A Unified Model of Redundancy Avoidance and Strategic Lengthening

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Abstract

Recent studies have revealed an intriguing link between redundancy and reduction: words that are more predictable in their context are more commonly reduced (shorter and with less articulatory detail [1,2,3]). These studies have, however, also found a puzzling asymmetry: Content words are reduced when predictable given the previous word, but function words are reduced when predictable given the *following* word. We present a solution to this puzzle that unifies work on redundancy with work on strategic lengthening [4]. We find that the apparent backward-predictability effect on function word reduction is an artifact caused by speakers' tendency to slow pronunciation when the next word is unavailable.

Study 1 replicates the effect of previous studies. We use linear mixed models to analyze the effect of redundancy on 15,000 instances of "a" from a spontaneous speech corpus, while controlling for various factors that influence reduction (speaker differences, speech rate, presence of hesitations or disfluencies, phonological context, etc.). As expected [1,2], only backward-predictability of "a" (1b)–but not forward-predictability (1a)–reached significance.

Further analysis revealed that the apparent backward-predictability effect is predominantly driven by two factors. First, "a" is frequently followed by corrections. Unlike other disfluencies, corrections correlate with shortening of "a". Second, over a fifth of the tokens after "a" are part of collocations, as in "a lot of", that co-occur with "a" more than 70% of all times. This holds for less than 0.5% of all tokens *preceding* "a". As would be expected if frequent collocations are retrieved together, "a" is pronounced significantly shorter. Further support for the hypothesis that these frequent collocations have a special status comes from the bimodal shape of the distribution of the (log-transformed) backward-predictability of "a". After excluding collocations and cases with corrections, the backward-predictability effect was largely reduced.

Study 2 tests whether the remaining effect of backward-predictability is an artifact due to strategic lengthening before unavailable material. Here we model the availability of an upcoming word by its frequency and contextual predictability. We add two probabilistic measures of availability to the model: the frequency of the word following "a" and its trigram predictability (1c). The availability-trigram improves the model *and* subsumes backward-predictability. Thus the apparent effect of backward-predictability [2] seems to be spurious. Instead, "a" is strategically lengthened before unavailable words. **Study 3 and 4** provide further evidence for strategic lengthening from instances of complementizer and relativizer "that".

In conclusion, we propose a unified probabilistic model that attributes reduction to three underlying causes: **redundancy avoidance** (predictable words are reduced), **strategic lengthening** before unavailable material, and joint storage and retrieval of **collocations**. Redundancy avoidance affects function words less than content words, consistent with the absence of frequency effects on function word reduction [1]. But strategic lengthening affects function words more: their high availability and occurrence before low-probability words (lexical heads) makes them ideal candidates for strategic lengthening. We close by discussing extensions of the proposed model to capture phrase-initial function word repetitions ("the, the, the...") and the distribution of filled pauses ("uh", "um").

Examples

(1) **PRECEDING "a" FOLLOWING**
Your argument is pretty flimsy for a couple of reasons.

(1a) **Forward-predictability measure:** log P(*a* | *for*)

(1b) **Backward-predictability measure:** log P(*a* | *couple*)

(1c) **Availability-trigram measure:** log P(*couple* | *for a*)

References

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