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Facial expressions of pitch structure

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ABSTRACT

In two experiments, we examined whether the facial expressions of singers affect judgements of musical structure. In Experiment 1, a performer was recorded singing each of three intervals. Participants were shown the visual recording (no sound) and judged the size of the interval the performer was (imagined to be) singing. Judgments were made under five conditions of occlusion: no occlusion, occlusion of the mouth; occlusion of the eyes and eyebrows; occlusion of the mouth, eyes, and eye-brows; and occlusion of the entire face (only head movements visible). The results indicated that participants could decode pitch relations from facial expressions alone. Examination of the occlusion conditions indicated that participants could differentiate intervals based on eye-brow movements alone, and even based on head movements. In Experiment 2, we recorded a musician singing thirteen versions of the last phrase of "Silent Night." Versions differed in the pitch of the final tone, which was either the (expected) tonic of the song, or one of the other tones of the chromatic scale, including the tonic one octave above the expected note of the song. Participants were shown the visual recordings of the performances (no sound) and judged the "goodness of fit" of final note, as conveyed in the facial expressions of the singer. Mean ratings closely corresponded to the standard major tonal hierarchy, suggesting that the singer successfully communicated tonal structure through the use of facial expressions.

Keywords

Music and media, Visual cues, Facial expression, Pitch structure, Tonality

INTRODUCTION

The rise of the large concert space in the mid 1800's, in which audience members were often remote from performers, and then the invention of the gramophone and phonograph in 1895, nurtured a conceptual isolation of the acoustic dimension of music, and this conception has influenced theory and research, in spite of the fact that many musical performances are deeply multi-modal, such as those by Judy Garland and B.B. King. Research suggests that facial expressions used during music performances have striking effects on music perception (Davidson & Correia, 2002; Thompson, Graham, & Russo, 2005), including judgments of emotion, pitch relations, dissonance, and tonality. For example, B.B. King often communicates the affective connotations of his guitar playing through his facial expressions and body language.

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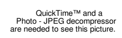

In this study, we sought to determine whether facial expressions of music performers communicate useful information about pitch structure (interval size and tonal relations), independently of any accompanying sound, and to identify some of the facial cues that are decoded by viewers.

METHOD: EXPERIMENT 1

Participants

Eighteen participants with varying levels of musical experience were recruited from an introductory psychology course at the University of Toronto at Mississauga. These participants included 8 males and 9 females, ranging in age from 18 to 21. All received course credit for their contribution.

Procedure

An accomplished folk singer produced ascending intervals of 2, 4, and 7 semitones. Performances were videotaped, and participants were presented with the video component only. Presentation conditions varied in the number of facial features occluded (see Figure 1). In the no-mask condition, no features were occluded. In the mouth mask condition, only the mouth was occluded. In the eyes mask condition, only the eyes (and eye-brows) were occluded. In the mouth and eyes condition, the mouth, eyes, and eye-brows were occluded. In the full-face condition, all features except the perimeter of the face were occluded. As a result, the only visual cue available was head motion. Each interval type was rated three times in each of the five presentation conditions.

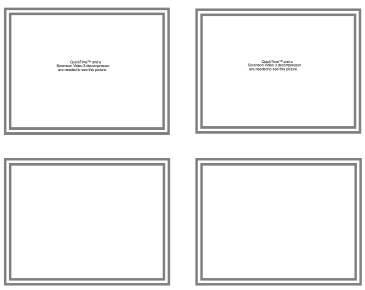

Figure 1: Mouth Mask Condition (upper left); Eyes Mask Condition (upper right); Mouth and Eyes Mask Condition (lower left); Full Face Mask Condition (lower right).

RESULTS

Figure 2 plots the mean ratings of interval size across mask conditions. Ratings fell consistently into the expected veridical order. The effect of interval size was highly significant in all conditions:

- No mask, $F(2, 34) = 73.73$, $p < .0001$
- Mouth mask, $F(2, 34) = 59.48$, $p < .0001$
- Eyes mask, $F(2, 34) = 106.08$, $p < .0001$
- Mouth &eyes mask, $F(2, 34) = 77.14$, $p < .0001$
- Full face mask, $F(2, 34) = 40.50$, $p < .0001$

Orthogonal contrasts confirmed that ratings for 2 semitones were significantly smaller than ratings for 4 semitones, $F(1, 17) > 25$, $p < .0001$ and with the exception of the full-face condition, ratings for 4 semitones were significantly smaller than ratings for 7 semitones, $F(1, 17) > 25$, $p < .0001$.

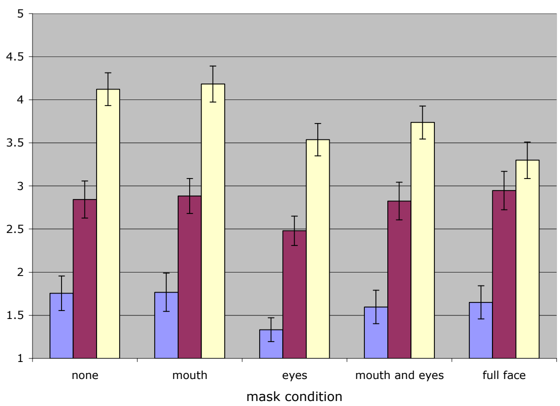

Figure 2: Perceived interval size ratings across conditions

METHOD: EXPERIMENT 2

Participants

Seven musically trained participants were recruited for participation. Although all of the participants had some affiliation with the lab, none had been exposed to the visual clips prior to the experiment.

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Procedure

An accomplished jazz singer was asked to sing a familiar tonal melody (last phrase of silent night) substituting the final tone for one of 13 possible probe tones spanning from the expected tonic to the octave above the expected tonic (i.e., C to C'). The singer was given time to rehearse and was asked to be as expressive as possible in her productions, without compromising pitch accuracy. All productions were verified to be accurate in pitch. Participants were presented with a video recording of each production and were asked to judge the extent to which the final tone appeared to fit with the preceding context. Ratings were made on a seven-point scale, where "1" corresponded to a very poor fit, and "7" corresponded to a very good fit.

RESULTS

As shown in Figure 3, scale positions (of the implied key) were consistently given higher ratings than non-scale positions. Correlation with the standardized major key profile was very high (Krumhansl & Kessler, 1982), suggesting that facial expressions used by the singer communicated tonal structure to the viewers.

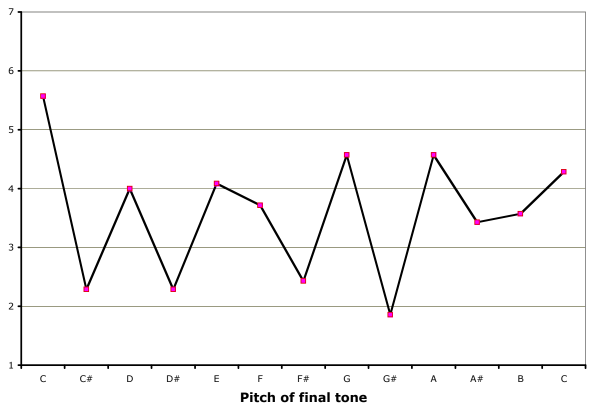

Figure 3: Recovered profile based on facial expressions alone.

DISCUSSION

In Experiment 1, listeners differentiated interval size based on facial cues alone. Differentiation was observed even when all facial cues were occluded (i.e., head movements only), but performance was enhanced when facial cues were available. In Experiment 2, listeners differentiated the tonal stability of notes based on facial cues alone.

CONCLUSIONS

Facial expressions provide an importance source of information about pitch structure. In the *symposium* on music and media, and in a forthcoming article, we discuss the implications of these and other visual effects for the deployment of music in contemporary media.

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