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EXPERIMENTAL RESEARCH ON
COGNITION AND EMOTION IN MUSIC
—A PRELIMINARY REPORT*—

Kuniaki Nagai

In a series of experiments\(^1\) the interaction between cognitive inconsistency (incongruity, dissonance, deviation, etc.) and emotion has been investigated from the psycho-physiological point of view, using such indices as GSR and verbal ratings.

With a view to the experimental study of psycho-physiological effects in the perception of tonal stimuli, Mishbach (1932) reported that pitch of tone influenced GSR and cardiovascular phenomena.\(^2\) He found that GSR amplitude was a U-shaped function of frequency of tonal stimuli. Recently, Berlyne et al. (1967) has reported that mean desynchronization duration of EEG appears as a U-shaped function of judged pleasantness of single tones or consonant pairs and dissonant pairs of tones.\(^3\) It should be noted that in their experiment\(^4\) desynchronization lasted longer (but not significantly so)

* The author is greatly indebted to: Professor H. Minami, of Hitotsubashi University, who has given me valuable guidance and understanding for this research; Associate Professor Y. Tokumaru and Lecturer K. Sano, of Kunitachi Music College, for their generous help in conducting experiments; Miss N. Kyuzaki, Mrs. K. Yoshikawa, Mr. T. Sanada, and Assistant Professor K. Nakamura, of Hitotsubashi University, for the encouragement they gave me.

for dissonant pairs than for consonant pairs.

While these studies are dealing with the psychological and physiological responses evoked by single tones or consonant pairs and dissonant pairs of tones, the author's interest has centered on the relationship between cognition of tone progressions and emotional responses in musical experience. This was done since highly abstract cognitive elements and sensuous elements, in other words, non-verbal cognition and emotion, are mutually related in music in a most immediate and direct way. The present experiment is concerned with dissonance and emotion in melody cognition.

Although melody is a series of meanings created by the presentation of tonal stimuli in sequence, meaning is not in the stimulus as such; it results from the triadic relationship between: (1) tonal stimuli; (2) what the stimuli point to or their consequents; and (3) the conscious audience. Therefore, this meaning formation depends upon the process of the individual's cognition of the melodic structure and comprehension of the whole syntactical implications of the tonal sequence in relation to the mental set the individual possesses. In the individual musical syntax is repeatedly learned and the proper habit response patterns are internalized. Thus, the ability of the individual to grasp the syntactical implications, which melodic style and patterns, and harmonic progressions have for one another, is

1 Music produces distinct emotional responses on the physiological level. It has a marked effect on GSR, EEG, pulse, blood pressure, respiration, etc. J. L. Mursell, The Psychology of music (New York: W. W. Norton & Co., Inc., 1937), pp. 27-28. See also T. Umemoto, Ongaku-shinrigaku [The psychology of music] (Tokyo: Seishin-shobo, 1966), pp. 192-206. This does not imply, however, that tone as such brings about physiological changes in the listener of music directly. There are two constant factors involved in the perception of music: tonal stimulation and the mental set of the listener. It is a response to the mental set that appears as a physiological change. L. B. Meyer, Emotion and meaning in music (Chicago: The University of Chicago Press, 1956), p. 11.

2 Ibid., p. 34.
3 Ibid., pp. 34-47.
acquired through his musical training and experience.\textsuperscript{1}

Dissonance in melody cognition, in the broadest sense of the term, takes place in the vertical relationship between melodic lines during the course of musical progress. For example, a non-fitting relationship between a melodic line and its accompaniment, or a non-fitting relationship between the structures of melodies performed simultaneously as in polyphony, is deemed dissonant.\textsuperscript{2}

It is then assumed that these non-fitting relationships will give rise to a structurally confused and ambiguous situation in organization. They will also conflict or block the listener's tendency to respond which, in turn, results in an emotion or affect characterized by confusion and lack of clarity,\textsuperscript{3} unless the ultimate resolution of dissonance is made.\textsuperscript{4} It is further assumed that a similar situation prevails in the case where the individual sings a melodic line at the accompaniment.

**Method**

Based on these notions, an experiment was carried out in order to investigate: (1) whether dissonance in melody cognition (discussed above) arouses emotion; and (2) whether the arousal of GSR is affected by the individual's musical training and ability to recognize changes in the harmony and structure of a melody.\textsuperscript{5}

For these purposes a piece of music was composed in 19th-century style (Score 1). Additionally, two pieces of experimental music were

\textsuperscript{1} Y. Tokumaru, "Perception of music, its role in music education," Memoirs of Kunitachi Music College, 1966, 1, 18.


\textsuperscript{3} Meyer, Emotion and meaning in music, pp. 14-16.

\textsuperscript{4} The ultimate resolution is made when the "final result is not in conflict with other aspects of the stimulus situation or other mental sets." Ibid., p. 16.

\textsuperscript{5} The author is not concerned here with GSR per se. What is of principal interest to the psychologist is not the actual sweating response, but the functional relationship between psychological events and GSR concomitant with them. Montagu and Coles advocate the use of GSR as a physiological indicator of psychological events. J. Montagu and E. M. Coles, "Mechanism and measurement of the galvanic skin response," Psychol. Bull., 1966, 5, 264.
They were the same as the original except for some parts of the accompaniment, which were manipulated to create dissonance in terms of: (1) the function of harmony; and (2) melodic style. First, 19th-century chords, not fitting the function of the harmony but relevant to the style of a particular melody, were partly inserted in its accompaniment (Score 2). Second, 20th-century chords, which deviate from and are irrelevant to the specific style of the melody, were used in the accompaniment (Score 3).

Five professional music teachers and five students in an amateur chorus were randomly assigned to experimental tasks. Both the teachers and the students were first induced to hear the original melody, and then to sing the melodic line at the piano accompaniment. After learning the melodic line, these subjects were asked to sing the same melodic line repeatedly, but this time the piano accompaniment was experimentally manipulated. As described above, certain parts of the accompaniment were replaced by two modes of variation, in the harmony progression and melodic style, of the original.

Through the whole experimental session the subjects' GSR were recorded. In addition, the subjects were requested to rate, before and after the experiment, their impressions of the melody and the accompaniment on 61-point scales.

Results

The results of verbal ratings showed that the two groups of subjects equivocally perceived and experienced dissonance, and changed their impression of the experimental melody in the negative direction. However, between the two groups, no statistically significant dif-

One of the difficulties in the discussion of the emotional responses to music, and the physiological changes which take place in the listener, is that no specification can be fully made between the character or the pattern of musical stimulation and the particular physiological responses brought about.

1 Composed by K. Sano, Kunitachi Music College, Tokyo, Japan.
2 From Kunitachi Music College.
3 From Hitotsubashi University.
4 See also infra, p. 11.
ference in GSR, measured as the change in conductance, was found. The verbal ratings and the GSR measurement showed that the two modes of experimental manipulation failed to produce differential effects. Between the two groups there was a slight difference in the profile of the conductance occurring in response to the experimental manipulation. Changes in the background level of resistance were slightly more stable, and changes in conductance were slightly smaller, in the subjects who had much professional training and experience in music than in those who had less.

In the light of these observations, the author foresees the possibility that this experimental method may be applied to the test of the individual's sensitivity to stylistic differences and his ability to perceive and comprehend harmonic progressions and syntactic meanings.

Since the results of the present research are not necessarily clear-cut, the improvement of the experimental design and the measurement technique is under contemplation.

SCORE 1

Measures 8, 13, 19, and 30 substitute for the instrumental part in measures 8, 13, 19, and 30 of the original score (Score 1). These are not fitting to the vocal line in terms of the harmony progression, but are relevant to the melodic style of the vocal line.

Measures 6, 11, 20, 28 and 33 substitute for the instrumental part in measures 6, 11, 20, 28, and 33 of the original score (Score 1). These are not fitting to the vocal line in terms of the harmony progression, but are relevant to the melodic style of the vocal line.
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