

SONG RECOGNITION BY FIELD SPARROWS

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SONGS of passerine birds may convey various kinds of information to other birds, such as the species and individual identity of the singer. Features of the song that do not vary from bird to bird presumably identify the species, while features that vary between birds may identify the individual (Marler, 1960).

Songs of an individual Field Sparrow (*Spizella pusilla*) possess features that occur in the songs of most other Field Sparrows, and usually have other features that make the individual's song unique (Figure 1). Most Field Sparrow songs consist of a series of notes that are longer and uttered more slowly at the beginning of the song than at the end (Saunders, 1922; Borror, 1961). Notes may be up-slurred, down-slurred, or steady in pitch, and neighboring males only rarely use the same notes. Each individual generally sings only one type of song, and neighboring males very rarely sing identical songs.

This sort of variation suggests that the temporal pattern of songs of Field Sparrows is important in species recognition, while other features of the song may make individual recognition possible. The objectives of this study were to determine (1) if Field Sparrows could distinguish songs of their own species from those of other species, (2) any species-specific features of Field Sparrow songs, and (3) if Field Sparrows can distinguish songs of different individuals. Observations of behavior of male Field Sparrows during playbacks of various real and synthetic songs were used to accomplish these objectives.

METHODS

I studied Field Sparrows at Blendon Woods Metropolitan Park, Franklin County, Ohio and Barnaby Center, Fairfield County, Ohio, from 11 April 1971 to 29 July 1971, and did all field work in the morning. I used a Uher 4000L tape recorder with a tape speed of 7.5 ips for making recordings and playbacks. Most playbacks were made through an external speaker connected to the tape recorder by a 100-foot cable; some were made using the Uher speaker.

A Field Sparrow that sang vigorously at some prior time was selected as a subject for a playback or series of playbacks. I watched the bird until I learned its general territorial boundaries and the positions of the song perches it frequented. Then I placed the speaker near one of its favorite perches or adjacent to a territorial boundary, depending on the experiment being conducted. I hung the speaker about 3 feet above the ground whenever possible, but in some places where no suitable sites for hanging it existed, I put it on the ground.

After the bird recovered from the disturbance of placing the speaker, I monitored its behavior during a number of 4-minute periods. During each of these periods four aspects of the bird's behavior were noted: the number of times it sang, the

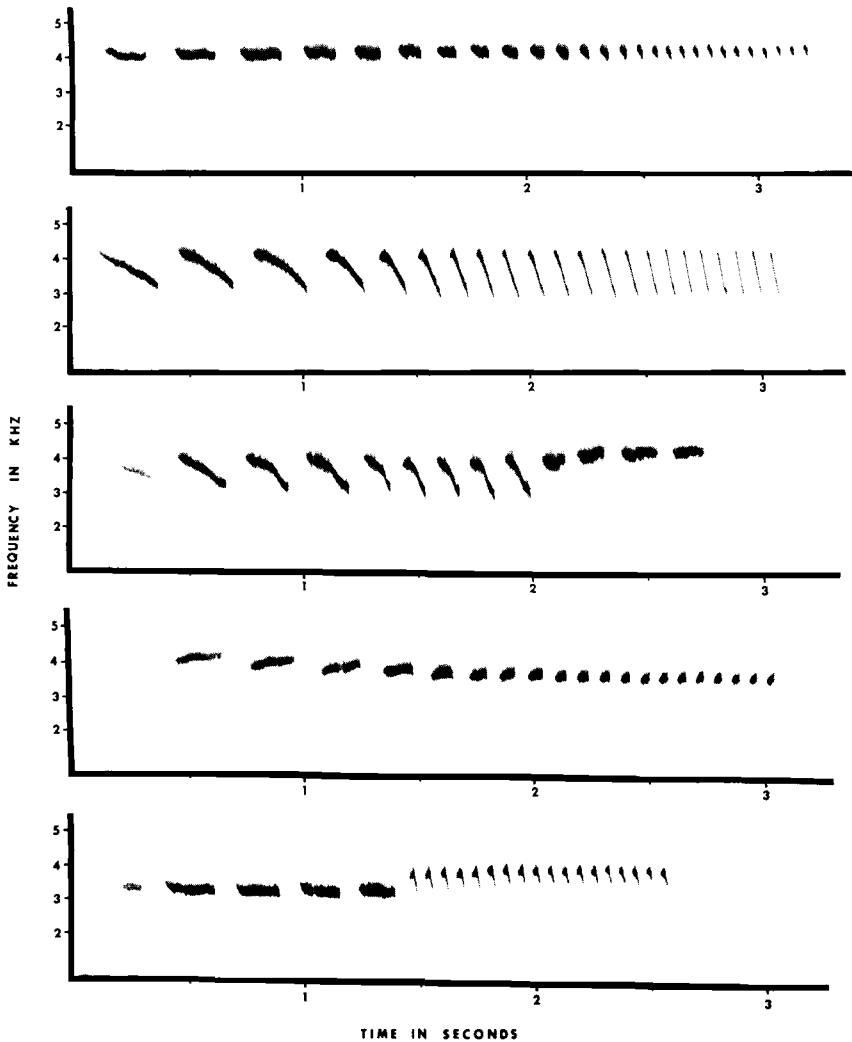


Figure 1. Audiospectrographs of the songs of five Field Sparrows that held adjacent territories at Barnaby Center during 1971.

number of times it flew, the number of times it flew directly over the speaker, and the distances of its perches from the speaker.

The playback experiments were designed to compare the bird's reactions to two or more different types of songs. Playbacks lasted 4 minutes and consisted of 20 equally-spaced songs; this arrangement approximated the cadences of Field Sparrows. The bird's behavior was noted before playback of the first type of song, during playback of the first type of song, and immediately after playback of the first type

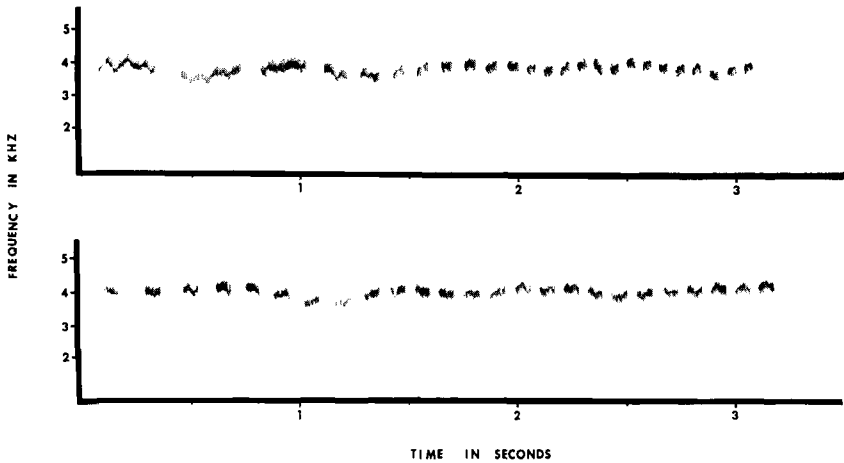


Figure 2. Audiospectrographs of the normal and abnormal synthetic songs. The normal synthetic song (top) has notes and intervals arranged in a manner similar to natural song. The abnormal synthetic song (bottom) has notes of equal length and intervals arranged in approximately the natural pattern.

of song. Then at least 10 minutes elapsed before the second series of observations began; this allowed the bird to recover from any residual effect of the first playback. During the second series of observations I again described the bird's behavior before playback of the second type of song, during playback of the second type of song, and after playback of the second type of song. In some experiments this sequence of observations was repeated using additional types of songs. The order of presentation of types of songs was randomized, and no bird was presented with playbacks more than once a week. I studied 26 individuals, and 8 of these were subjected to more than one series of playbacks. Experiments involving only one Field Sparrow were rejected because the bird disappeared during the playbacks. This bird was tested on a very cold, windy morning.

The songs used in these experiments were of two general sorts, actual songs (recorded in the study area or taken from recordings in the Ohio State University tape collection) and synthetic songs. The natural songs were those of various Field Sparrows and other species; the synthetic songs were made by recording a note from an audio-oscillator and then putting together pieces of this tape to make two songs. One approximated the note and interval lengths of a Field Sparrow song, while the other had notes of equal length and intervals similar in length to those found in Field Sparrow songs. For some unknown reason the pitch of the notes in the synthetic songs varied erratically over a narrow range, while those in Field Sparrow songs usually were slurred in a predictable manner. The notes in the synthetic songs had a buzzy quality, while those of a Field Sparrow were clear and musical (Figure 2).

The playback experiments involved the following comparisons:

Experiment 1. Field Sparrow/Chipping Sparrow (*Spizella passerina*). The Field Sparrow songs were recorded at University Park, Pennsylvania, and the Chipping

Sparrow (Pattern 17, Borror, 1959) songs were recorded in Hocking County, Ohio. Playbacks were made to 25 birds.

Experiment 2. Field Sparrow/Prairie Warbler (*Dendroica discolor*). The Field Sparrow songs were the same as in Experiment 1, and the Prairie Warbler songs were recorded in Hocking County, Ohio. Playbacks were made to 7 birds.

Experiment 3. Field Sparrow/normal synthetic song. The Field Sparrow songs were the same as in Experiment 1, and the synthetic songs had a tempo similar to that in a Field Sparrow song. Playbacks were made to 20 birds.

Experiment 4. Normal/abnormal synthetic song. The normal synthetic song was the same as the one in Experiment 3, and the abnormal synthetic song consisted of notes of equal length separated by intervals similar in length to those found in Field Sparrow songs. Playbacks were made to 7 birds that had responded vigorously to the normal synthetic song during Experiment 3.

Experiment 5. Neighboring Field Sparrow/non-neighbor Field Sparrow. Playbacks were made to 9 birds.

Experiments 1-4 were designed to test for species recognition, and during these I placed the speaker within the bird's territory. Experiment 5 was designed to test for the ability to discriminate between a familiar and an unfamiliar song, and during this I placed the speaker on or near the territorial border the subject held commonly with the neighbor.

RESULTS

The results of the five experiments are summarized in Table 1. Perch distances were not useful indicators of the birds' responses, because the birds did not change perches frequently unless they were highly stimulated. This made comparisons of perch distances during control and playback periods difficult.

Experiments 1 and 2.—Average song rate did not change significantly during these playbacks, and fewer than half the birds tested sang more while hearing the song of the Field Sparrow. The birds flew significantly more frequently during playback of the Field Sparrow songs than during the songs of the other two species; this increase in the number of flights occurred in 85 percent of the birds tested. Many birds oriented precisely to the speaker, as indicated by the number of overflights, and they perched closer to the speaker while hearing the song of a conspecific than during songs of the other species. Only 1 of 25 Field Sparrows reacted vigorously to the song of a Chipping Sparrow; this bird's territory was isolated from the territory of any other Field Sparrow, but bordered on territories of several Chipping Sparrows.

Experiments 3 and 4.—Average song rate did not change significantly during playback of either synthetic song; 50 percent of the birds sang more while hearing the song of the Field Sparrow and 30 percent sang more while hearing the normal synthetic song. Both the normal synthetic song and the Field Sparrow song stimulated the birds to fly more and to orient precisely to the speaker, and the birds tended to perch close to

TABLE 1
RESULTS OF THE PLAYBACK EXPERIMENTS¹

Situation and playback used	Behavior		
	Songs	Flights	Overflights
Experiment 1			
Prior to playback	5.1	0.5	0.0
Playback: Field Sparrow songs	5.3	7.6*	3.4*
Prior to playback	4.8	1.0	0.0
Playback: Chipping Sparrow songs	5.6	1.3	0.1
Experiment 2			
Prior to playback	0.7	0.7	0.0
Playback: Field Sparrow songs	1.3	9.8*	5.1*
Prior to playback	2.7	1.3	0.0
Playback: Prairie Warbler songs	1.4	0.7	0.0
Experiment 3			
Prior to playback	3.1	0.5	0.0
Playback: Field Sparrow songs	4.6	7.7*	3.9*
Prior to playback	6.8	0.8	0.1
Playback: normal synthetic songs	6.8	4.6*	2.5*
Experiment 4			
Prior to playback	6.1	0.6	0.0
Playback: normal synthetic songs	10.3	8.8*	4.4*
Prior to playback	4.6	2.3	0.0
Playback: abnormal synthetic songs	5.1	3.1	0.4
Experiment 5			
Prior to playback	1.2	1.1	0.0
Playback: non-neighbor songs	9.5*	5.8*	1.6
Prior to playback	3.2	1.6	0.3
Playback: neighbor songs	3.9	2.6	0.4

¹ The songs used in each experiment are identified in the accompanying text. The figures in the behavior columns are the averages of the birds tested; figures significantly different from those of the preplayback period are indicated by an asterisk. All comparisons were made using the Mann-Whitney U Test with $P < 0.05$ as the level of significance.

the speaker. The birds generally did not react quite so vigorously during playback of the normal synthetic song as they did during the Field Sparrow song, as reflected by the lower number of flights and overflights and a slightly smaller percentage of perches within 25 feet of the speaker (56 of 83 perches, 68 percent, as opposed to 81 of 113 perches, 72 percent). None of the birds tested behaved differently during playback of the abnormal synthetic song than they had prior to the playback.

Experiment 5.—Of 9 birds tested 8 sang more while hearing the song of a non-neighbor than while hearing the songs of neighbors, and the number of flights they made also increased significantly during the songs of non-neighbors. On the average the birds did not fly as much during

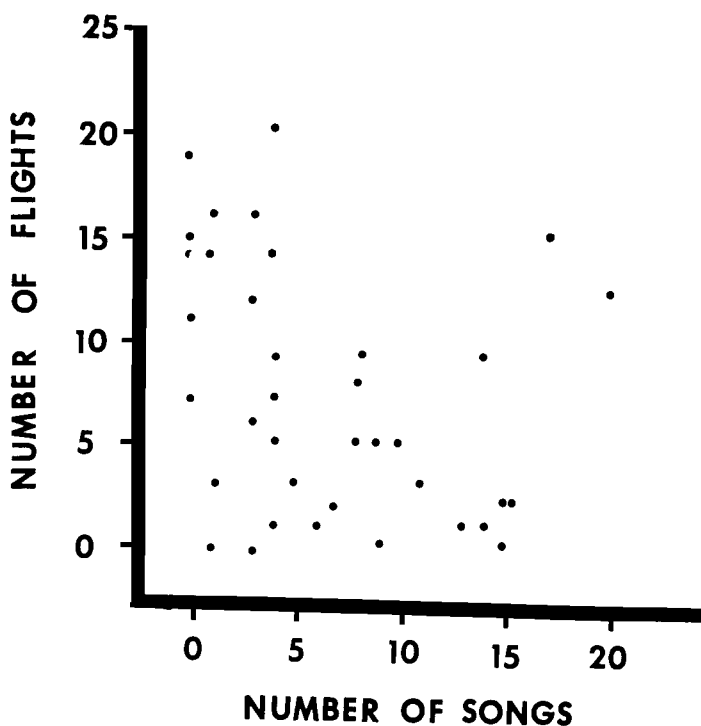


Figure 3. The relationship between the number of songs and the number of flights made by 38 Field Sparrows during playback of songs of a strange Field Sparrow. These two behavior patterns were weakly negatively correlated ($r = -0.3$; $P = 0.05$).

playback of the song of a strange Field Sparrow originating near a territorial border as they had when the speaker was within the territory. During playbacks of neighbors' songs neither the amount of singing nor flying increased significantly. Overflights did not increase significantly in either playback situation, and an overflight would carry the bird into his neighbor's territory with the speaker located on the boundary. Two birds did make overflights during playback of unfamiliar songs, but the borders of both their territories ran along roads and hence were not well-defined.

DISCUSSION

The results indicate that male Field Sparrows are able to distinguish conspecific songs and ignore songs of the Chipping Sparrow and Prairie Warbler, two species that Field Sparrows commonly meet in parts of

central Ohio and with which they share certain ecological similarities. No species whose range extensively overlaps that of the Field Sparrow has a song that resembles the Field Sparrow's in tempo, but the Rufous-winged Sparrow (*Aimophila carpalis*) (Borror, 1971) of southern Arizona and Mexico and the Olive Sparrow (*Arremonops rufivirgata*) of southern Texas and Mexico have song types that resemble the song of the Field Sparrow. Presumably these two species never meet Field Sparrows during the breeding season.

The strong response of the birds to the normal synthetic song confirms the importance of tempo in species recognition in the Field Sparrow; temporal attributes of the song are also important in Ovenbirds (*Seiurus aurocapillus*) (Falls, 1963) and the European Nightjar (*Caprimulgus europaeus*) (Abs, 1963). Other features of the Field Sparrow's song, such as the quality of the notes, may also help in species recognition.

Variation in the characteristics of notes, pitch, and timing within and between songs may serve to identify the singer individually, and the songs of neighbors from those of strangers. As in the Ovenbird (Weeden and Falls, 1959), Field Sparrows do not react vigorously to songs of familiar birds originating from positions where the familiar bird might reasonably be situated. This must save the male Field Sparrow time and energy, which he may then devote to rearing young. As Weeden and Falls suggested, the existence of only one song type per male and song type differences between males would facilitate the learning of songs of adjacent males.

These playback experiments indicate that male Field Sparrows react to strange males in two different ways. Numbers of songs and numbers of flights during playback of songs of a strange Field Sparrow were inversely correlated (Figure 3), and song increased significantly only when the playback originated on or near territorial borders. When the strange songs originated within the territory of a Field Sparrow, the male did not necessarily increase his song output, but most advertised their presence by flying, and these flights were often oriented precisely to the source of the strange songs. Thus Field Sparrows seem to answer long-range challenges by singing, but the birds partially abandon song when the challenge is more imminent. This strategy matches the response of the territorial owner to the seriousness of the threat, and hence saves the male energy and time. Most singing males at or near a Field Sparrow's territorial boundary will be neighbors in competition for females (about 6 percent of male Field Sparrows at Blendon Woods during 1970 and 1971 remained unmated), so a male enhances his chances of attracting

a female by responding to his neighbors with song because he continues to advertise himself with the signal that is most effective over long distances.

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SUMMARY

Male Field Sparrows were played songs of a strange Field Sparrow, neighboring Field Sparrows, synthetic songs, and songs of two other species. They did not respond to the songs of other species; they responded to a synthetic song that resembled a real song in tempo. Male Field Sparrows did not react vigorously to songs of neighboring birds when these were played near a common territorial border, but they did respond to the song of a stranger played from the same position. When the song of a stranger originated near territorial borders, Field Sparrows principally responded with song, but when the song of a stranger originated within the territories, Field Sparrows responded principally with flights. Male Field Sparrows seem to exhibit two different behavior patterns for coping with intruders, and they employ these differentially in a manner that makes their response appropriate to the position of the intruder.

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