Do we think about music in terms of space? Metaphoric representation of musical pitch.

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Introduction

We often talk about musical pitch using spatial language. In English, pitches can be *high* or *low*, melody lines can *rise* or *fall*, and we can sing at the *top* or the *bottom* of our range. Are spatial metaphors for pitch merely linguistic conventions, or is it possible that patterns in language reveal something fundamental about the way we mentally represent pitch?

There are several reasons to suspect that pitch and space are importantly related in the brain and mind. Auditory nuclei are organized tonotopically: changes in pitch correspond to analogous changes in the localization of activity on a neural map (Schreiner & Langer, 1997). PET data show that the same regions in right prefrontal cortex are engaged during attention to sounds that vary in musical pitch or spatial location (Zatorre, Mondor & Evans, 1999). Right hemisphere damage that compromises visuospatial memory also impairs the learning of new melodies (Samson & Zatorre, 1991).

Linguistic metaphors suggest that the relationship between pitch and space may be highly specific. We tend to borrow unidimensional, vertical spatial terms to describe pitch (e.g., *up, down*). Do we think about pitch in terms of vertical space? A nonlinguistic psychophysical paradigm, used previously to explore the spatialization of temporal representations (Casasanto & Boroditsky, 2002), was adapted to investigate the spatialization of pitch.

Experiment: Height, Length, and Pitch

Materials and Methods

Native English speaking subjects viewed lines 'growing' on a computer monitor, while listening to pitches through sealed headphones. Eleven Ss viewed lines that grew vertically (bottom to top), and twelve Ss viewed lines that grew horizontally (left to right). Nine line displacements ranging from 100-500 pixels in 50-pixel increments were fully crossed with nine pitches, ranging from middle C to G-sharp (an augmented 5th above) in semitone increments. For each of 162 trials, Ss reproduced either stimulus displacement or stimulus pitch.

It was hypothesized that if we think about pitch in terms of height but not length (i.e., the way we talk about it), then if any cross-dimensional interference of displacement on pitch estimation were observed, stimulus height would interfere Ss' pitch estimates more than stimulus length.

Results

Vertical displacement strongly modulated Ss' estimates of stimulus pitch (slope=0.37; r^2=0.77, p<0.003). For stimuli of the same average frequency, lines that grew higher were estimated to be higher in pitch. Ss incorporated irrelevant spatial information into their pitch estimates, even though task instructions encouraged selective attention to pitch. In contrast, horizontal displacement did not significantly modulate pitch estimations (slope=0.09; r^2=0.39, *ns*). The effect of length on pitch was significantly weaker than the effect of height on pitch (difference of slopes=0.28; t=2.68, p<0.02).

It is unlikely that the asymmetric effects of height and length on pitch estimation are due to some general perceptual asymmetry. A parallel experiment (report in preparation) investigated the effects of length and height on time estimation, and found the opposite pattern of cross-dimensional interference: length modulated duration estimates more than height did, consistent with the predominance of horizontal metaphors for time in English.

These results suggest that the metaphoric relationship between pitch and height is not only linguistic, it is also conceptual. The difference between the effects of height and length on pitch estimation is consistent with the occurrence of vertical but not horizontal pitch metaphors in English, though results are agnostic as to the direction of causation between language and thought. Ongoing studies will investigate whether linguistic metaphors merely reflect spatial schemas underlying pitch representations, or whether the way we talk about music can shape the way we think about it.

References

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