

Starlings Do Not Appear To Select Song Models On The Basis Of Species-typical Phonology Or Syntax

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Introduction

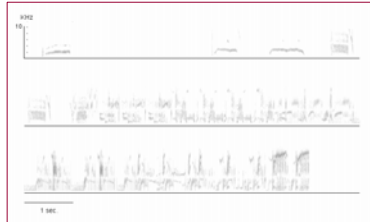
European starlings (*Sturnus vulgaris*) are known for mimicking a wide variety of sounds, yet they can be selective in their choice of a model—e.g., they may copy peers in preference to adults, and they fail to imitate humans in the presence of avian companions.¹ Here we ask whether, in the absence of differential contextual cues, starlings prefer to imitate normal starling songs rather than heterospecific songs or starling motifs arranged in an atypical sequence. Because the basis for selectivity may change with age,² we also ask whether the starlings' copying preferences vary with age or reproductive condition. Recent findings that starlings can learn arbitrary syntactic rules in a recognition task,³ and the implication that they might be capable of learning *de novo* the general rules governing their own complex songs, brings renewed interest to the question of learned predispositions in this species. The findings presented here are based on previously unreported data from series of published song-learning experiments.^{4,5}

Methods

Subjects and Housing: Twelve male starlings were collected from the wild at 8 to 10 days after hatching and hand-reared as a group. After 35 days they were assigned to the normal photoperiod or photoadvanced group and housed individually in sound-attenuated chambers, where they were exposed to an identical set of tape recordings.

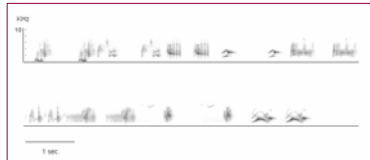
Tutoring Stimuli: Each tape contained recordings of two normal starling songs (with a mean of 37 motifs in each), a "scrambled" song, and 2 cowbird (*Molothrus ater*) songs. Each tape included 18 repetitions of each of the training stimuli in randomized order.

Song of a wild-caught adult male starling



Wild starling song typically consists of a succession of low whistles, variable warbles, click motifs, and high notes, in that order. Inter-motif intervals become progressively shorter.

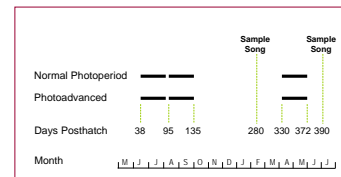
Scrambled Song



Motifs from a wild-caught starling song were rearranged using SIGNAL software from Engineering Design. The resulting scrambled song consisted of 9 motif types and included exemplars of all motif categories. The order of motifs and the intervals between them were determined using a table of random numbers. Each motif type was repeated once.

Tutoring Schedule: Both groups were exposed, morning and evening, to tutoring tapes during three 6-week sessions, starting at the ages of 2 months, 3 months, and 10-11 months. The training stimuli were different for each six-week session.

Tutoring Schedule



Light Schedules: To desynchronize the reproductive condition of the two groups, light cycles were manipulated so that the Photoadvanced group experienced long day lengths about 3 months early.

The Natural Photoperiod group was kept on a natural light cycle (42 deg. N), adjusted weekly.

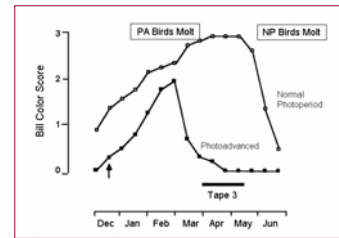
The Photoadvanced group was kept on a natural light cycle until Oct 25, when they were switched to L:D= 8:16. On Dec 20 they were switched to L:D = 20:4.

Manipulation Check: To assess physiological changes we monitored the time course of molting⁶ and changes in bill color,⁷ which are reliable indicators of the change from photorefractoriness to photosensitivity (yellow bills) and vice versa (black bills, molt).^{8,9,10}



Bill color was scored weekly on a scale from 0 (all black) to 3 (all yellow). The starling above would be scored as 2.5.

Changes in bill color and timing of molt

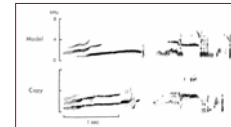


Bill color and molt scores indicate that the normal photoperiod (NP) group was in breeding condition (yellow bills) during exposure to the third training tape while the Photoadvanced (PA) group was photorefractory (black bills, molt). Both groups were photorefractory during the first two tutoring sessions. The arrow indicates a change in light-dark cycle for the photoadvanced group from L:D = 8:16 to L:D = 20:4.

Song Sampling: The birds were tape recorded every week to the age of 9 months, and every two weeks thereafter, to determine when song attained highest stability. We analyzed two 15-minute samples of song for each bird, one recorded in February and another in June-July. The photorefractory birds were molting in February and did not sing.

Identification of Imitations: Spectrograms of the subjects' songs were compared by eye with those on the training tapes. Two observers compiled libraries of the subjects' motifs displayed beside any model motifs they resembled. Four independent observers ranked the degree of similarity between potential models and copies on a scale from 1 (poor) to 5 (good). Copies with median ratings of 3 or more were counted as imitations.

Imitations



Song motifs acquired by a starling in the photoadvanced group. Median ratings for these imitations were 5 (left) and 4 (right).

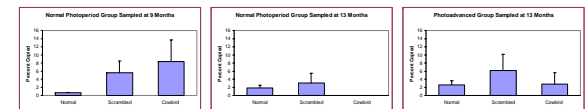
Results

Repeated-measures ANOVA revealed no significant differences in the proportion of normal, scrambled, or cowbird song copied, regardless of age or reproductive condition. Remember to take into account the unequal number of available models of each type.

Number of Imitations of Normal, Scrambled, and Cowbird Songs on Tutoring Tapes by Normal Photoperiod and Photoadvanced Starlings

	9 Months			13 Months		
	Normal Song	Scrambled Song	Cowbird Song	Normal Song	Scrambled Song	Cowbird Song
Normal Photoperiod						
Bird 1	1	0	0	1	0	0
Bird 2	0	0	0	4	0	0
Bird 3	1	0	1	11	4	0
Bird 4	2	3	1	5	1	0
Bird 5	1	0	0	0	0	0
Bird 6	1	2	0	0	0	0
Mean	1	1	0.3	4.2	0.8	0
SD	0.6	1.3	0.5	3.9	1.6	0
Photoadvanced						
Bird 7	0	0	0	0	0	0
Bird 8	0	0	0	0	0	0
Bird 9	0	0	0	11	1	0
Bird 10	0	0	0	5	7	1
Bird 11	0	0	0	12	1	0
Bird 12	0	1	0	8	1	0
Mean	0	0.2	0	6	1.7	0.2
SD	0	0.4	0	5.2	2.6	0.4

Mean (±SE) Percentage of Available Models Copied From Tapes



Conclusions and Discussion

Starlings do not appear to use species-typical song syntax or phonology as a basis for selecting models to copy. This is not to say that there are devoid of any predispositions to develop species-typical song. Naïve starlings raised in pairs, though not those raised in isolation, develop some approximation of normal syntax and phonology.¹¹ Perhaps there is no advantage for male starlings to be selective in their choice of models. Female starlings prefer males with large repertoires,^{12,13,14} and once a male has acquired species-typical syntax, elements from any source can be incorporated into a species-typical song.

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