MOVEMENT IS MORE STRONGLY ATTRACTED TO MUSIC THAN TO SPEECH

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INTRODUCTION

People often move in synchrony with musical beats whereas synchronization of movement with speech accents is rare. However, like music, language features rich rhythmic organization (e.g., Liberman & Prince, 1977) and serves as an inter-personal communication device (Auer, Couper-Kuhlen, & Müller, 1999). Hence, language should similarly favor synchronized movement.

Nevertheless, language is not characterized by regular isochronous beats (Ramus, Nespor, & Mehler, 1999) which are a universal property of music affording a synchronized motor response (London, 2004). Because of its regular isochronous beat structure, music may be more conducive to synchronization than speech.

Goal

Examine whether movement is indeed more strongly attracted to music than to speech considering motion timing and force trajectories

METHOD

EXPERIMENT 1

Participants 128 students without musical training from the University of Finance and Management in Warsaw (mean age = 22.4 years)

Material

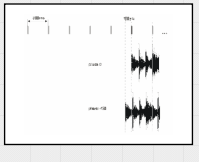
Target: thirty-five 30-ms computer-generated sounds with constant pitch (880 Hz) and intensity (IOI = 600 ms)

Distractors

Music: three computer-generated fragments of highly familiar music (e.g., circus music, "Sleighride", and Bee Gees' "Stayin' Alive"), inter-beat-interval = 600 ms

Speech: three fragments of well-known excerpts of Polish children poetry

Distractors were presented at one of 20 phase relationships with respect to the target ranging from -50% of the IOIs (-300 ms) to +45% of the IOIs (+270 ms) with a step of 5% of the IOIs (30 ms) (similarly to Repp & Penel, 2004).



4 CONDITIONS (between-subjects)

Original: no manipulation of the target or of the distractor
Pitch: same average pitch for target and distractors
Pitch+timing: same as in the Pitch condition, with exact timing in both distractors
Pitch+timing+timbre: same as in the Pitch+Timing condition, with non-musical distractor

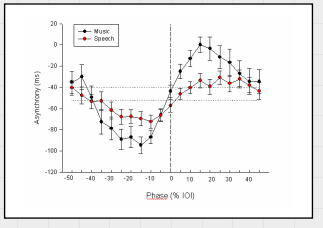
Procedure

Participants were asked to tap on a tapping pad with the index finger of their dominant hand along with the sounds of the target sequence trying to ignore the distractor.

EXPERIMENT 2: same as experiment 1 (Original condition, only). Participants (n = 23) were asked to put their index finger on the surface of a force transducer and to increase the finger's pressure force on the transducer when the target stimuli appeared.

Exp. 1 - Does music attract movement more than speech?

ASYNCHRONY in the ORIGINAL condition



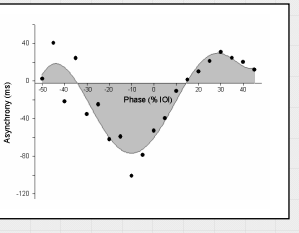
Both music and speech affected the asynchrony between the taps and the Target sounds. Several points in the asynchrony curves fall out of the confidence interval of asynchrony when participants tapped with the Target only (i.e., mean asynchrony ± standard error of asynchrony).

However, **music disrupted synchronization with the Target more than speech**.

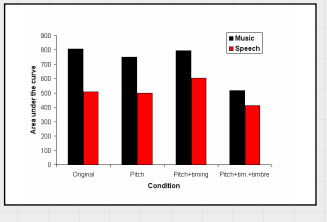
To examine the effect of music and speech distractors while taking individual differences into account, each asynchrony curve from individual performances was fitted with a 6-degree polynomial (for music, average R^2 = .62; for speech, R^2 = .52).

The area under the fitted curve reflects the degree of interference: the larger the area, the larger the interference.

This procedure was adopted to analyze asynchrony curves (see example) and SD of asynchrony curves.

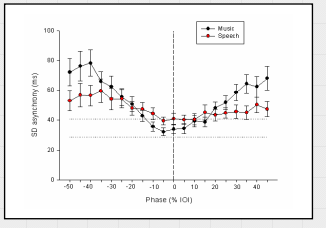


Areas under the curve for ASYNCHRONY



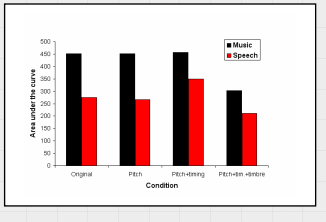
The difference between music and speech varied with the Condition (F(1,114) = 51.39, p < .001). However, in the *Pitch+timing+timbre* condition **music was still more disruptive than speech** (t(29) = 2.60, p < .01).

SD of ASYNCHRONY in the ORIGINAL condition



Similar results were obtained when examining the variability of asynchrony (SD of asynchrony).

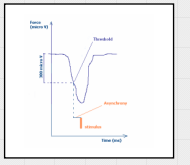
Areas under the curve for SD of ASYNCHRONY



As with Asynchrony, we found an interaction between the Type of the distractor and the Condition (F(3,114)=2.72, p < .05). Nonetheless, **music still affected the SD of asyncrony more than speech** in the *Pitch+timing+timbre* condition (t(29) = 3.41, p < .001).

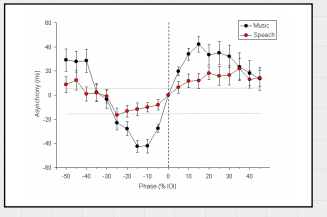
Exp. 2 - Does music attract movement more than speech when measuring force?

Asynchrony was measured from force trajectories by taking the interval between the stimulus onset and the point in time at which force crossed a criterion value of 300 µV, corresponding to 1.5 N (see the figure). 300 µV is the force intensity typically needed to obtain a response on the computer keyboard or on a response pad.



Both music and speech disrupted synchronization with the Target sequence. Several points in the asynchrony curves fall out of the confidence interval for asynchrony.

However, once again, **music disrupted synchronization with the Target more than speech**.



CONCLUDING REMARKS

There is converging evidence that musical rhythms attract movement more than stress structure is speech.

This is a robust effect, which persisted when music and speech were equalized for average pitch and temporal variability and with a neutral target sequence, and when considering both movement timing and force.

Music, because of the regularity of its metrical structure, may be particularly well-suited to engage brain mechanisms underlying sensorimotor synchronization and motor entrainment (e.g., the cerebellum and the basal ganglia).

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