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RESEARCH NOTE
Analysis of Melodic and Interval Recognition Data: Comments on Billingsley and Rotenberg

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Billingsley and Rotenberg (1982) explored the ability of children to process information between non-adjacent tones in tests for recognition of correctly transposed three-note and related two-note sequences. The paradigm had been developed by Cuddy and Cohen (1976) and was modified for use with children. The following remarks suggest that an analysis of recognition performance for *individual* sequences is preferable to the reported analysis of performance collapsed across sequences. Further developmental research on melodic and related interval tasks is encouraged.

In comparison to research with adult subjects, research with children poses additional methodological difficulties. Yet it is through developmental studies that questions about the relative contribution of age and experience may best be addressed (Bartlett & Dowling, 1980; Krumhansl & Keil, 1982; Serafine, 1979, 1983). Hence, the contribution of Billingsley and Rotenberg (1982) on the ability of children of different age levels to process two- and three-note sequences is welcome indeed.

In order to test an hypothesis that children can abstract information between non-adjacent tones, Billingsley and Rotenberg (1982) carried out an analysis which collapsed performance scores across sequences. In the following, it is suggested that the value of this investigation might be enhanced by an analysis which considers performance scores for individual sequences.

The paradigm used by Billingsley and Rotenberg (1982) was a modification of that reported by Cuddy and Cohen (1976) who tested adult subjects. In the original paradigm, each experimental trial consisted of a standard sequence followed by two transpositions, one of which was incorrect. In the incorrect sequence, one note was altered by one semitone. Two musical intervals were thus changed providing cues to the discrimination of the correct from the incorrect transposition. Alteration of an "outside" tone changed an interval between adjacent tones and an interval between non-adjacent tones.

As Cuddy and Cohen (1976) indicated, when the outside tone was altered the task could be carried out by a variety of interval abstraction strategies: attending to the interval between (a) adjacent tones (b) non-adjacent tones or (c) both adjacent and non-adjacent tones. They tested three models of interval information combination and noted that the model which used the maximum interval information – between adjacent and non-adjacent tones – generally provided a good fit to performance of highly trained subjects. However, the main point of interest with respect to the present discussion is that evidence for abstraction of information between non-adjacent tones is provided, on trials in which an outside tone is changed, by performance on three-note tests that exceeds the performance for related tests of intervals between adjacent tones.

In the study of Billingsley and Rotenberg (1982), there were 14 three-note melodies, each of which generated one interval test between adjacent tones. Subjects received the same order of presentation of three-note melodies and

of intervals. Billingsley and Rotenberg reasonably felt that the original method would produce a task quite difficult for children. Therefore, in contrast to Cuddy and Cohen (1976), discriminations were of two semitones rather than one, standards were repeated three times rather than once, and comparisons were transposed to one range rather than to two randomly selected ranges.

Although the three-note melodies led to slightly higher performance (mean = 8.9) than the intervals (mean = 8.4) this difference only approached the conventional level of statistical significance ($p < .10$). This is taken as possible evidence for the ability of children to abstract information between non-adjacent tones.

> A possible explanation of the trend for *all* children to perform better on three-note sequences is that non-adjacent intervals can be used at a marginal level of utility in music. (Billingsley & Rotenberg, 1982, p. 42)

Because the analysis collapsed information across melodies, it was unknown whether some melodies led to a greater abstraction of information between non-adjacent tones. This might be expected from the literature which suggests that more information is abstracted when a tonic or tonality is evident in the stimulus. Shatzkin (1984), for example, compared the effects of a context tone preceding an interval upon the identification of the interval. Differential accuracy in identification was accounted for in terms of the effect of the context tone upon implication of a tonic. Intervals with one note implied as tonic were more accurately identified. Diatonic sequences have been found to be easier to recognize than non-diatonic sequences particularly when the incorrect comparison contains a tone outside the prevailing key (Cohen, 1982; Cuddy et al., 1981; Krumhansl & Castellano, 1983). Absolute identification is superior for tones spaced as the major triad across octaves as compared to a set of chromatic tones spaced randomly over the same range (Cuddy, 1971). Moreover, children detect with greater ease a difference in the ending of a sequence when the original melody ends in a major triad (Brehmer, in Winner, 1982).

Therefore, stronger evidence of the ability to abstract information between non-adjacent tones might have arisen from analysis of the performance on each three-note and interval test. The rationale for the analysis of individual sequences follows directly from the work of Cuddy and Cohen (1976). For each of the standard sequences, the six temporal orderings of the major triad, *doh me sol*, there were six incorrect comparisons making 36 separate melodic tests in all. The percent correct for *each* of the separate melodic tests for each subject was entered into an analysis of variance. The interaction between melodic type and incorrect comparison type was significant, $F(10, 390) = 4.69$, $p < .001$ (see Cohen 1972, p. 82). For example, subjects recognized the *sol me doh* pattern on 73% of the trials when it was contrasted with an incorrect comparison having the lowest note lowered and on 85% of the trials when contrasted with an incorrect comparison having the highest note lowered. Mean performance on the six melodies ranged from 69% (*sol me doh*) to 80% (*doh me sol*), $F(5, 195) = 5.59$, $p < .001$ (Cohen, 1972, p. 71). Therefore, even within a highly restricted set of melodies, such as the sequential orderings of the major triad, each melody demands individual consideration. Cuddy and

Cohen (1976) point out that while tests of other standard melodies should be carried out, the collapsing of data over different melodies does not provide a complete picture.

They state:

> It is clearly necessary to examine the scores for each pattern and incorrect transposition individually, and while, of course, a wider variety of patterns should be studied, it is not appropriate to average data across different patterns for which the tones are randomly selected from trial to trial. (p. 268)

In the design suggested for the Billingsley and Rotenberg (1982) data, the score for each of the 14 three-note and interval tests for each subject would be entered into the analysis of variance with the between-subjects factors of Sex (2), Age (3), and the within-subjects factors of Note-Sequence Type (2) and Melody Type (14). A significant interaction between the latter two variables would be evidence that children process information between non-adjacent tones, provided that the performance on some (but not necessarily all) three-note sequences significantly exceeded that of the corresponding interval tests. A further interaction with the variable of Age would indicate that the processing strategy for intervals and three-note sequences depends on level of maturation or acculturation. Interactions with Age and Melody Type in separate analyses of interval and three-note tests would indicate the emergence of sensitivity to particular note configurations.

Billingsley and Rotenberg (1982) derived their sequences through random selection of notes. As a result, their sequences may have fallen by chance into a single category of musical structure, and individual differences among sequences might not have arisen. If, for example, the selected sets of three notes were all non-diatonic, i.e., could not be found in a major or minor scale, then they might be all equally unstable and equally difficult to process. In future studies, sets of three notes chosen to represent a range of stability (Bharucha & Krumhansl, 1983) or tonic implication (Shatzkin, 1984) might be employed. As well, to surmount difficulties of interpretation arising from dichotomous data, it would be important to provide multiple trials for each melody, e.g., using blocks of trials, from which a mean proportion correct could be computed and entered into the analysis. Moreover, the presentation of melodies in different orders on separate trial blocks would avoid the confounding of Practice and Melody Type.

Billingsley and Rotenberg (1982) set an important precedent for acquiring data about interval and triadic recognition from very young children. That overall performance on the three-note test marginally exceeded interval test performance is weak evidence for the hypothesis that young children abstract information between non-adjacent tones. Greater insight into the underlying processes and possibly stronger support for the hypothesis would follow from an analysis which does not collapse the data across melodies and accommodates for the characteristics of particular configurations of tones. Further developmental research which investigates melodies selected for their structural differences and in which there are multiple trials per melody may well contribute to the empirical basis for models of musical cognitive development.

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Author Notes

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