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Chaffinch Song Learning: Thorpe's Conclusions Revisited

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Song learning in the Common Chaffinch Fringilla coelebs: when reanalyzing Thorpe's records, we found that the Chaffinch should have a preliminary knowledge of song syntax.

Introduction

As Thorpe (1954, 1958) demonstrated, learning plays a key role in the mode of Chaffinch song development. On the basis of his experiments, he considered that Chaffinches raised by hand in acoustically isolated conditions produce songs of an extremely simple type. In short, unlike normal songs, these songs would not be divided into several sections (or phrases, to use his terminology). They would not comprise a final flourish and the fundamental frequency of their notes would be a little lower than normal.

A re-examination of Thorpe's sonagrams makes it possible to qualify these conclusions.

Material and Methods

Several of Thorpe's recordings are available on the British Library website. These recordings were analyzed with WaveSurfer software (Version 1.8.5, Hanning window and FFT= 512).

The bioacoustic terms employed in this note, illustrated in Figure 1, are drawn from the work of Slater and Ince (1979) and Metzmacher (1995).

Results

The sonagram (Fig. 1) equivalent to Thorpe's (1958, p 554: Fig. 2) reveals:

- a division of the sequence into four distinct sections (four types of syllable);
- a syllable (that of trill 2) made up of two different elements;
- a final syllable, definitely present but rather simple.

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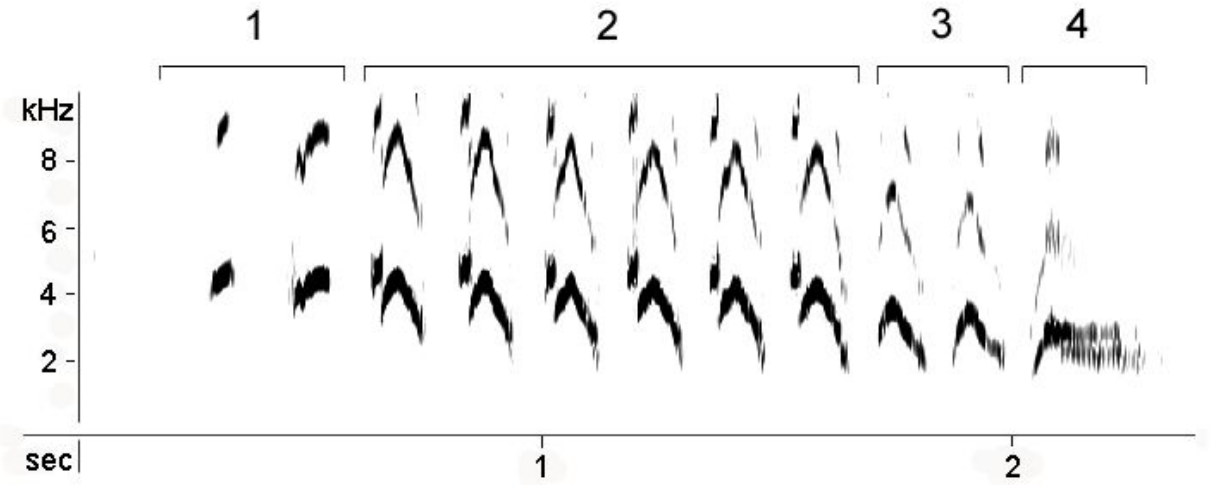

Fig. 1. - *Chaffinch song of a hand-reared auditory isolate (from a recording of Thorpe 1958).*

Discussion

The importance of learning in the mode of Chaffinch song development was confirmed (Slater and Ince, 1982; Metzmacher, 1995). However, a re-examination of Thorpe's sonagrams (1954, 1958) showed that when raised in acoustic isolation, a Chaffinch is already able to emit a song comprising several trills and ending in a terminal syllable longer than the others (Fig.1). It can also combine several elements to produce a syllable.

Under these rearing conditions, the fundamental frequency of the syllables in the song's first section does appear rather low, but, in nature, syllables are sometimes recorded which are not pitched any higher at the beginning of a song. The terminal flourish, on the other hand, might appear abnormally low, but this is also the case in certain Chaffinch songs recorded in nature (Metzmacher and Mairy, 1972: p236, Fig. 7a).

When young Chaffinches are reared in a group and without the possibility of hearing adults, their songs are more complex, but, for Thorpe (1958, p554), this complexity tends to be of a different nature. In addition, Thorpe (1954, see sonagrams pp468–469) qualifies these songs as abnormal and considers that their final syllable is either absent or extremely simple. A final syllable is, however, clearly present in all his sonagrams, and final flourishes recorded in nature are not always more complex (Metzmacher and Mairy, 1972). Moreover, Thorpe (1954, p468: Fig. 4) states that sections 1 and 2 of two of his sonagrams are "elaborate, but highly abnormal", without specifying what qualifies them as abnormal.

From an analysis of his experiments, Thorpe (1954) concludes that the song of the Chaffinch has a very reduced innate base. Close examination of his results suggests, however, that the Chaffinch could have a precognition of its song's syntax. This pre-knowledge implies that Chaffinches, like other songbirds, possess "an innate structure used as a reference and which dictates the rules to be respected to emit the syllables of a song" (Gould and Marler, 1987).

From a functional point of view, the Chaffinch, like other Oscines (see for example Suthers, 1990 and 1997), is capable of using both sides of its syrinx as potentially independent sound sources. Furthermore, the left side of its syrinx is dominant (Nottebohm, 1970 and 1971), sectioning the right hypoglossal nerve having less effect on its song than sectioning the left nerve (ibid.). Chaffinches could exploit this lateralization of vocal control to increase their vocal diversity. Moreover, the right syrinx could cover a higher frequency band than the left, as is the case in the Northern Cardinal Cardinalis cardinalis (Suthers and Goller in Suthers, 1997) and the domestic

canary *Serinus canaria* (Suthers *et al*., 2004). This would allow Chaffinches to attain a maximal frequency bandwidth. On the other hand, by closing the right side of the syrinx, individuals could produce a syllable covering a narrower frequency band. Such a mechanism may partly explain the contrast between trills 2 and 3 in Fig. 1 and the division of the resulting sequence into several sections. This result could be produced thanks to the structure and way of functioning of the syrinx. If this mechanism is confirmed, a model for imitation purposes would not be necessary for Chaffinches to produce a song containing various trills and presenting the main specific features.

In a group, young Chaffinches undoubtedly stimulate each other to sing, and consequently exercise both their respiratory pressure and the muscles of the syrinx controlling the position and the tension of the labia. They thereby gain control of the parameters enabling them — according to the model of Laje et *al.* (2002) — to produce a great diversity of syllables.

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Discography

Recordings of Thorpe : The British Library (http://sounds.bl.uk/)