LETTER

Simple stimuli, simple strategies

Contentious debate surrounds our report (1) that European starlings recognize complex syntactic structures—an ability otherwise claimed to be uniquely human. In studying zebra finches (ZFs), van Heijingen et al. (2) have concluded that these abilities are best explained by simple perceptual strategies. However, critical methodological differences between the starling and ZF studies invalidate the conclusions of van Heijingen et al.

The stimulus design of van Heijingen et al. permitted simple solution strategies unavailable to the starlings of Gentner et al. (1). Curiously, within a pattern class, each "A" element always co-occurred with the same "B," and the same bigrams appeared in multiple exemplars, allowing ZFs to solve the task by learning only three bigrams. Also, the first and last elements of each exemplar were contingent and common across pattern classes and thus uninformative. This may have forced subjects to ignore these positions and focus attention on the central elements. In contrast, Gentner et al. trained naive starlings with 16-exemplar sets of patterned stimuli (built from 16 elements) that explicitly avoided diagnostic bigrams within and between classes. It is well established that small stimulus sets with overlapping perceptual features promote perceptual rather than relational categorization (3), which van Heijingen et al. overlooked.

Generalization tests also differed between studies. ZFs generalized to patterns composed of novel elements from familiar acoustic classes (A and B), but with the same statistical dependencies, and then classified patterns composed of novel elements from novel acoustic classes (C and D), which defined the vocabulary for probe stimuli. In contrast, starlings were never tested with novel elements; all training and testing patterns were composed of the same 16 elements. van Heijingen et al. assume that switching from one vocabulary to another, without any bridging experience, is a valid test of syntactic learning. This represents a view of syntactic processing that is ungrounded in psychological research. Humans generalize artificial grammars across vocabularies at modest levels, requiring explicit instruction, and often using n-gram strategies and surface similarities (4). The results of van Heijingen et al. fit this pattern.

The strategies proposed by van Heijingen et al. cannot explain why all of the starlings tested showed better recognition of unique grammatical probes than of the agrammatical "primacy" and "recency" stimuli. Moreover, they cannot explain the significant response differences for starlings between A*B* and the $n = 3, 4$ probe stimuli (which van Heijingen et al. did not test). van Heijingen et al. parenthetically note the failure of their solution strategy to account fully for our agrammatical probe results and ignore the results of our additional probe tests entirely. Our argument is not that simple strategies cannot explain some probe responses of starlings, but that a more general, abstract strategy is required to explain all our results.

The study of van Heijingen et al. falls short, both as a replication of Gentner et al. and as a valid test of syntactic learning. It is troubling that PNAS readers did not have access to the significant methodological differences between the studies of van Heijingen et al. and Gentner et al. and worrisome that the paper apparently was reviewed without consideration of such details. We urge that the complete methodology and analysis of van Heijingen et al. be made available, as they kindly made available to us, to allow serious readers the opportunity to review all aspects of the study and reach their own conclusions.

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