

Social and communicative biases jointly influence grammatical choices in learning

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Language users are faced with a variety of choices at different levels of organization. These choices are guided by various biases, some stemming from communicative or processing constraints [1], others from social factors [2]. While the role of these biases in isolation is well-documented, less is known about their *joint* influences on speakers' choices. We employed an artificial language learning paradigm to investigate this, using two well-established biases as a test case: a bias for communicative efficiency [3, 4] and a social bias towards identifying with particular speaker groups [2]. We hypothesized that the social bias would interact with the communicative bias, such that learners would converge on languages that satisfied both pressures.

Exp. 1. 60 English speakers were recruited online via Prolific to learn an artificial language. Participants first learned the nouns referring to characters (e.g., 'barsa' for 'mountie') and then learned the grammar by watching transitive scenes ('mountie kicks chef') accompanied by sentences in the language. At the end of the experiment, participants produced sentences in the artificial language to describe novel scenes. They were informed that there are two dialects in the language (each associated with a different alien color during training, Fig. 1). Both dialects had uninformative word order (SOV/OSV 50/50%). The *case dialect* used consistent case marking on the object (100%) and thus left no uncertainty about sentence meaning; the *no-case dialect* used no case and thus permitted maximal uncertainty (subjects were not case marked in either dialect). The language overall had 50% case-marking (conditioned on the dialect) and 50% SOV order (not conditioned on the dialect). Earlier work has shown that, in the absence of social pressures, learners favor robust communication and reduce uncertainty by maintaining case in languages with flexible word order [5, 6]. We modeled a social bias by manipulating which aliens were cast as 'potential trading partners' in the instructions, encouraging participants to feel positive towards one dialect (bias-for-case or bias-for-no-case conditions) or no specific dialect (no-bias condition). **Results.** We assessed the amount of case used in production using a mixed logit model (max RE). Learners in the bias-for-case condition used the same amount of case as learners in the no-bias condition ($\beta = -0.3$, $z = -0.61$, $p = 0.54$, Fig. 2a). Learners in the bias-for-no-case condition produced significantly less case compared to the no-bias condition ($\beta = -1.65$, $z = -3.12$, $p < 0.001$). We further tested whether learners develop strategies to mitigate the increased uncertainty due to dropped case (e.g., fixing word order) by comparing the conditional entropy (i.e., the amount of uncertainty) in the linguistic systems produced across conditions. Learners in the bias-for-no-case condition had significantly higher uncertainty compared to the no-bias condition ($\beta = 0.11$, $z = 4.23$, $p < 0.001$; Fig. 2b), while the no-bias and bias-for-case conditions did not differ from each other ($\beta = -0.02$, $z = -0.79$, $p = 0.42$), suggesting that learners of the bias-for-no-case condition did not adopt strategies to mitigate the increased uncertainty due to dropping case.

Exp. 2 asked whether learners develop such strategies with increased training. We recruited 20 participants in the bias-for-no-case condition with tripled exposure compared to Exp. 1 (administered over 3 consecutive days). **Results.** On the final day of Exp. 2, learners used the same amount of case as learners in the bias-for-no-case condition in Exp. 1 ($\beta = -0.08$, $z = -0.19$, $p = 0.84$) but their linguistic systems had significantly less uncertainty compared to the bias-for-no-case learners in Exp. 1 ($\beta = -0.05$, $z = -2.43$, $p < 0.05$). Thus, increased exposure led learners to change linguistic systems to mitigate uncertainty while still expressing the social bias by dropping case.

Conclusion. Our findings suggest that communicative and social biases jointly shape speakers' linguistic choices and pathways for language change. Interestingly, while participants responded to social biases even in relatively early stages of learning, communicative strategies to mitigate uncertainty played a role only after more substantial exposure.



Figure 1: Examples of sentence exposure (left) and sentence production (right) trials. Pictures represent still images of the videos participants saw. The alien informant was present in each sentence-exposure video but absent during sentence-production trials.

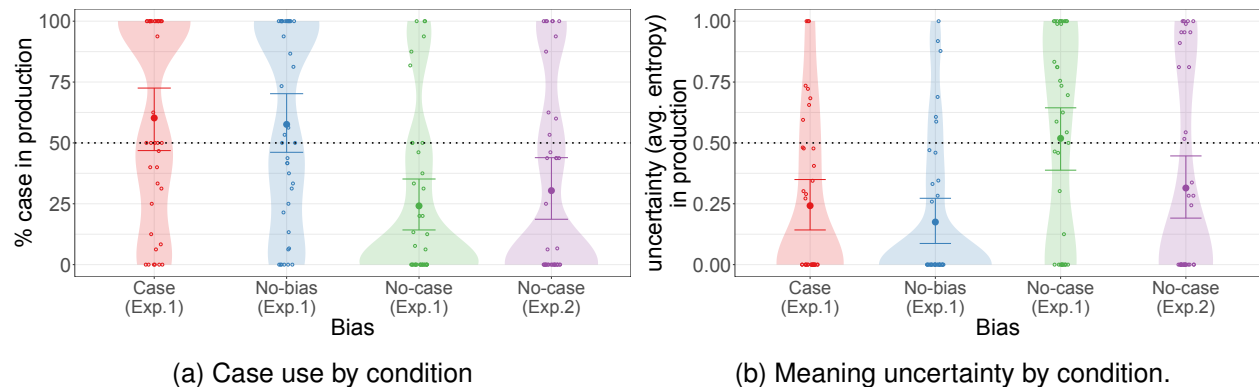


Figure 2: Case use and meaning uncertainty in production. Dashed line represents input value. Large dots represent condition means. Small dots represent individual participant means. Error bars represent bootstrapped 95% confidence intervals.

References

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