

The intersectivity of distal PP modifiers

Yoad Winter

Utrecht University

Many modifiers are naturally associated with predicates and pass familiar tests for intersectivity. A classic example is nationality adjectives like *American*, which support the equivalence *John is an American surgeon* iff *John is American* and *John is a surgeon*. Here the predicative use of the adjective makes the equivalence with predicate conjunction a straightforward test for intersectivity of the adjective's attributive form. However, conjunction tests are not applicable when the modifier has no conjoinable predicative use. For instance, adverbial modification in *John sings beautifully* cannot be tested for intersectivity by considering conjunctions like *John sings and John is beautiful(*ly)*. Still, famously, in event semantics there are other phenomena that motivate the intersective analysis of adverbials.

Here we argue that a similar situation exists with distal modification of PPs as in *John is 1km above NYC*. Strengthening an argument by Zwarts & Winter (2000), we show that in PP modification, the distal modifier (*1km*) cannot be treated as a predicate between the landmark (NYC) and the located object (John). Nevertheless, using vectors, we argue that an intersective analysis of distal PP modifiers is forthcoming. We show some limitations of Z&W's strategy, and illustrate how their use of shortest vectors can be improved, while maintaining an intersective analysis of distal modifiers.

Z&W analyze modified PPs as in (1), where the landmark and the located object have simple geometric shapes:

(1) The point is *straight, diagonally / 10cm* above the circle.

For projective modifiers like *straight* and *diagonally*, Z&W propose a *non-intersective* analysis: the modifier applies to a set of vectors denoted by *above the circle*: the vectors that point upwards from the circle. The modifier selects only those vectors that point straight/diagonally *relative to the directionality* of the vectors in the set.

For distal modifiers like the measure phrase *10cm*, Z&W use the following intersective analysis.

(2) the shortest vector from the circle to the point is in an upward direction **and** that vector is 10cm long.

This expects the following equivalence, which treats *10cm* as the distal predicate *10cm from*:

(3) x is 10cm above y \Leftrightarrow x is 10cm from y **and** x is above y

However, the equivalence in (3) does not hold in general. Consider the following example.

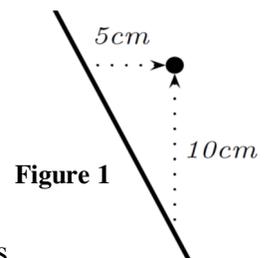
(4) The point is *10cm* above the line.

While sentence (4) is judged as true in Figure 1, Z&W's analysis treats it as false.

The shortest vector from the line to the point does not point upwards, and it is shorter than 10cm (actually shorter than 5cm). Z&W intersective strategy incorrectly expects (4) to be equivalent to the following sentence.

(5) The point is *10cm* from the line **and** above the line.

The core of the problem for Z&W's account is that modification of the PP in cases like (4) takes into account the *distance in the direction that the preposition encodes*, and not just the shortest distance. In a similar way, Z&W would treat the sentence *the point is 5cm right of the line* as false in Figure 1, while actually it can be interpreted as true.



To solve the problem for Z&W's analysis we use the fact that (4) can be paraphrased as in (6).
 (6) The vector to the point *that points upward from the line* is 10cm long.

Based on this observation, we use the following compositional analysis.

Distal PP Modification: *Let M be a measure phrase modifier and P' be the modified element within the PP. We analyze the modified PP as follows.*

[[P']] = the set of vectors from the landmark pointing in the direction set by the preposition

[[M P']] = the set of vectors in [[P']] **intersected with** the vectors that are M long

[[y is PP]] \iff there is a vector in [[PP]] ending at y

Consider now first the sentence *the point is above the line* in Figure 1:

[[above the line]] = the set of vectors that point upward from the line

[[the point is above the line]]

\iff the point is at the end of one of the vectors pointing upward from the line

This statement is true in Figure 1, as intuitively required. Further, for sentence (4), with the situation of Figure 1:

[[10cm above the line]] = the set of vectors that point upward from the line AND are 10cm long

Accordingly, (4) is analyzed as claiming that the point is at the end of one of the vectors that point upward from the line and are 10cm long. This statement is again true in Figure 1, as intuitively required.

Further results – non-convex objects: We show that the proposed analysis naturally extends to non-convex objects (e.g. the shape “L”), as in (7) below w.r.t. Figure 2.

(7) The Mañana project lies 9km south of the border of Park Lawrence.

Independently of modification, sentence (7) shows a problem for Z&W's strategy in (2). In Figure 2, the shortest vector from Park Lawrence to Mañana points westward, hence not in a southward direction. Our proposed strategy correctly analyzes (7) as true in Figure 2.

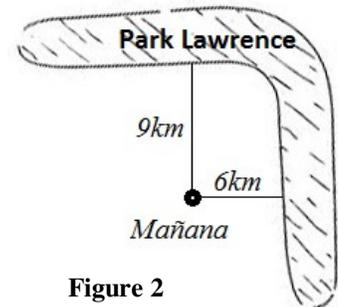


Figure 2

Further results – intersectivity: Looking further at the intersectivity of distal modifiers, we note that in a similar way to the failure of the

conjunction criterion in (3), they also fail Partee's (2010) criterion of intersectivity in (8).

(8) Jan is an American surgeon and Jan is a violinist \implies Jan is an American violinist.

Distal PP modifiers do not pass this test – as Figure 1 illustrates, the following entailment is invalid:

(9) The point is 10cm above the line and right of the line $\neq \implies$ The point is 10cm right of the line.

This is again similar to how adverbials fail this test:

(10) John played beautifully and sang $\neq \implies$ John sang beautifully.

We conclude that distal PP modifiers are intersective, and that this intersectivity is deeply connected to the workings of vectors in the modification process. However, this does not imply that standard tests for intersectivity with adjectives work with distal modifiers, as Z&W's account expects. Rather, intersectivity is a property of the semantic mechanism, similarly to the event-based account of cases like (10). When the derivation of vector-based meaning is properly

treated, distal PP modification can be modelled as intersective, but without deriving incorrect equivalences with conjunctive sentences like (6) or invalid entailments as in (9).

Partee, B. H. 2010. Privative adjectives: subsective plus coercion. In *Presuppositions and Discourse: Essays offered to Hans Kamp*, eds. Bauerle et al. Zwarts, J. & Y. Winter 2000. Vector space semantics: a model-theoretic analysis of locative prepositions, *Journal of Logic, Language and Information* **9**, 169–211.