

## Non-Existential Indefinites and Semantic Incorporation of PP Complements

Indefinites that appear as complements in prepositional phrases show some systematic variations in their interpretation, which to the best of our knowledge have not been observed before. Consider the contrasts between the following pairs:

- (1) a. The house is close to a lake.                      b. The house is far from a lake.  
(2) a. The house is less than/at most 20m from a lake.      b. The house is more than/at least 20m from a lake.

Traditionally, we may expect the indefinite *a lake* to be interpreted as an existential quantifier. This is indeed the case in (1a), which means that there exists a lake  $x$  such that the house is close to  $x$ . In the case of (1b), however, the prominent interpretation is universal: for every lake  $x$ , the house is far from  $x$ . A similar contrast appears in (2).

This kind of examples raises two general questions. Empirically, we would like to have a characterization of such contrasts: what are the prepositional structures that give rise to non-existential interpretations of indefinites, and of which kinds of indefinites? Second, the theoretical sources for non-existential indefinites and contrasts as in (1) and (2) should be clarified. In this paper we answer these questions. We propose that non-existential effects as in (1b) result from *semantic incorporation* ([3]) between the predicative reading of the indefinite and the preposition. We argue that this is a general process with prepositions and predicative indefinites. Its results can be semantically equivalent to existential quantification, but we show that this is the case only with prepositional structures as in (1a) and (2a) that are *upward point-monotone* in the formal sense of [4].

The following examples show that the effect of prepositional structures on indefinites does not amount to a simple contrast between existential and universal interpretation.

- (3) The bird is more than 20m above a cloud.  
(4) The dog is less than 20m outside a doghouse.  
(5) The house is between 20m and 40m from a lake.

In (3) the indefinite is clearly not simply existential: for *every* cloud  $x$  that is below the bird,  $x$  should be more than 20m from the bird. However, this interpretation is not truly universal, since clouds that are above the bird do not matter for the truth-value of the sentence. In (4), it is not enough that there is a doghouse  $x$  such that the dog is less than 20m from  $x$ , since we must also require that the dog is not inside any doghouse, and hence *a doghouse* is not interpreted as an existential quantifier. On the other hand, this indefinite in (4) is clearly not interpreted as a universal quantifier. In the case of (5), the house is less than 40m from at least one lake and there is *no* lake less than 20m from it, and therefore it is neither existential nor universal.

Examples (1)-(5) display a broad spectrum of non-existential effects that are sensitive to the preposition in use. We explain this behavior by assuming a predicative denotation of the indefinite, and allowing the preposition to accept such predicates as a direct spatial argument. Each prepositional function can thus provide a different quantification effect over the elements denoted by the predicate. While to the best of our knowledge, the idea that locative prepositions are able to combine with predicates was not discussed in literature before, such a mechanism is analogous to the well documented ability of verbs to combine with such expressions ([2]). One mechanism for achieving this combination is *semantic incorporation* ([3]), where a verb is type-shifted into a function that combines with a predicative NP. For instance, a transitive verb of type  $e(et)$  can undergo existential incorporation by shifting to type  $(et)(et)$ . We propose a similar semantic incorporation scheme for prepositions with predicative denotations of indefinites, but without any existential quantifier built-in into the incorporation operator.

In previous work ([4]) the semantics of a locative PP is given using a prepositional function  $P$  that receives the location in space, or *eigenspace*, of the entity  $C_e$  denoted by the comple-

ment. The resulting semantic structure is  $P(\text{loc}(C_e))$ , where  $\text{loc}$  is a function that assigns each physical entity its eigenspace, and  $P$  is a spatial function. For instance, in a PP like *outside the lake*, the  $\text{loc}$  function maps the lake entity to its eigenspace, and the preposition *outside* maps this location to all the locations that do not overlap with it. We suggest to apply an incorporation operator that allows prepositions to directly accept predicates over entities instead of single entities. The idea is that instead of applying the prepositional function  $P$  to the eigenspace of a single entity, it is applied to the union of the eigenspaces of all the entities in the predicate’s extension. For example, in the case of the expression *outside a lake*, we first union the eigenspaces of all the lakes, and then the preposition *outside* produces the set of entities that are outside this combined eigenspace.

In (1b), this process derives the statement that the house is far from the union of the eigenspaces of all lakes, which accounts for the pseudo-universal interpretation. In (1a), by contrast, a house that is near the eigenspace of all lakes has to be near the eigenspace of at least one lake, which explains the existential effect in (1a). The same happens in (2), and a combination of existential and universal effects happens in (5), where the measure phrase is equivalent to *at least 20m and at most 50m*. In (4), the usual interpretation of *less than 20m outside x* is that the entity is less than 20m from  $x$ , and not inside  $x$ . If we substitute the combined eigenspace of all doghouses for  $x$ , we get the effect described earlier. As for (3), the formal definition of *above* is a bit more complicated, but the definition in [4] leads to the expected interpretation.

We conclude that all locative prepositions can be subject to incorporation with a predicative complement. Nevertheless, incorporation with some prepositions leads to readings equivalent to existential quantification. The notion of *point monotonicity* (PMON) discussed in [4] helps to define for which locative prepositions such equivalences hold. A preposition  $P$  is upward point-monotone if for all eigenspaces  $A, B$  s.t.  $\text{loc}(A) \subseteq \text{loc}(B)$  ( $B$  includes the area of  $A$ ):  $x P A \Rightarrow x P B$ . In other words: enlargement of the reference object preserves truth. We show that under incorporation, only prepositional functions that are upward point-monotone, including *inside* and *less than/up to x units from*, lead to readings that are equivalent to existential quantification.

In accordance with our analysis, non-existential effects with indefinites in PPs are limited to predicative indefinites like *a lake*. Indefinites like *some lake*, which are less acceptable in predicative sentences (cf. *?this is some lake*), lead to ordinary existential readings in sentences like *the house is far from some lake*.

In the full version we also discuss the relationships between our proposal and two further topics: NPI licensing in PPs, and temporal PPs. Consider the following examples.

(6) The house is far from/\*close to any lake.

(7) Most shelters are built more than 2 years after a war.

In (6) we see that NPI licensing is related to the semantics of spatial PP modification. We show that such contrasts with NPIs are expected by our incorporation-based approach using standard notions of monotonicity, but this would not be the case in approaches that treat PP complements uniformly as entity-denoting. Further, we show that pseudo-universal effects similar to (1b) and (2b) appear with temporal PPs as in (7), and propose an extension of our incorporation-based account to temporal PPs.

**References** [1] W. A. Ladusaw. *Polarity Sensitivity as Inherent Scope Relations*. PhD thesis, U. of Texas at Austin, 1979. [2] L. McNally and V. Van Geenhoven. On the property analysis of opaque complements. *Lingua*, 2005. [3] V. van Geenhoven. *Semantic Incorporation and Indefinite Descriptions*. CSLI, 1998. [4] J. Zwarts and Y. Winter. Vector space semantics. *Journal of Logic, Language and Information*, 2000.