuss in this paper, there are only words with one feature. Then both $word_F$ and $word_G$ violate a constraint and their competition needs to be decided by ordering the faithfulness constraints. The following tableau shows the patterns of violations with the ordering FAITH(F) >> FAITH(G).

INSERT TABLE 2 ABOUT HERE

We will now go through a series of binary competitions between prepositions, starting with two very basic prepositions: *in* and *on*.

3. *In* versus *on*. Even though *in* and *on* are very short and frequent prepositions in English, characterizing their semantics has turned out to be far from simple. One of the reasons for this is that, even though *in* and *on* are often characterized as topological prepositions, their semantics is actually not purely geometric, i.e. based on spatial inclusion or contact. There are many functional and force-dynamic factors in their use and interpretation that have to do with how the Ground object fulfills its role with respect to the Figure as a container or a means of support. For discussion about this, I refer the reader to Herskovits (1986), Vandeloise (1991), Feist (2000), Bowerman and Choi (2001), Coventry and Garrod (2004), Carlson and van der Zee (2005). There is also polysemy and vagueness in the way *in* and *on* and similar items in other languages apply to a variety of different situations (as shown, for instance, in Cuyckens 1991, Levinson and Meira 2003).

Despite the complexities that characterize the semantics of *in* and *on*, I am going to assume two semantic features CONT(AINMENT) and SUPP(ORT) that are relevant for the use of *in* and *on*. CONT is lexically associated with *in* and SUPP with *on*. These two features stand for complexes of spatial and force-dynamic properties of the relation between a Figure and a Ground. If a pen is in a box, it is included in the spatial region occupied by the box as a whole, but an apple in a bowl with apples might be outside the spatial region of the bowl, but still be part of what is contained by the bowl, as shown in Figure 2a.

INSERT FIGURE 2 ABOUT HERE

Similarly, the relation of SUPPORT will have a spatial ingredient of contact, e.g. when a book is lying on the table or a fly is on the ceiling, but this element of contact between Figure and Ground might be missing when there is still a prominent relation of force-dynamic support or attachment between them, as in Figure 2b and 2c. Even though there is no direct contact between Figure and Ground in these situations, we can talk about *the cup on the table* and *the lamp on the ceiling*.

What I am interested in now is what happens with a situation that has both containment *and* support. There are situations of pure containment, described by *in* PPs (*a fish in the water, a bird in the air*) and there are situations of pure support, described by *on* PPs (*a book on the table, a picture on the wall*). There are also situations that involve both containment and support, like a pen in a box or an apple in a bowl, in which the Ground object not only contains the Figure, but it also supports it from below. Another situation known from the literature is that of a light bulb in a socket: there is partial containment of the Figure in the Ground, but the socket is at the same time keeping the light bulb from falling. The important question is now: how is such an ambivalent situation described? Which preposition is used: *in* (the containment preposition) or *on* (the support preposition)?

It is clear that the preposition *in* is used for these situations. As was already obvious from the description in the previous paragraph, we talk about a pen *in* a box, an apple *in* a bowl and a light bulb *in* a socket and not about a pen *on* a box, an apple *on* a bowl or a light bulb *on* a socket. It is important to realize that this is not a trivial fact, but something important to be accounted for. Why is *in* used and not *on*? In the terminology of this paper, containment takes priority over support. We can express this now in Optimality Theoretic terms, by a combination of two faithfulness constraints FAITH(CONT) and FAITH(SUPP), ranked as in (1).

(1) FAITH(CONT) >> FAITH(SUPP)

When applied to the input [CONT,SUPP] (bowl-with-apple, socket-with-bulb), we get the optimization process that is worked out in the tableau in Table 3.

INSERT TABLE 3 ABOUT HERE

This process gives us as output the optimal description of ‘supporting containment’, given the way the two faithfulness constraints are ordered. Since there is no special-purpose preposition for this combination of features in English, we have to extend the use of one of the two relevant prepositions, and, because of the predominance of containment, it is *in* that takes care of this extension.

There is another way of representing this, through a small-scale *semantic space* (Gärdenfors 2000, Haspelmath 2003, Levinson and Meira 2003):

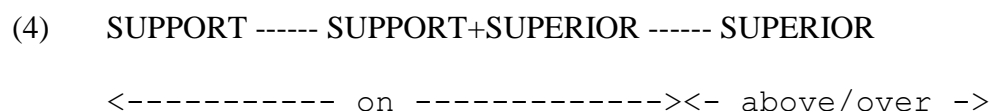
(2) CONTAINMENT ----- CONTAINMENT+SUPPORT ----- SUPPORT
<----- in -----><--- on --->

In this semantic space, there are only three semantic ‘points’: the extremes of pure support and pure containment and an area of overlap between containment and support, sharing a feature with both. As we can see, this area is covered by *in* and not by *on*, because of the higher ranked faithfulness for containment that we saw in the tableau of Table 3. Why would containment take priority over support? This is an important question to which we will return in section 7 after we have studied some other priorities in the production of prepositions.

4. *On* versus *above/over*. We saw in the previous section that *on* can be used for different situations of support. In many cases of support the Ground object is below the Figure, e.g. *a book on the table*, but there are many other situations where this is not the case, like *a picture on the wall*, *a lamp on the ceiling*. So, some of the situations that are covered by *on* can be characterized as [SUPPORT], others are [SUPPORT,SUPERIOR], i.e. the Figure is supported by the Ground *and* superior to it, with respect to the vertical axis, as in example (3a). Like in the previous section, I assume that *on* is only specified for the feature [SUPPORT]. If we would associate it with the combination [SUPPORT,SUPERIOR], then many uses of *on* would not be covered (e.g. *a picture on the wall*, *a lamp on the ceiling*). [SUPPORT] is the defining feature of *on*. The use of *above* however, suggests a situation in which support is absent and there is only superior location. The same is true for the locative uses of *over* (but not for motion and extension uses, see Lakoff 1987, Tyler and Evans 2001 for the relevant distinctions). This is shown in example (3b), in which there is no contact or support between the table and the lamp.

- (3) a. The lamp is on the table.
 b. The lamp is above/over the table.

Just like in the previous section, we can construct a small semantic space from the features SUPPORT and SUPERIOR and show how *on* and *above/over* divide up this space.



The preposition *on* covers the two meanings on the left, leaving the pure SUPERIOR sense to the prepositions *over* and *above*. An ambiguous situation, offering features for the application of different prepositions, shows again a clear priority for the faithful expression of only one spatial feature, SUPPORT in this case. The constraint ranking that corresponds to this priority is as follows:

(5) FAITH(SUPPORT) >> FAITH(SUPERIOR)

The OT optimization process for different inputs is very similar to what we have seen in the previous section with CONTAINMENT and SUPPORT, assuming the lexical specifications on_{SUPPORT} and $above_{\text{SUPERIOR}}$ and $over_{\text{SUPERIOR}}$:

INSERT TABLE 4 ABOUT HERE

Notice that this time there are three competing prepositions, two of which, *above* and *over*, are identically specified in this case with SUPERIOR. Obviously, *above* and *over* are not semantically equivalent lexical items. There are many other uses of *over* that are not (or not exclusively) specified as SUPERIOR, but that require features for moving or extended figures or ‘end-point focus’ (see also the next section):

- (6)
- a. Sam walked over the hill.
 - b. Mother put the tablecloth over the table.
 - c. Alex lives over the hill.

Also, there are differences between the superiority use of *above* and *over* in (3b) that are not accounted for by a simple feature SUPERIOR (Coventry and Garrod 2004), but for our purposes at this point, it is sufficient to characterize *above* and *over* as both SUPERIOR.

We can combine the two rankings that we have now seen in the following way:

(7) FAITH(CONTAINMENT) >> FAITH(SUPPORT) >> FAITH(SUPERIOR)

This does not necessarily make sense, however, because containment and superiority might exclude each other. Strictly speaking, a Figure can only be above a Ground if it is not inside that Ground. Nevertheless, with more liberal interpretations of containment and support, we might think of examples in which all three spatial elements are present, e.g. *the flowers in the vase* (Vandeloise 1991). The flowers are partially in the vase, they are supported by it in various ways, but they are also largely above the vase. If this is really a situation that satisfies the three relations (and this of course depends on the way we define the spatial features SUPPORT, CONTAINMENT and SUPERIORITY), then it also confirms our predictions in an interesting way: the preposition used here is *in*, and not *on* or *above*. In other words: CONTAINMENT is stronger than both SUPPORT and SUPERIORITY. This analysis is shown in the tableau of Table 5.

INSERT TABLE 5 ABOUT HERE

Interestingly, CONTAINMENT even takes priority in the well-known puzzle of Figure 2a, where an apple is not in the geometric interior of the bowl, but on top of a pile of apples. We can still say that this apple is *in* the bowl, because (as argued by Vandeloise 1991, Coventry and Garrod 2004, and many others), the notion of CONTAINMENT is not purely geometric,

but it has an important functional or force-dynamic element, which extends its use beyond the narrow area of purely spatial inclusion.

5. *Around* versus *over*. The preposition *over* is probably one of the most polysemous and intensively studied prepositions in English. We have already seen that it is used in a way quite similar to *above*, to indicate the location of ordinary objects. There is also a prominent use to describe how an object moves along a *path* that is located above the Ground object, as illustrated in the examples in (8), taken from Lakoff (1987).

- (8) a. The bird flew over the yard.
b. Sam walked over the hill.

The path of *over* goes *via* the region that is above the Ground, which means that most of its points, except possibly the end points, are above the Ground. We can represent this for the purposes of this paper as a combination of two features: [PATH, SUPERIOR]. Whether the path follows a straight line (as in (8a)) or is curved around the Ground (in (8b)) is simply not specified as part of the meaning of *over*. The features also leave open whether or not there is contact between path and Ground or whether the Ground supports the moving object. All that we need is the specification SUPERIOR to indicate where the PATH is.

What I want to study in this section is the interaction of *over* with the preposition *around*. *Around* is one of the most complicated and polysemous prepositions of English (Schulze 1991,1993,Zwarts 2004), so it is necessary to make idealizations to study its interaction with *over*. Let us assume that *around* refers to paths that curve outward with respect to the Ground, i.e. that are convex, as in the pictures in Figure 3.

INSERT FIGURE 3 ABOUT HERE

Typical examples of such convex paths are given in (9):

- (9)
- a. Alex ran around the house
 - b. Alex drove around the barrier
 - c. Alex came around the corner

To distinguish these different senses from each other, we would need to specify how much of the object is enclosed by the path: COMPLETE (for 9a), HALF (for 9b), QUARTER (for 9c). However, since this is not relevant for the comparison with *over*, I use the more general feature CONVEX that I take to apply to all three senses. I refer to Zwarts (2004) for more precise definitions of the various senses and shapes of *around*.

I assume that *around* does not specify *where* the path is relative to the Ground: above, below or beside it. This requires some justification. One might have the intuition that *around* is strictly a *horizontal* path preposition: it simply does not apply to paths that have a vertical orientation, let's say because it is lexically associated to the set [CONVEX, HORIZONTAL]. However, this analysis misses the point that there are situations in which *around* in fact *can* refer to paths with a vertical orientation, when the path completely encloses the Ground:

- (10)
- a. The snake coiled around a branch.
 - b. The airplane made a looping around the bridge.

So horizontality can not be an inherent lexical feature of *around*, and I will show that it must be an *effect* of its competition with other items that have to take priority in expressing the

location of a path above a Ground. There is also a more principled objection against including HORIZONTAL in the definition of *around*, because it is not clear what the semantic motivation would be of including this feature. Why would *around* have to be horizontal, and why only with partial enclosure?

So, assuming the specifications $over_{[PATH,SUPERIOR]}$ and $around_{[PATH,CONVEX]}$, these two prepositions now have a theoretical overlap:

- (11)
- | | | |
|----------------|-----------------------|----------------|
| PATH | PATH | PATH |
| SUPERIOR ----- | SUPERIOR+CONVEX ----- | CONVEX |
| <-- over --> | ??? | <-- around --> |

In virtue of their definitions, *over* and *around* could in principle both apply to a spatial situation with a path that is *both* SUPERIOR and CONVEX. The question is: which preposition is actually used in that case? Let us consider the situation in Figure 4.

INSERT FIGURE 4 ABOUT HERE

Which of the following two sentences is the correct way of describing this situation?

- (12)
- a. Sam climbed around the wall.
 - b. Sam climbed over the wall.

The competition between *over* and *around* with respect to Figure 4 has *over* as a clear winner. Sentence (12a) could only be used if the climbing path of Sam is located more or less in a horizontal plane. We see a similar thing with paths that enclose only a corner or edge of an object, as in Figure 5.

INSERT FIGURE 5 ABOUT HERE

When the path is in the horizontal plane, we use the preposition *around* (example (13a) and Figure 5a) but when that same path has a vertical orientation, *over* (example (13b) and Figure 5b) is used.

- (13) a. Sam climbed around the edge.
b. Sam climbed over the edge.

So, if there is a strong bias to a particular superior location of the path, then this bias needs to be reflected in the choice of the superior preposition *over*. If the path completely encloses the Ground, as the first path in Figure 3, then there is no such bias. All the directions are represented in the path and then *around* is the only appropriate preposition.

We get the picture that is by now familiar. There are two faithfulness constraints ordered in the following way:

- (14) FAITH(SUPERIOR) >> FAITH(CONVEX)

The expression of superior location of a path has priority over the expression of convexity of the path. If the input is [PATH,SUPERIOR,CONVEX], then the optimal output with these constraints is the output *over*_[PATH,SUPERIOR]. Notice that there is no lexical item (say *curver*_[PATH,SUPERIOR,CONVEX] ‘over with an arc’) that specifically refers to paths that are both convex and superior to the Ground object, otherwise that preposition would have been chosen as the optimal output. Having such an item would be too expensive for the lexicon, which

simply cannot provide specific words for every possible combination of features. In other words, a choice *has* to be made by giving priority to one of the features, by ordering the features as in (14).

Another conceivable but questionable way to make sure that *over* applies to the situation in Figure 4 and Figure 5b is to add another feature to *over*, namely CONVEX. This is in line with the proposal of Dewell (1994), for instance, who argues that the prototype of *over* involves paths that have an arc or curve. *Over* will then presumably take precedence over *around* because it is the more specific, richer item. But the problem with this approach is that we need to get rid of the feature CONVEX in the many cases where *over* simply refers to a straight path above the Ground object, like in (8a). The advantage of the approach that I sketched is that the lexical meanings of *over* and *around* have a wider coverage (because they are underspecified), but *around* gets limited in application through the priority of *over*.

An interesting question is how *around* interacts with other directions besides the superior one. Consider the path in Figure 6.

INSERT FIGURE 6 ABOUT HERE

When the curve of the path goes through the under region of the Ground object, we have a path that we would rather describe as going *under* the Ground than *around* the Ground, i.e. FAITH(INFERIOR) >> FAITH(CONVEX). However, if the indicated region is the backside of the Ground, then there might be a true choice between *around* and *behind*:

- (15) a. We passed around the desk
b. We passed behind the desk

This suggests that there is no ordering between FAITH(BEHIND) and FAITH(CONVEX). We will come back to this in the next section when we consider the deeper motivations for constraint ranking in this domain.

6. Motivating spatial priorities. The methodological approach of this paper was to make the meaning specifications of prepositions as simple and general as possible. In this way the potential areas of application of prepositions will inevitably *overlap* with each other and these situations of overlap force us to investigate why one preposition takes precedence over another preposition in such a situation.

The total set of priorities that we have seen adds up to the following ranking (omitting FAITH(INFERIOR), which is only partially ordered with respect to the others):

(16) FAITH(CONTAINMENT) >> FAITH(SUPPORT) >> FAITH(SUPERIOR) >>
FAITH(CONVEX)

In order to understand this hierarchy we need to take a closer look at the way the semantic features relate to each other, starting with CONTAINMENT and SUPPORT. These two notions are not completely independent of each other, but situations of containment will *typically* also be situations of support. So there is a kind of default inference from CONTAINMENT to SUPPORT, based on our knowledge of typical containers, gravitation, the mechanisms of support, and on what is statistically the most common way of using *in*. If I learn that the pen is *in* the box, then I will make the inference that it is lying *on* the bottom, kept from falling by the box. If a Figure is in a container Ground, it will usual not be floating freely in the hollow part of that container, but the gravitational pull will make sure that the inside of the container also fulfills a support role through contact with an internal surface.

The reverse is not true. There are many situations of support (by tables, floors, etc.) that do not bring along containment or inclusion.

By ranking FAITH(CONTAINMENT) over FAITH(SUPPORT) the lexical system draws heavily on this regularity. Most situations that combine CONTAINMENT and SUPPORT can be analyzed as situations that first of all have the feature CONTAINMENT and *because of that* also the feature SUPPORT. Applying the preposition *in* to combined situations does not extend it very much beyond the range of application that we find anyway for this preposition on the basis of its association with the notion of containment. Seen from a slightly different, pragmatic perspective, the preposition *in* is stereotypically enriched with the notion of support, or, in other words, its prototypical use of *in* involves both containment and support.

A similar story can be told for the relation between SUPPORT and SUPERIOR. The typical, most common instance of support involves situations where the supporting Ground is *under* the supported Figure. That is the easiest way to avoid a Figure from falling. There is therefore a default implication from ‘G supports F’ to ‘F is superior to G’. Of course, there are also other ways to defy gravitation: attaching something to the vertical surface of a wall or to a ceiling (*a painting on a wall, a lamp on a ceiling*), but these assume special assumptions about attachment or adhesion and the nature of Figure and Ground. The implicational relation between SUPPORT and SUPERIOR makes it natural to treat situations that combine both as special cases of SUPPORT and not of SUPERIOR. Such combined situations form in fact the prototypical core of the preposition *on*.

In the same way, *over* acquires a stereotypical curved path, often incorporating the feature of convexity (as suggested in Dewell 1994). Many cases where a Figure moves *over* a particular Ground object can be understood against a canonical background of spatial assumptions. When I go over a fence, I typically start on the ground level, then I have to

move up to be on or above the fence and then down again on the other side of the it, yielding the arced kind of path that is stereotypical for *over*. It is in fact natural to move over objects in this way, given that flying is unusual and objects are not flat. There is a default implication from SUPERIOR to CONVEX as far as paths are concerned and the faithfulness constraints for prepositions make use of this implication by making convexity less prominent than superiority. The conceptual and statistical bias is thus built into the priorities for lexical description.

There are two important conclusions to draw from this account. The first conclusion is that the ranking in (16) cannot be subject to cross-linguistic variation. The priorities discussed here are determined by what the spatial and physical world is like. This does not mean that there cannot be cross-linguistic variation in how these concepts can be lexicalized, but the priorities cannot be changed. What might vary between languages is how many prepositions are available and what kind of spatial features these prepositions carry.

The second conclusion is that it seems possible to have a system with relatively simple lexical meanings and still account for prototype effects and pragmatic enrichments. In my proposal these two are factored out between a system of lexical specifications (like $in_{\text{CONTAINMENT}}$) on the one hand and a hierarchy of faithfulness constraints on the other hand. This is in line with the lexical-pragmatic approach of Blutner (2000). His bidirectional version of Optimality Theory can also account for how competing prepositions like *in* and *on* are understood by a hearer (see also Levinson 2000 for a very similar idea in Gricean terms). When we compare *the pear in the bowl* with *the pear on the bowl* we get the stereotypical interpretation for the first expression, but a marked interpretation for the second expression (with the bowl upside down and the pear balancing on top of it). This fits the well-known division of pragmatic labour of Horn (1984). The priority of *in* over *on* allows us to derive this division. When *on* is used with a typical container instead of *in*, the hearer will have to

figure out a plausible non-stereotypical interpretation for that use of *on*, a process which can be modeled within Blutner's definition of optimality over form-meaning pairs.

7. Conclusion. In this paper, we have seen some basic priorities between prepositions at work. It is obvious that after this first exploration, it is important to go beyond unanalyzed features like SUPPORT and CONVEX to a more principled and precise system of meaning distinctions. Then we can base our conclusions and hypotheses on a more solid foundation and extend them to other prepositions.

It would also be interesting to study further implications of the (partial) hierarchy that we worked out in this paper:

(17) CONTAINMENT >> SUPPORT >> SUPERIOR >> CONVEX

in on over around

The task for future research is to work out the hierarchy of spatial priorities, both theoretically and empirically and to study its implications for a much broader range of languages, morphosyntactic categories, and linguistic domains. In this way we can better understand to what extent the structure of the language of space is shaped by very basic properties of the spatial world around us.

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Notes

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¹ Not much work has been done about lexicalization or the mapping from meanings to words in Optimality Theory. Jones (2003) deals with kinship terminology from an OT perspective, while Solstad (2003) consider the use of prepositions from this perspective.

² In my own work I have tried to formalize these notions in terms of vectors (Zwarts 1997, Zwarts and Winter 2000), and curves (Zwarts 2004, Zwarts 2005).

³ By using only the feature SUPERIOR I am collapsing the place and path use of *over* here. In a fuller treatment we would want to make this distinction explicit, e.g. PLACE SUPERIOR versus PATH (or VIA) SUPERIOR. Here we concentrate on *over* as a preposition of spatial superiority, glossing over these more general spatial distinctions.

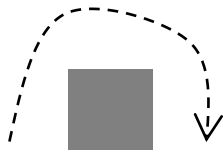


Figure 1: *Over or around?*

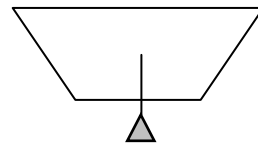
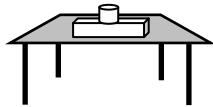
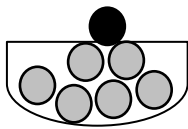


Figure 2: (a) apple in bowl, (b) cup on table, (c) lamp on ceiling

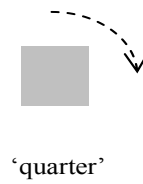
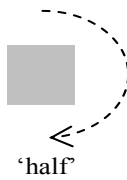
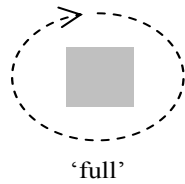


Figure 3: Three paths around an object



Figure 4: *Over the wall or around the wall?*



Figure 5: (a) *around the edge* and (b) *over the edge*

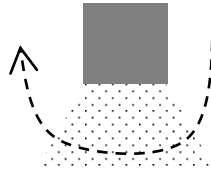


Figure 6: Passing *under* or *behind* an object

'It rains'	SUBJECT	FULL INTERPRETATION
Rains	*!	
☞ It rains		*

Table 1: Inserting an expletive subject

[F,G]	FAITH(F)	FAITH(G)
☞ word _F		*
word _G	*!	

Table 2: The optimally faithful word for [F,G]

[CONT,SUPP]	FAITH(CONT)	FAITH(SUPP)
☞ in _{CONT}		*
on _{SUPP}	*!	

Table 3: Optimal description of supporting containment


[SUPP,SUPER]	FAITH(SUPP)	FAITH(SUPER)
 on _{SUPP}		*
above _{SUPER}	*!	
on _{SUPER}	*!	

Table 4: Optimal description of superior support


[CONT,SUPP,SUPER]	FAITH(CONT)	FAITH(SUPP)	FAITH(SUPER)
 in _{CONT}		*	*
on _{SUPP}	*!		*
above _{SUPER}	*!	*	
on _{SUPER}	*!	*	

Table 5: Optimal description of flowers *in* a vase