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FlashReport

Music strengthens prosocial effects of interpersonal synchronization – If you move in time with the beat

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ABSTRACT

In many of our daily social interactions, we need to coordinate and to synchronize movements. Various studies have demonstrated that interpersonal movement synchronization has positive effects on cooperation and affiliation. Here, we investigated whether music as compared to a metronome can further strengthen these prosocial effects. We used a within-subjects design in which participants watched videos of two figures walking side by side – without being engaged in a motor task themselves. The participants' task was to imagine that they are one of these figures and that the other figure represents an unknown person. Manipulated factors were *acoustic accompaniment* (music, metronome, and silence) and *synchrony* (both in phase with the beat, *other*-figure out / *self*-figure in phase, and *other*-figure in / *self*-figure out of phase). Participants rated the closeness of the two figures, the likability of the *other*-figure, and how well they felt as the *self*-figure. All three ratings were higher with music compared to the metronome. Additionally, with music but not with the metronome, the likability of the *other*-figure was significantly lower when the *other*-figure was walking out of phase and the *self*-figure in phase, as compared to the other way around (*other*-figure in phase and *self*-figure out of phase). In conclusion, music can strengthen the prosocial effects of interpersonal movement synchronization, provided that one interacts with a person who moves in time with the beat.

Interpersonal coordination of movements is an important part of our daily life. We coordinate our steps in crowded places, synchronize expressive gestures on dance floors, make music together, or play team sports. Such situations require the alignment of movements between two or more people on a millisecond scale. The social entrainment model of McGrath and Kelly (1986, as cited in Clayton, Sager, & Will, 2004) assumes that many human behaviors are oscillatory or rhythmical and that endogenously created oscillations can become entrained to each other *within* individuals and *between* individuals. Moreover, oscillatory behavior of individuals or groups can become entrained to an external pacemaker. Various studies suggest that the synchronization of movements increases affiliation, cooperation and prosocial behavior (Fessler & Holbrook, 2014; Hove & Risen, 2009; Marsh, Richardson, & Schmidt, 2009; Reddish, Fischer, & Bulbulia, 2013; Valdesolo & DeSteno, 2011; Valdesolo, Ouyang, & DeSteno, 2010; Wiltermuth & Heath, 2009) and that music can act as a powerful pacemaker in joint action (D'Ausilio, Novembre, Fadiga, & Keller, 2015; Keller, Novembre, & Hove, 2014).

Kokal, Engel, Kirschner, and Keysers (2011) showed that individuals were more helpful toward a partner who drummed synchronously compared to asynchronously. The authors assessed helpfulness by counting the number of pencils that the participants collected after the tapping partner (i.e., the experimenter) "accidentally" dropped them. Stupacher, Witte, and Wood (2016) expanded this design and showed that participants picked up more pencils to help a synchronized compared to an unsynchronized tapping partner when they tapped in time with high-groove music, but not with a metronome. However, in the same study, the authors could not replicate these results with explicit self-reports.

The studies of Kokal et al. (2011) and Stupacher et al. (2016) used between-subjects designs, indirect measures and active sensorimotor synchronization tasks to provide some evidence that the prosocial bonds created through movement synchronization might be strengthened with music as an external pacemaker. To further investigate the special role of music in social bonding, the current study implemented a within-subjects design without active motor engagement that distinguished between synchronous and asynchronous movements on the one hand and different acoustic accompaniments on the other hand. Compared to between-subjects designs, the strength of the current within-subjects design is its greater statistical power. Participants

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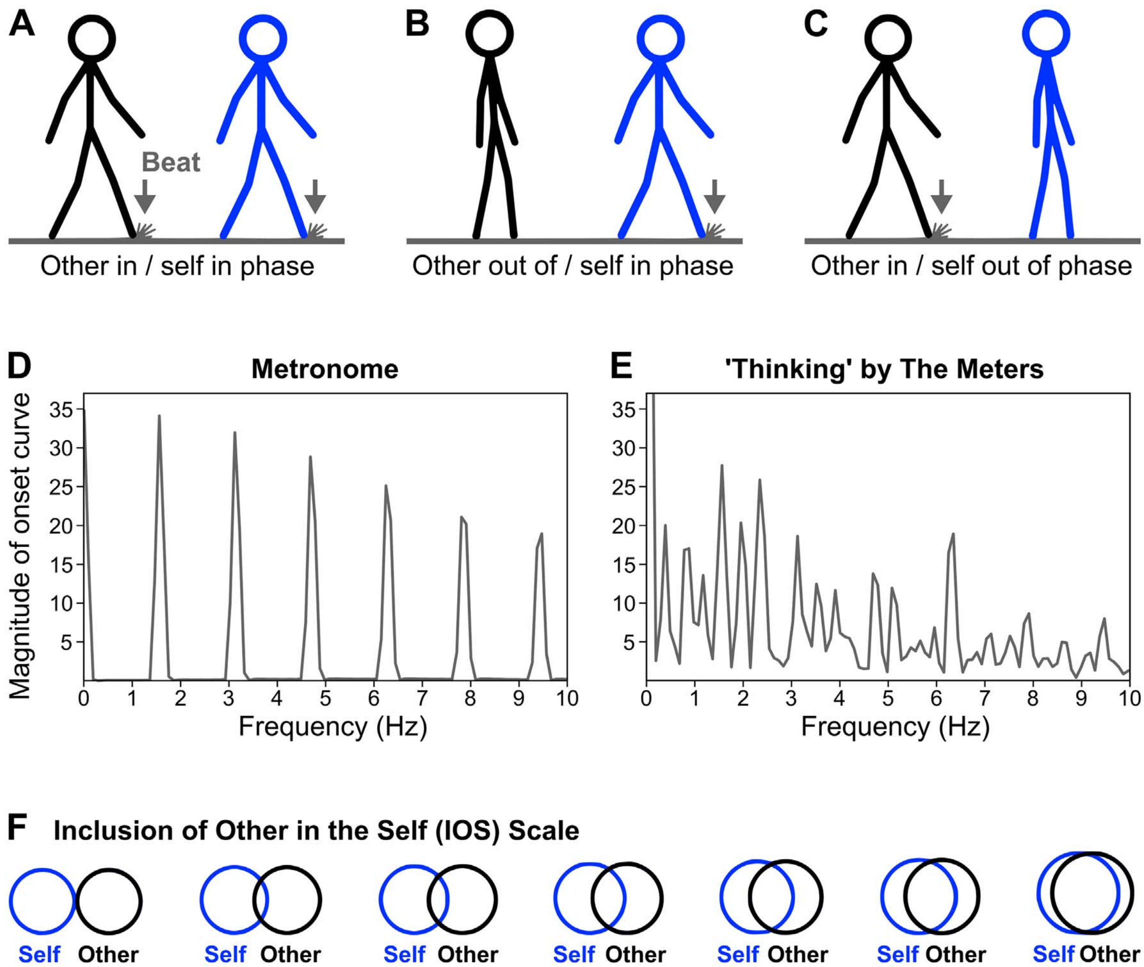

Fig. 1. A–C) Depiction of the different *synchrony* conditions. The beat of the music and the metronome were aligned with each stride. The time when the foot hit the ground was highlighted by a dust cloud. The task of the participants was to imagine that they are the blue figure and that the black figure represents an unknown person. The position of the two figures (blue left vs. blue right) was counterbalanced. D) Frequency spectrum of the onsets of the metronome. E) Frequency spectrum of the onsets of the instrumental track "Thinking" by The Meters. Onset curves were extracted with the *mironsets* function of the MIR toolbox for Matlab (Lartillot & Toiviainen, 2007). F) Adapted Inclusion of Other in the Self scale (Aron et al., 1992) to rate the closeness between the *self*- and *other*-figure. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

watched videos of two stick figures that were walking in phase or out of phase with music or a metronome (Fig. 1A–C). They imagined that they are one of these figures and that the other figure represents an unknown person. As dependent variables, participants rated the closeness of the two figures, the likability of the *other*-figure, and how well they felt as the *self*-figure.

We expected that when both figures are walking in phase (Fig. 1A), music as compared to the metronome has a positive effect on ratings of closeness, likability of the *other*-figure, and well-being as *self*-figure. We further expected that when the *other*-figure walks out of phase and the *self*-figure walks in phase (Fig. 1B), the prosocial effect of music would be weakened when rating the closeness between the figures and the likability of the *other*-figure.

Method

Participants

Ninety-nine participants (62 female, 37 male, $M = 24.1$ years, $SD = 6.2$, sample size set in advance) took part in the experiment. One additional participant was excluded due to technical difficulties with the headphones. We used the Goldsmiths Musical Sophistication Index (Müllensiefen, Gingras, Stewart, & Musil, 2013; Schaal, Bauer, & Müllensiefen, 2014) to assess the participants' musical training ($M = 24.1$, $SD = 11.6$; below the 43rd percentile of the norm group) and general musical sophistication ($M = 72.3$, $SD = 22.2$; below the 33rd percentile). According to the Declaration of Helsinki, the study was approved by the local ethics committee and participants provided written informed consent.

Stimuli

The figures were created with the software Pivot Animator v4.1 (Motus Software). One stride consisted of 21 single frames. At a framerate of 33 fps this was equal to 636 ms between steps. Eighteen different videos were created resulting from the combination of the following factors: *synchrony* (Fig. 1A–C), *acoustic accompaniment* (music, metronome, silence), and *position* of the figures (blue figure left vs. right). For the music accompaniment we chose the instrumental track "Thinking" by The Meters with a 636 ms inter-beat-interval (Fig. 1E). The metronome was a woodblock sound with an inter-beat-interval of 636 ms (Fig. 1D). Audio was presented over AKG K271-MK2 headphones. The loudness was set to be loud and clear but comfortable. When walking in phase with music or the metronome, the figures' steps were temporally aligned with the beat. When walking out of phase, the steps were delayed by eight frames. The videos (see Supplementary Material) lasted 12 s and were presented on a 24″ monitor (Samsung SyncMaster SA450; video size 1280 × 720 px; viewing distance 70 cm)