Amplifying the bias to order Nouns before Adjectives in language: Evidence from emerging sign language and silent gesture studies

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Cross-linguistically, roughly 64% of the world's languages order Nouns before Adjectives, compared to the roughly 27% with the reverse order [1]. Yet, the factors driving this cross-linguistic tendency towards the NounAdj (i.e., post-nominal) order remains largely unknown. To investigate the factors motivating this asymmetry, Exp1 analyzed elicited corpora from three cohorts of Nicaraguan Sign Language (NSL1, NSL2, NSL3). As a newly emerging language, NSL provides an opportunity to observe the development of a NounAdj word order preference naturalistically. In Exps 2 and 3, we tease apart the factors contributing to the NounAdj preference in a laboratory setting. Exp2 asked whether there is a cognitive bias towards the NounAdj word order while Exp3 examined the contribution of domain-general regularization biases to the prominence of the NounAdj order cross-linguistically.

Exp1: We extracted 223 manual utterances containing a Noun and at least one Adjective (modifier) and coded for order (NounAdj or AdjNoun) within each Noun Phrase. Binomial tests showed a reliable preference for the NounAdj order for each NSL cohort (Table 1). Linear mixed models revealed no difference between cohorts (p's > .3), suggesting that after NSL1 the strength of the NounAdj bias was not affected by inter-generational language transmission.

Exp2: We asked whether a similar pattern would be observed among English-speakers asked to gesture without talking (Silent Gesturers). We analyzed 276 Noun Phrases from a corpus and also found a preference for NounAdj (Table 1). Thus, productions from Gesturers and Signers of an emerging language both point to a "natural" way of ordering Nouns versus Adjs [2]. But, the NounAdj preference was stronger for Gesturers compared to NSL cohorts (p's < .01).

Exp 3: Given this, we asked whether the bias toward regularizing variation in an input language [3-5] might have contributed to the stronger NounAdj preference for NSL speakers compared to Silent Gesturers. If so, then we may likewise expect a weaker NounAdj bias among Nicaraguan Homesigners compared to NSL cohorts. We thus recruited 160 English-speakers to a web-based silent gesture regularization study. Comprehenders saw an event (e.g., someone waving a spotted spoon) and then were trained on two gesture vignettes describing that event. Vignettes differed only in the order of the Noun versus Adj gestures. Critically, the frequency that participants saw NounAdj versus AdjNoun vignettes varied by condition. In Majority NounAdj Conditions, they saw NounAdj and AdjNoun orders in 75% versus 25% of trials, respectively. Frequencies were reversed in the Majority AdjNoun Conditions. We analyzed Entropy Change [6-7] scores and proportion of Majority Order selections using mixed models. In line with predictions, Entropy Change scores showed evidence of regularization in Majority NounAdj (p's < .01) but not Majority AdjNoun conditions (Fig 1A). Participants also selected Majority Order vignettes more frequently when vignettes were in the NounAdj configuration (p < .01; Fig 1B). Thus, participants were more willing to regularize towards the NounAdj order than to the AdjNoun order.

Our results point to two factors driving the cross-linguistic prominence of NounAdj word orders. The first is a cognitive bias for NounAdj orders stemming from a "natural" way of representing objects and their attributes (Exp1 & Exp2). The second factor is a regularization bias amplifying those underlying preferences (Exp3). Ongoing work investigates the NounAdj order among Homesigners, in silent gesture communication, and in iterated learning paradigms.

Table 1: Proportion of NounAdj versus AdjNoun utterances for each participant group. Raw counts are given in parentheses.

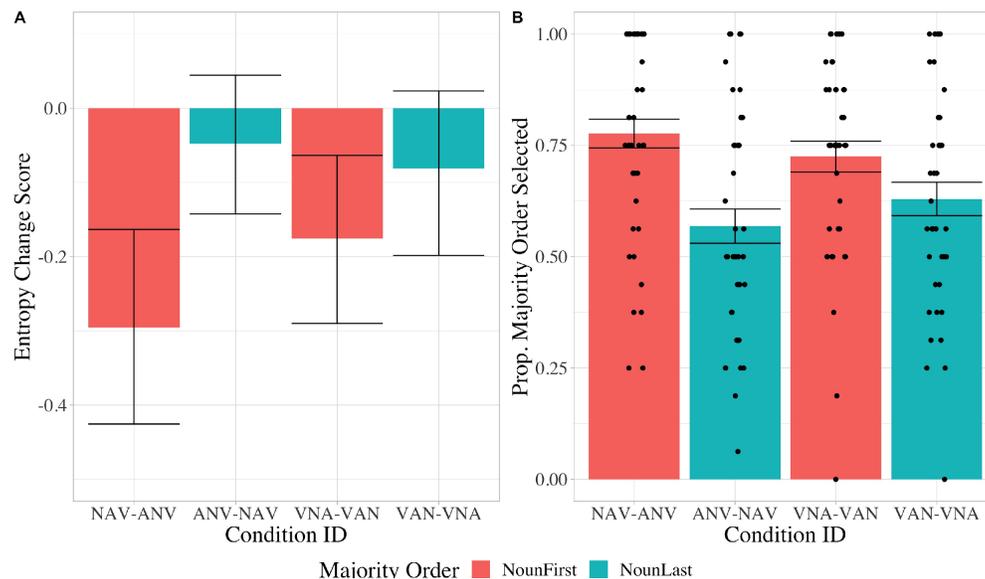| Language Group	NounAdj	AdjNoun	SD	p	NounAdj 95% CI
NSL1 (n=8)	.84 (62)	.16 (12)	.37	< .001	(.73, .91)
NSL2 (n=6)	.89 (62)	.11 (8)	.32	< .001	(.79, .94)
NSL3 (n=8)	.87 (69)	.13 (10)	.33	< .001	(.78, .94)
Silent Gesturers (n=20)	.61 (168)	.39 (108)	.49	< .001	(.55, .67)

Figure 1(A). Mean Entropy Change scores in each condition of Exp 2. Negative scores indicate a reduction in variation (i.e., regularization). Error bars show bootstrapped 95% CIs. (1B) Mean proportion of Majority Order selections for each participant in each condition of Exp2. Error bars show 95% CIs. The position of the non-target Verb element did not contribute significantly to either set of results.

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