

The polysemy of container pseudo-partitives

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The question. A pseudo-partitive phrase headed by a container word, such as *bucket of water*, may be interpreted as either the container object or its contents. In "Mary broke the bucket of water", *bucket of water* satisfies the selectional restriction of *break* if it is interpreted as a container, while in "Mary spilled the bucket of water" *spill* requires it to be the amount of water. Existing approaches (Selkirk 1977, Rothstein 2009, Partee and Borschev 2012) take the two readings to arise from different syntactic and semantic representations. This paper tests this hypothesis experimentally using acceptability judgments and the co-predication test. We asked if the two interpretations of a container construction are available concurrently in the same representation, and can therefore satisfy the contradictory selectional requirements of two predicates in the same sentence as in "Mary broke the bucket of water that Chris spilled". Our results show that unlike the prediction of current theories, co-predication does not lead to ungrammaticality. We propose instead an analysis of the container construction based on Asher's (2011) dot-type framework that treats the pseudo-partitive as a complex object constructor.

The experiments. We compare pseudo-partitives with two classes of lexical ambiguity, namely polysemy (*a heavy/sad book*) and homonymy (*a bitter/handsome date*) for which co-predication has been reported to be grammatical and illicit, respectively. In experiment 1 (n=36), a 2x2x2 factorial design, we manipulated the order of presentation of 2 biasing predicates, the 2 senses selected by these predicates and the type of ambiguity, homonymy or polysemy. (1-a) illustrates a mismatch condition: the physical object sense of newspaper is selected by *lying* in the relative clause, but the matrix predicate selects for the organization sense. (1-b) exemplifies a homonymy condition. Subjects rated these sentences on a 5-point scale from -2 (very bad) to 2 (very good). In experiment 2 (n=42) we compare these ratings to speaker's judgments about the container pseudo-partitive plus a mass containee (*bucket of water*) or count (*box of books*), using the same design and procedure as experiment 1. (1-c) illustrates a mass, containee-container order, mismatch condition.

- (1) a. The newspaper that was lying in the rain (*concrete*) went bankrupt (*abstract*). [polysemy]
- b. The date that tasted bitter (*inanimate*) was very rude (*animate*) to Jane. [homonymy]
- c. The carton of milk you drank (*containee*) is not recyclable (*container*). [pseudo-partitive]

Results. Graphical summaries of the data are provided in Figure 1 below. Each plot consists of 4 equal-width and equal-height bars, i.e. bars whose areas are the same. Each bar corresponds to one of the 4 order*sense combinations. Within each bar, we plot the proportion of 2, 1, 0, -1 and -2 answers in increasingly darker shades of gray: 2 is almost white, while -2 is very close to black. These values are specified on the y-axis on the left side of the plot. The data is not continuous but ordered categorical (-2, -1 ..., 2 are ordered labels, not actual numbers), so we use mixed-effects ordinal probit regression models (with random intercepts for subjects and items) to analyze the data. The probabilities we report are derived from these models, but the data plots in Figure 1 tell the same basic story.

Homonyms are judged significantly worse (probability of -2=32.6%, probability of 2=4.9%) than polysemy (p(-2)=4.4%, p(2)=29%) on mismatching conditions. The distribution of the results for the pseudo-partitive is more complex. There is a significant internal difference between the two matching (container-container p(-2)= 4.3%, p(2)=29.5%; containee-containee p(-2)=12.5%, p(2)= 13.4%) and mismatching conditions (containee-container p(-2)=11%, p(2)= 15%; container-containee p(-2)= 15%, p(2)=10%). There was also an effect of order between conditions given the first selected sense: if the first sense is "container", then ratings are higher if the second sense match, but if first sense is "containee", then ratings do not differ depending on second sense. There was no effect of the mass/count status of the containee noun and it did not interact with other factors significantly.

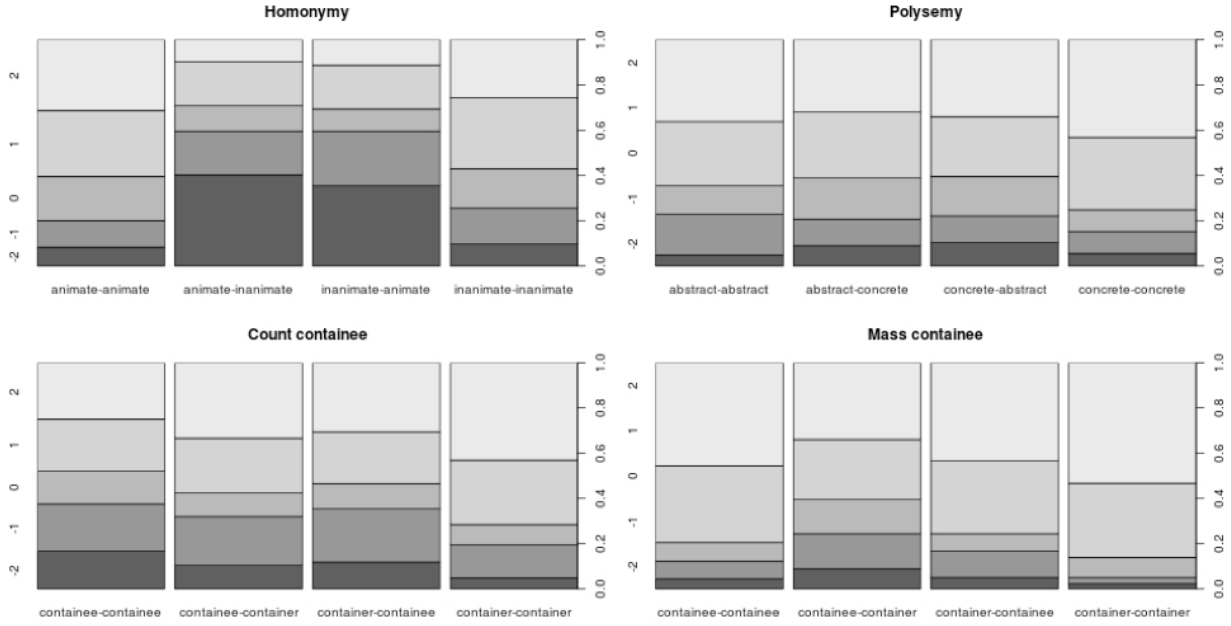


Figure 1: Responses by condition, where lighter grey = 2 and darker grey = -2

These results indicate that in the pseudo-partitive construction both the container and the containee are available for predication, since mismatching conditions were rated higher than ungrammatical fillers and homonymy co-predication. This is unlike other binominal phrases such as *the mother of the bride*, where both nominals can be picked up anaphorically, but only the head *mother* can justify selectional requirements. Proposals that treat the container as a relational noun, such as Rothstein (2009) and Partee and Borschev (2012) are thus incompatible with our results.

Discussion. This data supports the need to add to our ontology complex objects of the sort proposed by Asher (2011), which consist of distinct aspects that can be independently targeted for predication, and moreover that complex types can be built through syntax. In the *glass of wine*, the properties $\lambda x.\lambda\pi:\text{concrete GLASS}(x, \pi)$ and $\lambda y.\lambda\pi:\text{substance WINE}(y, \pi)$, where π is the contextual parameter that tracks type presuppositions, is combined into a single one-place predicate $\lambda z.\lambda\pi:\text{glass}\bullet\text{wine GLASS-OF-WINE}(z, \pi)$, true of a dot-type which has as aspects *glass* and *wine*. While Asher's (2011) framework provides the formal means to model co-predication, it offers little insight into the restrictions natural language imposes on the possibility space for dot-types. The present studies help shed light on the issue by showing that the relations which license polysemy are not limited to those that link aspects of a singular object in the lexicon, but is extended to a relation between separate objects which can be established compositionally, namely the individuation relation between a container and the objects it contains.

Finally, our results also indicate that the aspects of this phrasal complex types do not stand on equal footing in processing, unlike *book-type* polysemy. Rather, when an aspect is selected by the relative clause, this generates a strong expectation that the same aspect will be selected in the matrix clause. Although we show that co-predication is not cost-free even for lexical polysemy, the size of the effect is larger for the container construction. An account of the flexibility of container pseudo-partitives must thus both approximate it to polysemy and distinguish lexical and phrasal polysemy at a level of representation which is reflected at least in offline processing measures. This paper will also report the results of a self-paced reading experiment intended to investigate the real-time processing effects of these contrasts which is currently underway, and will be able to provide more fine-grained evidence about the dynamic processes involved in parsing co-predication.