Polysemy in Sentence Comprehension: Effects of Sense Dominance

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Background

Polysemous words have **two related senses**, such as the **filling** in a pie, or the **filling** in a tooth. Two experiments investigated competing accounts of how polysemous senses are represented during sentence comprehension.

Underspecified Sense Account. On one view, readers retrieve an underspecified, *core meaning* (Caramazza & Grober, 1976; Ruhl, 1989) based on senses having a principled relation (Frazier & Rayner, 1990; Frazier, 1999; Pickering & Frisson, 2001; William, 1992). The core meaning can then be filled out more fully depending on the later context.

- Frazier and Rayner (1990) found that polysemous words did not show dominance effects, while homonyms did. Similar results were found by Pickering & Frisson (2001).

Separate Sense Account. On another view, there is little semantic or feature overlap between senses (Cruse, 1986; Klein & Murphy, 2002; Rice, 1992), suggesting that different senses are represented separately.

- Klein and Murphy (2001) found facilitation for consistent senses of polysemes in a semantic judgment task, and a cost for switching from one sense to the other.
- Priming of different polysemous senses was only slightly different from results with homonyms.
- More recently, Klepousniotou, Titone, and Romero (2008) varied the semantic overlap between senses, finding that low overlap senses showed larger effects of context and dominance in a priming task.

The Present Experiments

Priming tasks find that consistent context-to-sense combinations are easier to process than inconsistent cases, but they have not focused on the role of sense dominance. On the other hand, reading experiments have not found such processing differences, but included only a subordinate context. To resolve this dispute, we used past stimuli from priming experiments in a reading task with a factorial design.

Biasing context: dominant vs. subordinate sense (pretested)
1. We expected to find that **switching from a dominant context to the subordinate sense would be harder** than the other way around.

Neutral context: We included a neutral, non-biasing context.
1.If senses are stored separately, **a dominant, more frequent sense should be easier to process** than a subordinate, less frequent sense.
2. ***How* dominant a sense is** should predict processing difficulty.
3. If polysemes are represented as an abstract, core meaning, there should be no dominance effects.

Design & Materials

context	dominant sense	subordinate sense
DOM	The **caterer** tested the filling that was in *the pie* before leaving.	The **caterer** tested the filling that was in *the tooth* before leaving.
SUB	The **dentist** tested the filling that was in *the pie* before leaving.	The **dentist** tested the filling that was in *the tooth* before leaving.
NTRL	**She** tested the filling that was in *the pie* before leaving.	**She** tested the filling that was in *the tooth* before leaving.

- The disambiguating word (*pie/tooth*) was equated for length, syllables, and frequency.
- We used the 25 polysemous words from Klein and Murphy (2001, 2002).
- Sense frequency ranged from strongly biasing (91% dominant, 1% subordinate for *coat*) to relatively equal bias (53% dominant, 40% subordinate for *chicken*).

Expt. 1 = 36 *S*s, Expt. 2 = 54 *S*s

Expt. 1: Self-paced Reading

The caterer/dentist/She * tested * the filling * in the pie/tooth * before leaving.

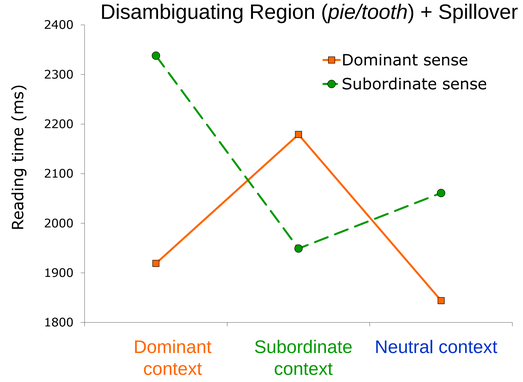
Biasing context

1. Consistent context-to-sense sentences were read more quickly than inconsistent ones.
2. Readers had **more difficulty switching from dominant-to-subordinate** than from subordinate-to-dominant.
3. Readers interpreted the senses as intended: Reading time for the two consistent conditions was not different.

Neutral context

1. The **dominant sense** was significantly **easier to read** than the subordinate sense.
   - Excluding 7 equal bias items increased the significance for Disambiguating and Spillover regions.
2. The **degree of sense dominance** significantly **predicted the difference in reading times**.
   - β =.42, R^2=.18, $F(1, 23)$=5.04, p=.03
3. The dominant sense continuation was read just as quickly in the neutral and dominant contexts.

Conclusion: The dominance effect in neutral context is evidence for separate sense representations.



Expt. 2: Eye-tracking

The caterer/dentist/She tested * the filling * that was in the * pie/tooth * before * leaving.

Biasing Context

We found the same pattern of results as Expt. 1.

1. Inconsistent context-to-sense sentences were harder to understand than consistent ones.
   - Regression Path: Spillover, Wrap-up
   - First-Pass Regressions Out: Wrap-up
   - Regressions-back in: Context, Between
   - Second-Pass : all regions
   - Total Time: Polyseme, Disambiguating, Spillover
2. Earlier and more widespread difficulty for dominant-to-subordinate switch.
   Dominant context conditions differed for
   - Regression Path: Spillover, Wrap-up
   - Second Pass: all regions except Wrap-up
   - Total Time: Polyseme, Disambiguating, Spillover

   Subordinate context conditions differed for
   - First-Pass Regressions Out: Wrap-up
   - Regressions-back in: Between
   - Total Time: Disambiguating

Neutral Context

Degree of dominance predicted the difference score of the item means, p < .06

significant *t*-test difference, p < .05
marginal *t*-test difference, p < .10
significance increased without 7 equal bias items

Measure	Sense	Context *She tested*	Polyseme *the filling*	Between *that was in the*	Disambiguating *pie/tooth*	Spillover *before*	Wrap-up *leaving.*
First Pass (ms)	Dominant	412	314	405	347	319	155
	Subordinate	366	330	380	370	325	195
Regressions Out (%)	Dominant		10.06	9.91	13.36	25.47	27.52
	Subordinate		15.41	14.94	18.24	21.70	33.80
Regressions back (%)	Dominant	34.75	24.68	30.97	19.02	10.53	
	Subordinate	35.85	33.33	32.86	15.88	7.07	
Regression Path (ms)	Dominant		383	449	405	434	435
	Subordinate		371	466	438	521	494
Second Pass (ms)	Dominant	137	139	212	131	78	29
	Subordinate	143	181	266	180	83	32
Total Time (ms)	Dominant	510	450	606	482	391	385
	Subordinate	580	507	645	550	402	472

1. The **dominant sense was easier to read** than the subordinate sense.
   - First Pass: Wrap-up (marginal)
   - Re-reading was shorter on the Polyseme and Disambiguating regions.
   - Analyses without 7 equal bias items increased the significance of comparisons.
2. The **magnitude of sense dominance** for each item significantly **predicted the difference** between Neutral context conditions on the Polyseme and following region.

Conclusions

1. We found clear evidence that for polysemous nouns, inconsistent context-to-sense sentences were harder to understand than consistent ones.
2. There were numerous differences between dominant and subordinate senses, including differential difficulty in switching from dominant to subordinate sense and dominance effects in neutral contexts.
3. Dominance effects were stronger when equal biased items were removed from analyses; amount of lexical bias predicted processing difficulty.
4. All these effects suggest that the different senses are represented separately in the lexicon, with the dominant sense having a stronger representation than subordinate senses.