Coreference*

Reinhard Muskens

The relation of *coreference* obtains between two expressions if and only if they denote the same individual. Thus the name *Mont Blanc* and the definite description *the highest mountain in Europe* corefer. If two English noun phrases A and B both denote an individual, they are coreferential if and only if the sentence *A is B* is true.

In mathematical languages and in predicate logic coreferential terms can be interchanged in any sentence without altering the truth value of that sentence. Replacing $3 + 5$ by $12 - 4$ in any formula of arithmetic will never lead from truth to falsity or from falsity to truth. But natural languages are different in this respect. While in some contexts it is always allowed to interchange coreferential terms, other contexts do not admit this. An example of the first sort of context is *likes bananas*: for any two coreferential noun phrases A and B the sentence *A likes bananas* is true if and only if *B likes bananas* is. A context that does not allow intersubstitution of coreferents is *The Ancients knew that appears at dawn.* If we fill the hole with the noun phrase *the Morning Star* we get the true (1a), while if we plug in *the Evening Star* we get the false (1b). Yet *the Morning Star* and *the Evening Star* both refer to the planet Venus and are thus coreferential.

(1) a. The Ancients knew that **the Morning Star** appears at dawn

b. The Ancients knew that **the Evening Star** appears at dawn

Contexts in which coreferential terms are not always interchangeable without altering truth value are called *opaque;* if a context is not opaque it is *transparent.* The example above shows that verbs of propositional attitude

like *know* can give rise to opaque contexts, but many other constructions can as well. In (2), for example, we see that replacing *Noam Chomsky* by a coreferential description may lead from truth to falsity if the name occurs in the scope of a temporal adverbial. (3) shows that a modal operator can have the same effect: substituting *Neil Armstrong* for a description that denotes the same person leads from a true statement to a one that presumably is false.

(2) a. In 1950, Noam Chomsky was **Noam Chomsky**

b. In 1950, Noam Chomsky was **the author of Syntactic Structures**

(3) a. Neil Armstrong might not have been **the first man who walked on the moon**

b. Neil Armstrong might not have been **Neil Armstrong**

The fact that predicate logic is completely transparent, while opacity is the rule rather than the exception in English, seems to imply that predicate logic is not the right vehicle for describing the semantics of English. Many semanticists therefore conclude that, in order to model the logic of English, special logics should be applied that have opaque contexts themselves. These so-called *intensional* logics contain temporal and modal operators and operators of propositional attitude, and are thus closer to the structure of English than ordinary predicate logic is.