Key Processing Precedes Emotional Categorization of Western Music

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ABSTRACT: To investigate whether key processing precedes the appraisal of valence in music, participants listened to pairs of clips of same or different valence, played either in the same key or one semitone apart. They judged whether the second clip expressed the same emotion as the first one. Our predictions were confirmed: the response times obtained were shorter when both clips were played in the same key than when they were played one semitone apart.

KEYWORDS: key; appraisal; valence

Most theorists agree that emotions are fast processes that can be elicited in the absence of conscious cognitive mediation, but that some cognitive processing is required for most emotion.[1] According to Ekman and Davidson, the challenge now is to specify the types of cognitive operations that are critical to the emotion-generation process. The goal of this study was to show the importance of key processing for emotions generated by music.

Indeed, using five experiments testing an amusic patient (I.R.), Peretz and colleagues[2] challenged this idea by showing that there may be separate affective and cognitive pathways.[3] The pathway for emotional evaluation would be quick, precocious, and present in everyone. The route for nonemotional judgments would probably be slower, appear somewhat later in development, and be sensitive to musical expertise. This conclusion would be very much in line with Zajonc.[4,5]

Our study was an attempt to show whether key processing may be a "stimulus antecedent"[6] involved in appraisal processes of valence in music. Over the years,[7,8] studies on the categorization of the emotional valence in music have shown that the two most important factors were tempo and mode. To identify the mode of a piece of music, identifying its key is a necessary step because music theory defines modes according to the nature of the intervals that exist between the different scale notes and the tonic.[9] Therefore, we predicted that participants would process the key of a piece before categorizing its emotional valence.

Sixty-two participants took part in the experiment: 38 students in psychology with little or no music education (referred to as nonmusicians) and 24 musicians,

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TABLE 1. Average correct response times (msec [SDs]) as a function of key, valence similarity, and musical expertise

	Musicians		Nonmusicians	
Emotion	Same	Different	Same	Different
Same key	2,947 (1,225)	2,541 (995)	2,953 (1,393)	2,898 (1,365)
Different key	3,198 (1,535)	2,960 (1,248)	3,058 (1,460)	3,010 (1,494)

including music students and professional musicians. They were presented with 24 musical excerpts from Gosselin and colleagues:[10] 12 peaceful and 12 sad clips. The stimuli were played on a Midi keyboard by a professional pianist in order to convey the clearest possible expression. To prevent peaceful and sad clips from being distinguished on the basis of small differences in range (the peaceful melodies being, on average, higher in pitch than the sad ones) or small tempo differences (the peaceful clips being slightly faster than the sad ones), we modified the clips slightly to be aligned to similar ranges and tempi. The key of the clips was also manipulated so that the tonic of the two clips in the pair were either identical or one semitone apart. The 24 clips thus were combined to create 48 pairs of clips: 24 "same emotion" pairs (peaceful-peaceful, or sad-sad, but the two melodies of a pair were never identical) and 24 "different emotion" pairs (peaceful-sad, or sad-peaceful). Each series of 12 pairs was made of six pairs in the same key, and six pairs in different keys.

The experimental procedure was split into two sessions, between which participants had to take a short break. During the experiment, participants worked at their own pace, starting each excerpt by clicking on the space bar. For each pair of clips, participants listened to the first melody entirely and had to indicate if it expressed peacefulness or sadness, by clicking on "peaceful" or "sad" on the screen. The main task was performed on the second clip of the pair. As soon as they started the second clip, participants had to decide as quickly as possible whether it expressed the same emotion as the previous clip. They were informed by a feedback signal if they gave an incorrect response. Note that participants were not asked to identify the emotion (category) verbally in the second task, when their response times were measured. They pressed a key labeled "same" or "different."

The first analysis, run on the emotional judgments made on the first clip of each pair, showed that participants correctly identified the emotional valence of the clips, on average, 90.86% of the time and thus replicated the findings of Gosselin and colleagues.[10] Musicians were slightly more accurate (93.58%) than nonmusicians (89.14%), but the difference was not significant.

Correct response times for the responses on the second clip on each pair are displayed in TABLE 1. We kept in the analysis the correct response times only when the first clip of the pair had been correctly categorized. A 2 (key relationship) × 2 (valence similarity) × 2 (sessions) × 2 (musical expertise) ANOVA was performed on correct response times. There was a main effect of key relationship, with longer response times for pairs of melodies played in different keys (3,057 ms) than for pairs played in the same key (2,835 ms), $F(1,60) = 9.41$, $P < .004$, MSE = .614E+06.

The present finding thus suggests that participants may have processed the key of each piece before appraising its valence. Further research would be necessary to document whether key processing also occurs before distinguishing between musical excerpts of a high arousal level (e.g., happy or fearful music).

[Competing interests: The authors declare that they have no competing financial interests.]

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