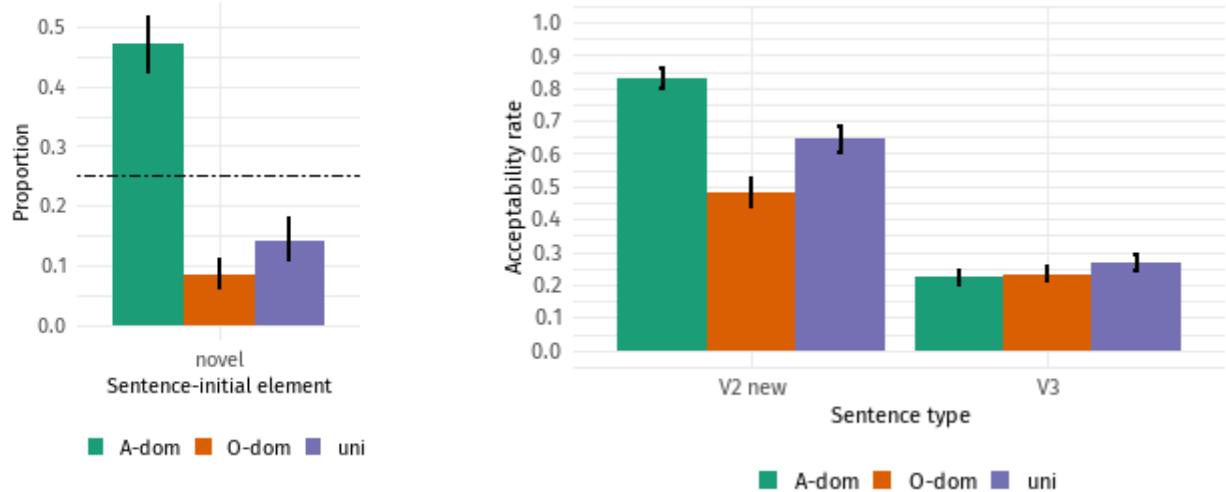


The role of input variability for the acquisition and loss of V2

1. Background Verb second (V2), while characteristic of most Germanic languages, is a typologically rare phenomenon, with the loss of V2 well-documented in English and French (among others). The loss of V2 has been tied to a decline of clauses with non-subjects in preverbal position (Lightfoot 1999, Yang 2000). This seems intuitive: V2 should be difficult to acquire without a critical mass of such sentences. Indeed, a distribution heavily skewed toward any one type of element in initial position might lead learners to acquire a language with fixed rather than V2 order. However, despite its relevance for theories of the loss of V2, the effect of skewed V2 input on the acquisition of V2 remains empirically untested. Here we test the hypothesis, inspired by work showing the importance of variation in the input (Gómez 2002), that the distribution of initial elements most likely to facilitate the acquisition of V2 is a uniform or maximum entropy distribution. Deviations from such a distribution should lead to less robust learning of a general V2 rule allowing elements to freely occur in clause-initial position so long as the verb is second.

2. Corpus study Before testing the hypothesis experimentally, we first consider the distributional properties of clause-initial elements in German. Previous work has revealed a skewed distribution such that S(subject)>A(djunct)>O(bject) (Bohnacker & Rosén 2008). We replicated this skew in a large scale corpus study using three subcorpora of the dependency treebank corpus TüBa-D/DP (Kok & Pütz 2019). Across all corpora S is the most frequent preverbal element (Wikipedia 50.2%, European Parliament proceedings 59.2%, speeches of German officials 60.3%) followed by A (wiki 42.0%, europarl 30.2%, speeches 27.7%) and O (wiki 2.3%, europarl 2.3%, speeches 4.3%). Importantly, however, such counts do not take into account the base frequencies of the elements. For instance, S may be the most likely initial element simply because subjects are more likely than objects or adjuncts. Without controlling for base frequency, it is therefore impossible to determine whether the distribution of initial elements is in fact meaningfully skewed. We simulated 10,000 frequency distributions over clause-initial-elements by randomly selecting one element in each V2 sentence to be clause-initial. If the conditional probability is similar across all elements (S, O, and A), the observed frequencies should approximate the simulated frequency distribution. This was not the case: across all corpora, S was significantly higher than expected in initial position, while O was significantly lower than expected. In europarl and wiki, A was significantly higher than expected but in speeches significantly lower than expected. These findings suggest that even when base frequencies are taken into account, the frequency of initial elements is indeed highly skewed in German, a diachronically stable V2 language. While this suggests that a skewed frequency can still result in successful acquisition of V2, a tendency for such skewed distributions in V2 languages more generally may nevertheless result in a learnability problem as suggested by Lightfoot (1999) and Yang (2000).

3. Artificial language learning experiment To test experimentally whether a uniform distribution of preverbal elements results in more robust learning we conducted an artificial language learning experiment. We recruited 314 monolingual English speakers via Prolific. Participants were taught a pseudo-artificial language with English vocabulary but V2 word order: The verb occurred consistently in second position but either S, O and A could appear preverbally. In the uniform condition ($n = 74$) participants were trained on input in which S, O and A were equally frequent preverbal elements. In the O-dominant ($n = 78$) and A-dominant ($n = 78$) conditions, O and A, respectively dominated the preverbal position (60%) while the other two types were equally infrequent. Participants were tested via production and a judgement task, both including novel constituent types.



(a) Production of novel preverbal constituents

(b) Ratings of novel V2 vs. V3 sentences

We predicted that participants in the uniform condition would show more robust learning of V2 as evidenced by better generalisation of the V2 rule. For productions, this meant a higher rate of novel constituents in preverbal position; for judgements a higher acceptance of V2 with novel preverbal constituents and better discrimination between novel V2 structures and ungrammatical V3 sentences. Mixed-effect logistic regression models confirmed our prediction for the uniform vs. O-dominant contrast ($\beta = .91, SE = .45, p = .04$) but not for the uniform vs. A-dominant contrast ($\beta = -2.55, SE = .43, p = 2.75^{-9}$) in production (Fig. 1a). Similarly, in judgements of novel V2 sentences, our predictions were confirmed for uniform vs. O-dominant ($\beta = .99, SE = .31, p = .001$) but not for uniform vs. A-dominant ($\beta = -1.45, SE = .32, p = 7.01^{-6}$; Fig. 1b). Finally, participants in the A-dominant condition showed better discrimination between novel V2 and ungrammatical V3 sentences compared to the uniform condition ($\beta = 1.95, SE = .47, p = 2.87^{-5}$) whereas the uniform and O-dominant conditions differed only marginally ($\beta = -.82, SE = .45, p = .07$).

4. Discussion Evidence from large-scale corpora of German suggests that the input to learners likely features a skewed distribution of preverbal constituents. We predicted that such a skewed input should generally lead to degraded learning of V2 compared to a maximally diverse uniform distribution. This prediction was partially confirmed: participants learning from O-dominant input were less likely to learn a robust V2 rule. However, V2 was learned robustly from uniform and A-dominant distributions although the latter being more beneficial for learning. While these results show for the first time that V2 can be learned relatively quickly in the lab, they leave open a number of questions. We discuss potential explanations for our findings, including a special role of subject-initial preverbal elements in driving poor acquisition of V2, and a particular bias against initial objects (notably rare in German as well) which may also relate to the diachronic instability of V2.

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