decreased group effectiveness. It is important to note that these effects were enhanced when the accused was also sanctioned. Presumably, sanctioning increases the probability that the attribution is valid.

The precise reasons for the observed effects are not altogether clear. Since the accused was himself aware that the others knew about the attribution, it is possible that the observed effects were due to differences in the confederates' behavior under different conditions. Farina, Allen, & Saul (1968) have shown that awareness that others have information indicating that a person is stigmatized can produce differences in that person's behavior in the group. However, their Ss were naive, whereas the Ss in the present experiment were trained in their roles. They were instructed to behave in the same way regardless of the situation; observation and self-report data suggested that they were able to do so reasonably well, except for differences imposed upon them by the other group members. We believe differences among experimental conditions are due to an interaction between the confederate and others, brought about largely by the differential reaction of other group members to the confederate.

In the attribution conditions, the accused was not accepted as a member of the group, and consequently, his contributions were not acceptable. His attempts to influence the group decision served as a source of interference, thus reducing the effectiveness of the group.

The failure to find significant differences in the questionnaire data is also interesting. The naive Ss seemed to make a conscious effort to avoid making unfavorable ratings of the accused. In a postexperimental interview, they were reluctant to admit that they had noticed the accusation or that they had allowed it to influence their behavior. That the accusation did produce negative consequences for the group cannot be denied, however. Group members apparently regarded consideration of the attribution as socially unacceptable; hence, they expressed their rejection of the accused indirectly via interaction within the group.

In brief summary, the mere fact that group members knew that one of them had been accused of producing a negative outcome influenced the interaction pattern, and consequently reduced the effectiveness of the group. The accused was, at best, tolerated by the other group members. He found it difficult to participate in the group discussion, and his contributions appeared to be given less weight than in a control condition. These effects were greater when the accused had also been sanctioned for the negative event.

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Discrimination of simultaneous and successive pure tones by musical and nonmusical subjects*

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Pairs of sounds, whose components were two pure tones presented simultaneously or successively, were discriminated by music and nonmusic students under same-different, matching-to-sample, and ABX modes of judgment. In contrast to the results of a previous study involving complex piano notes as components, there was no significant difference in the accuracy of discriminating simultaneous-simultaneous and successive-successive pairs or in the discrimination of simultaneous-successive and successive-simultaneous pairs.

In a previous study (Doehring, 1968), 27 Ss with a wide range of age and musical training made same-different judgments of pairs of two-component sounds, where the components were piano notes played either simultaneously or successively. Pairs of successive notes were discriminated significantly better than pairs of simultaneous notes, indicating a less-than-perfect ability of the observers to "hear out" the components of the simultaneous sounds. Discrimination of simultaneous followed by successive notes was significantly better than discrimination of successive followed by simultaneous notes, suggesting that listeners are better able to analyze than to synthesize the components of complex sounds. The relative difficulty of the discrimination tasks could have been influenced by the fact that the components were themselves complex tones, by the particular mode of judgment required, and by the amount of musical experience of the Ss. The present study also involved discrimination of pairs of two-component simultaneous and successive sounds, but with pure tones used as components and presented under three different modes of judgment to a group of music students and a nonmusic control group. The purpose was to determine if differences in relative difficulty of simultaneous and successive tonal combinations would vary as a function of complexity of component sounds, musical training, and mode of judgment.

*Thanks are due to Harriet Emerson for recording, testing, and data analysis, to Thomas Weisz for modification of the intonation trainer, and to Bonnie Bartholomeus and Daniel Ling for comments on the manuscript. This research was supported under Grant MA-1652 from the Medical Research Council of Canada.

METHOD

The Ss were eight university music students with at least 8 years of formal musical training and eight students with no formal musical training, all with normal hearing. Tones were tape-recorded from a Johnson Intonation Trainer with a three-octave range from 139 to 988 Hz that had been modified to produce pure tones equated in loudness. Tapes were played back from a Uher 22 Special tape recorder to TDH 39 earphones. Experimental events were controlled by an automatic programming system.

A *simultaneous sound* was two pure tones played together for ½ sec. A *successive sound* was two ½-sec tones played in immediate succession, with the low note always played first. The interval between sounds, either simultaneous or successive, was always 1 sec. Three modes of judgment were used: a *same-different* judgment of two sounds, a *matching-to-sample* judgment of two sounds that followed a sample sound, and an *ABX* judgment of two sounds that preceded a sample sound. The judgments were made under four conditions: (1) *simultaneous-simultaneous*—all sounds simultaneous; (2) *successive-successive*—all sounds

Table 1
Percent Correct Discrimination by Eight Music (M) and Eight Nonmusic (NM) Students

Condition	Same-Different M	Same-Different NM	Match to Sample M	Match to Sample NM	ABX M	ABX NM	Combined Modes M	Combined Modes NM	Total
1. Simultaneous-Simultaneous	96	91	93	96	98	97	96	94	95
2. Successive-Successive	97	85	95	88	95	83	96	85	91
3. Successive-Simultaneous	79	65	74	58	63	68	73	63	68
4. Simultaneous-Successive	76	62	84	56	71	62	77	60	69
Combined	87	75	86	75	82	78	86	76	81

successive; (3) *successive-simultaneous*—the first (or the first two in ABX) sounds successive and the last (or the last two in matching to sample) sound simultaneous; and (4) *simultaneous-successive*—the first (or the first two in ABX) sounds simultaneous and the last (or the last two in matching to sample) sounds successive.

The same tonal combinations as those of the previous study were used, where the tonal range (4 to 11 semitones), the variable tone (high or low), and the direction of change (higher or lower) were systematically varied. The amount of change was always 1 semitone. In same-different there were 24 trials per condition, with an equal number of same and different trials; in matching-to-sample and ABX there were 12 trials per condition, with an equal number of trials in which the matching sound was first or second. The order of trials was randomized within each condition. Each S was given all conditions under all modes of judgment, a total of 192 trials. Within each group, half the Ss were tested in the order 1, 2, 3, 4 and the other half in the order 2, 1, 4, 3. The order of the three judgment modes was balanced within each group.

The Ss were tested individually in a soundproof room, with test sounds presented binaurally at about 80 dB. Instructions were given before each new condition and judgment mode. Responses were made by pushing an appropriately marked button, with immediate knowledge of correctness given by illumination of the pushbutton representing the correct choice. On the first session, S was given a pure tone audiogram and the Seashore Measures of Musical Talent (Seashore et al, 1960), and the discrimination tasks were completed in two additional sessions.

RESULTS

Table 1 shows percent correct discriminations. Results were analyzed by analysis of variance and by product-moment correlation, with significant effects further assessed by the Newman-Keuls test, where necessary.

There was no significant difference between Conditions 1 and 2 or between Conditions 3 and 4. Conditions 1 and 2 were, however, significantly superior to Conditions 3 and 4 (.01 level), and the music group was significantly superior to the nonmusic group (.05 level). Percentages correct for the three modes of judgment were virtually identical, and there were no significant interactions.

Correlations among conditions were calculated for the two groups combined (N = 16). Condition 1 was significantly correlated with Condition 2 (.65) but not with Conditions 3 (.23) and 4 (.22), whereas Condition 2 was also significantly correlated with Conditions 3 (.62) and 4 (.71), and the latter two conditions were also significantly correlated (.79). The only significant correlations between the four conditions and the six subtests of the Seashore test were correlations of the pitch and timbre subtests with Conditions 1 (.60 and .73) and 2 (.66 and .86) and correlations of the tonal memory subtest, which involves discrimination of tonal sequence, with all four conditions (.66, .86, .57, and .68, respectively).

DISCUSSION

The previous finding (Doehring, 1968), that simultaneous sounds are discriminated less well than successive sounds, was not replicated for either music or nonmusic students under any mode of judgment. It seems most likely that the use of pure tones rather than complex piano notes made it easier for the listener to "hear out" the components of two-tone simultaneous sounds. This increased separability of simultaneous components probably contributed also to the lack of significant differences between successive-simultaneous and simultaneous-successive conditions, rendering the processes of tonal synthesis and analysis less different. However, the simultaneous and successive sounds cannot have become entirely equivalent, since discrimination was much more difficult when the judgment involved a combination of simultaneous and successive sounds. The significant correlations involving conditions and Seashore subtests must be interpreted with caution, but they do indicate the important role that judgments of tonal sequence played in the discrimination tasks.

Music students performed all tasks somewhat better than nonmusic students, but there were no variations in relative difficulty of discrimination conditions or modes of judgment as a function of music training. Apparently both music and nonmusic Ss abstracted the components of complex tones in the same manner with respect to the experimental variables, in contrast to the seemingly qualitative differences in octave discriminability reported by Allen (1967) for music and nonmusic Ss.

Variation of the type of judgment required did not markedly affect task performance. The main conclusion to be drawn is that the use of pure tones as components increased the similarity between two-component simultaneous and successive sounds. Although this seems to support Ohm's acoustical law, that a complex sound is perceived by analysis into its component tones (von Békesy, 1960), it seems more fruitful to consider the relative difficulty of simultaneous and successive perception than to concentrate on methods of demonstrating the analyzability of complex tones per se. Discrimination of simultaneous and successive tones should be more broadly interpreted with respect to such factors as sequential organization (Bryden, 1967), selective attention and memory (Norman, 1969), and possible neural mechanisms (Deutsch, 1969).

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