

## How much does verb semantics determine verb syntax?

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Verbs vary in terms of which syntactic frames they can appear in. In principle, this could be an unpredictable fact about the verb that must be acquired, much like the phonological form of the verb. However, many theorists posit that there is a systematic relationship between the semantics of a verb and the syntactic frames in which it can appear (Levin and Hovav, 2005). This Semantic Consistency Hypothesis has played a central role in many theories of language acquisition and processing (e.g., Gleitman, 1990).

Despite its theoretical importance, tests of the Semantic Consistency Hypothesis are scattered. This is a function of scale: with thousands of verbs, hundreds of frames, and dozens of purportedly determinative semantic features, it is difficult to study more than a tiny fraction. While researchers have identified at least 280 verb classes in English (groups of verbs that appear in all and only the same syntactic frames) (Kipper et al., 2008), only a few have been systematically investigated.

We address the issue of scale through crowd-sourcing, recruiting large numbers of volunteers, each of whom may provide only a few annotations. Ultimately, we hope to study 8,000 verbs across 280 verb classes. To date, we have focused on 83 verb classes covering 2,167 verbs and 10,976 verb/frame combinations. For each semantic feature and for each verb/frame combination, we continue collecting data until there is unambiguous agreement across annotators, as determined by a modified entropy criterion (explained in the presentation). Analysis focuses on these “finished” items (see Table 1).

We selected six semantic features from those most commonly invoked in prior theoretical work. We also included one semantic feature (EVALUATION – roughly, whether an event is good or bad) that has not been invoked, which provides a control. Each task was extensively piloted to ensure annotators understood the instructions.

At time of analysis, we have obtained 568,940 annotations from 11,260 annotators (see Figure 1 for more information about participant contributions), sufficient to analyze an average of 5,159 verb/frame combinations per semantic feature (see Table 1). We operationalized “semantic consistency” as the percentage of verbs in a class that have the same annotation. For instance, if every verb in a class involves the verb’s subject undergoing a physical change, that class would have 100% consistency for the PHYSICAL CHANGE feature. Because a verb’s semantics often depends on the syntactic frame it is in (Goldberg, 1995; Levin & Rappaort Hovav, 2005), we calculate consistency separately for each syntactic frame and then average.

Semantic consistency, averaged across verb classes, was near ceiling for our six critical semantic features (see Table). This strongly supports the Semantic Consistency hypothesis. Interestingly, semantic consistency was much lower for the control feature (EVALUATION), lending support to the claim that semantic consistency is specific to some “core” set of semantic features (Jackendoff, 1990; Pinker, 1989). In the presentation, we consider how the specific findings (which verbs involve which features; see Table 2) compare to prior theoretical work.

Despite being the most comprehensive investigation of the Semantic Consistency Hypothesis to date, it should be noted that our study focuses on only seven semantic features for only a fraction of verbs in a single language. These results may not generalize. We are continuing to collect data and hope to present results for more verbs and features in the future.

Task	Semantic Feature	Anns.	Anns./Item	Items Done	Items Total	Consistency
Entropy	PHYSICAL CHANGE	83,568	8	5528	9916	96%
Equilibrium	APPLICATION OF FORCE	92,799	9	4239	10902	94%
Explode on Contact	PHYSICAL CONTACT	76,149	8	4324	9924	98%
Fickle Folk	CHANGE OF MENTAL STATE	60,813	8	3259	7477	99%
Philosophical Zombie Hunter	MENTAL STATE	92,030	9	2719	9894	96%
Simon Says Freeze	LOCATION CHANGE	75,185	8	4638	9582	97%
A Good World	EVALUATION	88,396	8	7716	10904	76%

Table 1: Task, semantic feature, number of annotations, mean annotations/item, number of items fully annotated, mean consistency.

Task	Semantic Predicate Tested	VerbNet 3.1 Class	VerbCorner Results (modal response consistent with VerbNet)
Equilibrium	APPLICATION OF FORCE	push-12	Yes
Simon Says Freeze	LOCATION CHANGE	drive-11_5	Yes
Simon Says Freeze	LOCATION CHANGE	throw-17_1	Yes
Simon Says Freeze	LOCATION CHANGE	pour-9_5	No
Explode on Contact	PHYSICAL CONTACT	pelt-17_2	Yes
Explode on Contact	PHYSICAL CONTACT	swat-18_2	Yes

Table 2: Preliminary findings from some VerbCorner tasks - consistency with VerbNet semantic predicates

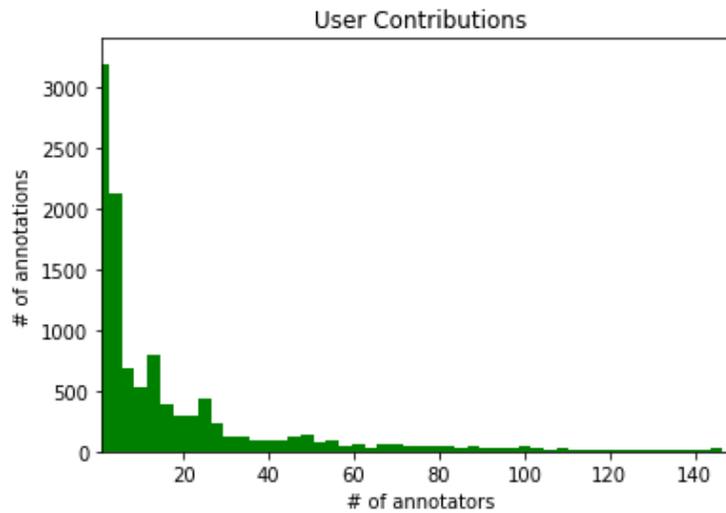


Figure 1: How many annotations do participants contribute?