Polysemy and Inference: Reasoning with Underspecified Representations

BACKGROUND: To which sorts of representational structure do mental inference rules apply? The answer assumed by most psychologists, linguists, and philosophers is that the mental representations we infer over are the same representations that fix denotations. This identification makes good cognitive sense: if argument structures are sensitive to denotational representations, then valid structures are guaranteed to preserve truth. Despite this widespread assumption, direct evidence is lacking. Studies of inferential ability typically require participants to judge arguments presented using *unambiguous* natural language sentences (see Khemlani & Johnson-Laird, 2012, for an overview). While such studies may yield insight into which inferential schemas we possess, they cannot discover which type of representation these schemas are sensitive to. This is for the simple reason that any two token instances of an unambiguous word share *many* levels of representational structure, such as orthographic and denotation-determining. Furthermore, recent work suggests that words may involve an additional, intermediate level of *underspecified* representation which constrains but does not uniquely fix denotations (Falkum, 2015; Pietroski, 2018, 2025; Quilty-Dunn, 2021).

Thus, in the present study, we deploy a novel paradigm testing inferences over lexically ambiguous words, that is, words sharing only *some* types of representation. For example, homonyms share an orthographic representation (e.g., “bat”) but map to multiple, unrelated denotational representations (flying mammals and clubs used in baseball). Polysemes are single word forms that map to multiple, related senses. For instance, “breakfast” refers to both dining events and foods. Previous work suggests that—unlike homonyms—polysemes have an underspecified level of representation that is neutral between a word’s denotation-determining representations (Frazier & Rayner, 1990; Frisson, 2009).

Leveraging lexical ambiguity, our experiment uses arguments that instantiate structural schemas at some but not all levels of representation. We utilize such equivocal arguments to investigate the cognitive representations used in mental inference. We show that humans reason over underspecified representations, rather than relying on a form-based pattern matching strategy or truth-preserving denotations. These results are robust across all tested underspecified representations and argument forms. They also cannot be explained by alternative strategies, such as non-inferential heuristics or re-analyses of arguments that do not rely on words’ underlying representations. Together, our findings challenge longstanding views in philosophy, linguistics, and psychology that words and/or concepts correspond to unique meaning representations that are the basic constituents of domain-general thought processes.

METHODS: In two experiments (N=148), we collected validity judgments on syllogistic arguments which equivocated over polysemes and homonyms (**Table 1**). There was a total of 224 arguments evenly divided between four forms (**Table 2**) in which the middle term was either a polyseme or homonym. We also had valid and invalid fillers. For equivocal arguments, each premise was designed to uniquely constrain the intended sense. If participants accept equivocal polysemy arguments, this is consistent with their use of either orthographic or underspecified representations. However, if they also reject equivocal homonymy arguments, they cannot be inferring over orthographic representations. We also conducted norming studies to gather judgements on the plausibility of the premises and conclusions when presented in isolation (i.e. no context of argument) which were included as additional factors in the mixed-effects models. Additionally, we carried out follow-up experiments (elided here for space) to rule out alternative explanations.

RESULTS: Participants endorsed arguments with equivocal polysemes as valid (65%) more often than arguments with equivocal homonyms (48%— **Fig 1**). Our primary analyses (elided for space) confirm this difference using mixed-effects logistic regression via nested model

comparison. Beyond classic belief bias effects, polyseme-based arguments show a validity boost twice as large as those involving homonyms or fillers (**Fig 2**). Finally, while participants vary in their overall rates of argument acceptance, the boost to polyseme items is stable across participants. These findings provide behavioral evidence that individuals can reason over underspecified representations. Participants reliably accept equivocal polysemy arguments, which is compatible with their use of either form representations or underspecified representations, but is not consistent with their use of denotational representations. Furthermore, participants reliably judge as invalid equivocal homonymy arguments, which is not compatible with individuals inferring over form representations. Thus, we conclude that individuals spontaneously use underspecified representations in inference.

REFERENCES: **Falkum, I. L. (2015)**. The how and why of polysemy: A pragmatic account. *Lingua*, *157*, 83–99. **Frazier, L., & Rayner, K. (1990)**. Taking on semantic commitments: Processing multiple meanings vs. multiple senses. *Journal of Memory and Language*, *29*(2), 181–200. **Frisson, S. (2009)**. Semantic Underspecification in Language Processing. *Language and Linguistics Compass*, *3*(1), 111–127. **Khemlani, S., & Johnson-Laird, P. N. (2012)**. Theories of the syllogism: A meta-analysis. *Psychological Bulletin*, *138*(3), 427. **Pietroski, P. M. (2018)**. *Conjoining meanings: Semantics without truth values*. Oxford university press. **Pietroski, P. M. (2025)**. One word, many concepts: Endorsing polysemous meanings. In U. Stojnić & E. LePore (Eds.), *The Oxford handbook of contemporary philosophy of language* (First edition, pp. 258–286). Oxford University Press. **Quilty-Dunn, J. (2021)**. Polysemy and thought: Toward a generative theory of concepts. *Mind & Language*, *36*(1), 158–185.

Polysemy	Homonymy
(P1) Some **dinners** are black tie (P2) All **dinners** are foods (P3) Some foods are black tie	(P1) All **bats** share a common ancestor (P2) Some sporting goods are **bats** (C) Some sporting goods share a common ancestor

Table 1. Example stimuli.

Dimatis	Disamis	Datisi	Darii
Sm P are M	Sm M are P	All M are P	All M are P
All M are S	All M are S	Sm M are S	Sm S are M
Sm S are P	Sm S are P	Sm S are P	Sm S are P

Table 2. Aristotelian arguments tested.

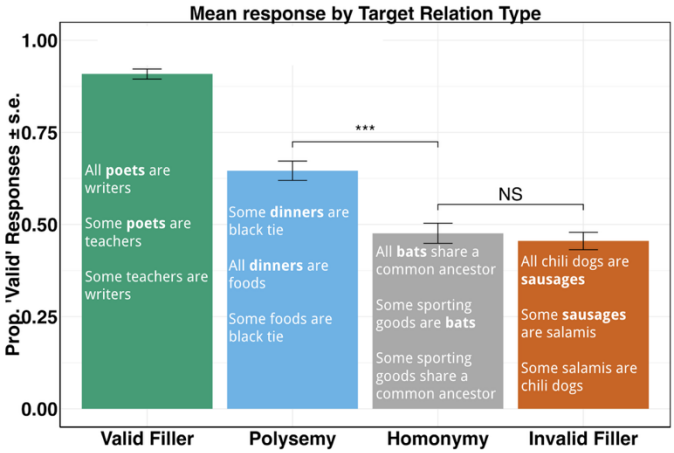

Figure 1. Mean validity judgment by middle-term type in experiment 2.

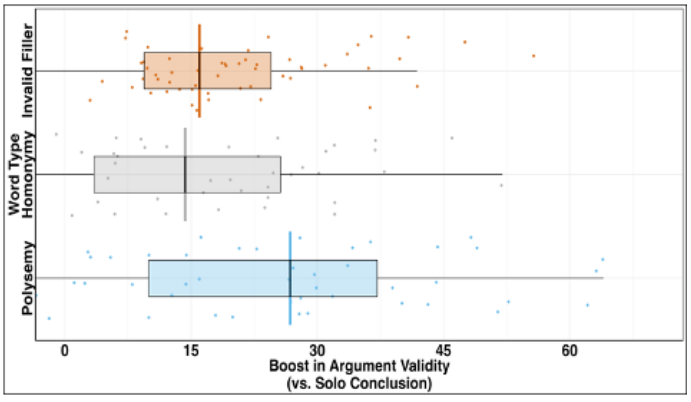

Figure 2. Boost in argument validity by middle-term type, above plausibility ratings for isolated conclusions, from experiment 1.