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Seeing Sound Moving: Congruence of Pitch and Loudness with Human Movement and Visual Shape

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ABSTRACT

Background

Musical parameters associate perceptually and cognitively with other domains, specifically the spatial and kinetic. Kohn and Eitan (2009) analyzed the videotaped motion responses of 106 children (aged 5 and 9) to short music excerpts depicting bi-directional changes in pitch, loudness and tempo. Results indicated that different musical parameters tend to activate different motion dimensions, and that the directions of change in musical and motion parameters are significantly associated. An interesting finding emerges from the comparison between stimuli presenting convex (rises followed by falls) and concave (falls followed by rises) pitch contours: while convex stimuli tended to engender comparable rise-fall movements, concave stimuli were *not* associated with fall-rise movement.

Aims

Complementing our previous research of motion responses to music, we investigate here adult participants' *perceptions* of congruence between changes in music and movement, as well as comparable perceptions of congruence between music and visually perceived shape. In particular, we examine whether the effect of overall motion pattern (convex vs. concave) on audio-spatial mappings, revealed for pitch in our previous studies, extends to other parameters, measures and populations.

Method

27 musically untrained adults individually performed two experiments in counterbalanced order. Musical stimuli in both experiments included bidirectional changes in pitch and loudness: rising-falling or falling-rising chromatic scales (pitch), and a repeated tone in crescendo-diminuendo or in diminuendo-crescendo (loudness). In Exp1, visual stimuli were comprised of 4 videotapes of a dancer, presenting vertical (ascent-descent or descent-ascent) and horizontal (opening-closing or closing-opening) movements. These were matched with the musical stimuli to create 16 (4X4) audiovisual combinations. Increasing movement (rise, opening) was defined as congruent with increasing musical change (pitch rise, crescendo); accordingly, 8 combinations were hypothetically defined as congruent (e.g., rise-fall in both pitch and movement) and 8 as incongruent (e.g., rise-fall in pitch, fall-rise in movement). Participants ranked on a 6-point Likert-type scale how well the music and movement in each audiovisual stimulus matched. In Exp2, participants were presented with the same 4 music stimuli (audio only) and with 4 (static) visual shapes (e.g., V, inverted V), and selected one that best matched each musical stimulus.

Results

Exp1: For loudness change, congruent stimuli were rated higher than incongruent combinations for both vertical and horizontal movement ($p<.001$). For pitch change, congruence was significant for vertical ($p<.001$), but not for horizontal movement. Generally, congruence effects (differences between ratings of congruent and incongruent stimuli) were significantly higher for loudness, as compared to pitch, and for vertical, as compared to horizontal movement ($p<.05$). Congruence effects were significantly higher for convex, as compared to concave musical contours ($p<.05$), particularly for pitch, and marginally higher ($p=.071$) for movement increase followed by decrease (particularly open-close), as compared to the decrease-increase patterns.

Exp2: Most participants (67-81%) chose the "correct" shape for each musical stimulus ($p<.0001$). Participants with correct matches in Exp2 also exhibited significantly higher congruence effects in Exp1, as compared to participants with incorrect matches ($p< .001$).

Conclusions

Adult non-musicians strongly associate particular bodily movements and visual shapes with particular changes in musical parameters: pitch rise and fall with rising and falling motion, and crescendo and diminuendo with both rising-falling and opening-closing motion. Notably, these associations are stronger for loudness, as compared to pitch, even when vertical motion (spatial rise and fall) is involved. Perceived congruencies are affected not only by the local directions of motion (e.g., rise, fall) but also by overall contours (in both music and motion), such that mappings involving convex (inverted U) contours are stronger than mappings involving concave contours. This suggests that cross-modal mappings may be affected by higher-level patterning, and specifically that inverted-U patterns may facilitate such mappings.

Keywords

Cross-modal correspondences, musical movement, musical space, pitch contour, loudness

REFERENCE

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