EVIDENCE FOR THE COGNITIVE ORIGINS OF SYNTACTIC HARMONY

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1. Background

There is a consensus that cognition-general mechanisms and biases shape syntactic typology. However there is very little direct behavioral evidence linking such mechanisms to specific typological patterns in syntax. Here we test a recent proposal by Culbertson and Kirby (2016) that syntactic harmony–alignment between syntactic heads and dependents (Greenberg, 1963)–reflects a domain-general bias for simplicity (Chater & Vitányi, 2003), acting on linearized, language-specific categories (i.e., heads and dependents). Previous research suggests that human learners do indeed prefer syntactic harmony (e.g., Culbertson, Franck, Braquet, Barrera Navarro, & Arnon, 2020). However, if harmony is the result of a domain-general bias for simplicity, then a similar preference should hold when sequences of *meaningless and/or non-linguistic* categories are linearized.

2. Experiment 1: meaningless letter sequences

In Experiment 1 we take one step away from syntactic harmony by using sequences of meaningless letter strings rather than combinations of meaningful words. Stimuli consisted of two categories: 'head' elements and 'dependent' elements. In natural language these categories are presumably learned based on similarities in structure and/or meaning. Here, the categories are distinguished based on length and structure. Heads are comprised of contrasting CVCVC strings, and dependents of CVC strings. Dependents paired with each type of head have C's that match the heads in terms of voicing, and V's chosen from the same set in order to help learner identify the relevant head-dependent combinations (akin to different phrase types in natural language).

Participants (N=74) were randomly assigned to one of three conditions: harmonic (either Head-Dep or Dep-Head), non-harmonic across heads (Head-Dep order for one head type, Dep-Head for the other), and non-harmonic within heads (one Dep type for each Head type was Dep-Head, the other Head-Dep). They

were exposed to grammatical sequences in the language, and then tested using 2AFC. Accuracy was highest in the harmonic condition (vs. non-harmonic across heads $\beta = -3.18 \pm 0.81, p < 0.001$; vs. non-harmonic within heads $\beta = -5.70 \pm 0.83, p < 0.001$) and lowest in the non-harmonic within heads condition (vs. non-harmonic across heads $\beta = -2.38 \pm 0.55, p < 0.001$).

3. Experiment 2: paired abstract shapes

Experiment 2 was identical to Experiment 1 in terms of the structure of the "languages" and the experimental conditions participants (N=76) were assigned to. The only difference was in how head and dependent elements were constructed: heads were single larger shapes, dependents were two smaller stacked shapes, positioned either to the left or right of the larger shape. As in Experiment 1, dependents paired with each head matched, here in the roundness of the shapes in order to help learners identify the relevant head-dependent combinations. Accuracy was highest in the harmonic condition (vs. non-harmonic across heads $\beta = -1.88 \pm 0.72, p < 0.001$; vs. non-harmonic within heads $\beta = -4.02 \pm 0.71, p < 0.001$) and lowest in the non-harmonic within heads condition (vs. non-harmonic across heads $\beta = -1.92 \pm 0.51, p < 0.001$).

Figure 1. Head and dependent stimuli.

Figure 2. Experiment 1.		Figure 3. Experiment 2.	
Heads	Dependents	Heads	Dependents
H1: nageng, negang, genang, ganeng	Dep1a: bav, baz, dav, daz Dep1b: veb, ved, zeb, zed	H1: ⬤⬤◖◗	Dep1a: ✳✳✳✳ Dep1b: ♣♣♣♣
H2: shukoth, shokuth, koshuth, kushoth	Dep2a: puf, pus, tuf, tus Dep2b: fop, fot, sop, sot	H2: ⬤⬤◖◗	Dep2a: ✳✳✳✳ Dep2b: ♣♣♣✦

4. Discussion

In language, we see a preference for harmony in the linearization of grammatical categories—heads and dependents comprising syntactic phrases. Here we have shown that a linearization preference akin to harmony will emerge in similarly structured stimuli when no linguistic meaning is present, and even when the stimuli are non-linguistic in nature. Our findings suggest that rather than being language-specific, the origins of harmony lie in a cognition-general bias for simpler representations, active in individual learners, likely amplified over time via cultural transmission.

References

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