An Integrational Approach to Measuring Expressions in Natural Language

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abstract

Krifka (1990) observes that sentence (1) has the two readings paraphrased in (2):

(1) Four thousand ships passed through the lock.

(2) a. There are four thousand different ships that passed through the lock. (object-related reading)

b. There were four thousand events of a ship passing through the lock. (event-related reading)

In order to account for the difference between the two readings, Krifka proposes that only the event-related reading involves the function he calls Object-induced Event Measure Function or the relation he calls Object-induced Event Measure Relation. However, OEM/OEMR is defined with the notion of iterative events, and because of this, his analysis fails to account for cases that involve events with the sub-time-interval property such as (3):

(3) Mary carried a container.

In order to capture the semantics of these sentences in a principled way, I develop a new approach to interpreting measuring expressions. On this approach, for a given sentence involving a measuring expression, a function $f(I)$ from time-intervals into real numbers is defined, and the truth conditions of the sentence are obtained by calculating the Lebesgue integral of $f(I)$ over the set $X$ of time-intervals in the context. In the case of (1), we thus have (4) as the truth conditions:

(4) $\int_X f(I) d\mu = 4000$

$\mu$ is the counting measure here. It is then argued that the two readings of (1) follow from two different definitions of $f(I)$ which are compositionally derived from different scope configurations involving the noun phrase.

The integrational approach naturally extends to cases of events of creation/destruction or production/consumption of mass entities such as (5), which are continuous in nature.

(5) Mary drank three liters of water.

For (5), it never suffices to only consider time-intervals with a positive length. Rather, one should look at each time-point and the rate of drinking water at that time-point. We therefore define a function $g(I)$ which yields a rate of drinking for a given time-point $I = [t,t]$, and obtain the truth conditions by integrating it over the set $X$ of time-intervals of the form $[t,t]$ in the context:

(6) $\int_X g(I) d\mu = 3$

The measure $\mu$ used in this case should now be equivalent to the Lebesgue measure.

A uniform treatment of discrete and continuous cases is possible by having a uniform measure $\mu$ which is decomposed into mutually singular measures $\mu_l$ and $\mu_c$, where $\mu_l$ is essentially the Lebesgue measure defined on time-intervals of the form $[t,t]$, and $\mu_c$ is the counting measure defined on time-intervals with a positive length: $\mu_l \perp \mu_c$ and $\mu = \mu_l + \mu_c$. This theory can thus account for a variety of cases involving a measuring expression with new insight.

References:

Krifka, Manfred. (1990). Four Thousand Ships Passed Through the Lock: Object-Induced Measure Functions on Events. *Linguistics and Philosophy* 13, 487-520