Proceedings of the 9th International Conference of Students of Systematic Musicology (SysMus16), Jyväskylä, Finland, 8th - 10th June 2016. Birgitta Burger, Joshua Bamford, & Emily Carlson (Eds.).

Social effects of interpersonal synchronization during listening to music compared to a metronome: What can we learn from implicit measures?

Jan Stupacher[1], Matthias Witte[1], Guilherme Wood[1]

[1] University of Graz, Graz, Austria
jan.stupacher@uni-graz.at

Abstract

Interpersonal coordination, such as simultaneous rhythmic movement, is a fundamental way to form socioemotional connections. The social and emotional power of music might further strengthen such interpersonal bonds. Here, we tested if interpersonal synchronization (synchronous vs. asynchronous finger-tapping) affects sympathy and helpfulness more strongly when listening to music compared to a metronome. We tested 40 participants and used an explicit and an implicit measure to assess their social orientation toward a tapping partner (i.e., one of two experimenters). Participants directly rated the friendliness of the experimenter on a 9-point Likert scale. As a more indirect or implicit measure of social orientation, we counted the number of pencils (out of a total of eight) that the participants collected after the experimenter "accidentally" dropped them. After five seconds, the experimenter started to help the participants or collected the pencils herself. Results of the pencil test showed that participants were more helpful toward an experimenter who tapped synchronously compared to asynchronously. Importantly, this result was completely driven by the effect of interpersonal synchrony during listening to music. When listening to music, participants collected 38 pencils ($M = 3.80$, $SD = 3.29$) after tapping in interpersonal synchrony compared to only 13 pencils ($M = 1.30$, $SD = 2.67$) after tapping asynchronously. No such effect was found for the metronome. The results of explicit ratings of the experimenter's friendliness, however, did not confirm these effects. The direct ratings might have been more strongly influenced by social desirability or related motivational distortions. Since music is a product of social interactions and might even be the result of evolutionary adaptation, we conclude that especially during listening to music, interpersonal synchrony or asynchrony can fulfill or violate hard-wired social expectations. Additionally, we could show that implicit or indirect measures can help elucidate how music, movement and prosocial behavior are connected.

Keywords: social entrainment, interpersonal affiliation, joint action, sensorimotor synchronization

Introduction

Interpersonal coordination – be it behavior matching, such as mimicry, or interactional synchrony, such as simultaneous rhythmic movements (e.g., Bernieri & Rosenthal, 1991) – is a fundamental way to form socioemotional connections. Here, we addressed the question how synchronous and asynchronous finger-tapping with another person during either listening to music or a metronome influences sympathy and prosocial orientation.

Behavioral mimicry, interactional synchrony and music

Behavioral mimicry describes the mirroring of another person's gestures, postures or other movements (e.g., speech gestures, foot shaking; for a review, see Chartrand & Lakin, 2013). Factors that increase the tendency to mimic the behavior of another person include prosocial attitudes (Leighton, Bird, Orsini, & Heyes, 2010), being in a good mood (Likowski et al., 2011), and the likeability (Stel et al., 2010) or the goal to get along with this person (Lakin & Chartrand, 2003). In turn, being mimicked can positively affect feelings of liking toward the mimicker (Chartrand & Bargh, 1999), feelings of interpersonal closeness (Ashton–James, van Baaren, Chartrand, Decety, & Karremans, 2007), and prosocial behavior in adults (van Baaren, Holland, Kawakami, & van Knippenberg, 2004) and infants (Carpenter, Uebel, & Tomasello, 2013).

In contrast to behavioral mimicry, that usually includes a time lag of a few seconds, interactional synchrony describes movements that are temporally matched. A variety of research suggests that the interpersonal synchronization of movements, such as walking, pendulum-swinging, chair-rocking, body-swaying, or finger-tapping, promotes affiliation and prosocial orientation (e.g., Demos, Chaffin, Begosh, Daniels, & Marsh, 2012; Hove & Risen, 2009; Marsh et al., 2009; Reddish, Fischer, & Bulbulia, 2013; Valdesolo & Desteno, 2011; Wiltermuth & Heath, 2009).

By using a moving visual timekeeper, Hove and Risen (2009) showed that the degree of synchrony between the participants' and the experimenters' finger-taps was positively related to how much participants liked the experimenter. Such effects may even be stronger when moving together while listening to music. When rocking in a chair with a partner, the degree of synchronization with music is positively correlated with the feeling of interpersonal connectedness (Demos et al., 2012).

Listening to music has a strong emotional component and, similarly to social bonding, engages the endogenous opioid system (Tarr, Launay, & Dunbar, 2014). Furthermore, rhythmic synchronization in musical contexts represents a special form of social entrainment (Phillips-Silver, Aktipis, & Bryant, 2010), and can provide a controlled yet ecologically valid domain to study social interaction and joint action (Keller, Novembre, & Hove, 2014). In the current study, we tested the hypothesis that interpersonal synchronization affects sympathy and prosocial orientation more strongly when listening to music compared to when listening to a metronome.

Measures of sympathy, affiliation and prosocial behavior

Direct or explicit measures, such as self-reports, are one of the main pillars of experimental psychology. However, they can suffer from credibility issues, are vulnerable to consistency seeking, and depend on the participants abilities to introspectively access the processes that underlie their feelings and behaviors (Paulhus & Vazire, 2005). In contrast, indirect or implicit measures, such as implicit association tests (Greenwald, McGhee, & Schwartz, 1998), affective priming tasks (Fazio, Jackson, Dunton, & Williams, 1995; Fazio, Sanbonmatsu, Poweu, & Kardes, 1986), the seating distance to another person (Holland, Roeder, van Baaren, Brandt, & Hannover, 2004), or the number of collected pencils that another person dropped (Macrae & Johnston, 1998), do not require introspection. This particular characteristic led to the assumptions that implicit measures can reflect unconscious mental representations and are less susceptible to motivational distortions, such as social desirability (for a review and discussion of these assumptions, see Gawronski, LeBel, & Peters, 2007). However, it is important to note that although specific factors can affect implicit measures without affecting comparable explicit measures (e.g., Gawronski & LeBel, 2008), implicit measures do not necessarily reflect unconscious mental representations (Gawronski et al., 2007). Additionally, domain-specific motivational distortions (e.g., the motivation to control prejudice reactions) might be more powerful in explaining differences between implicit and explicit measures than social desirability in general (Gawronski et al., 2007; Hofmann, Gschwendner, Nosek, & Schmitt, 2005).

Various implicit measures have previously been used to assess prosocial orientation in the domains of mimicry and interpersonal synchronization. In a row of chairs, participants who had been mimicked sat closer to a chair with belongings from another person than participants who had not been mimicked (Ashton–James et al., 2007). Being mimicked also increases the likelihood of collecting pencils that another person dropped (van Baaren et al., 2004). Similar tests have been used to show that helpfulness is increased after playing a prosocial video game compared to playing a neutral or aggressive video game (Greitemeyer & Osswald, 2010), and decreased when reminded of money (Vohs, Mead, & Goode, 2006). In a musical context, Kokal, Engel, Kirschner, and Keysers (2011) showed that participants collected more pencils to help a synchronous co-drummer compared to an asynchronous one.

Since previous studies on behavioral mimicry and interactional synchrony successfully assessed affiliation and prosocial orientation with implicit and explicit tests, the current study combined and compared both methods.

Methods

Participants

Forty students of the University of Graz (20 females, mean age $= 23.7$ years, $SD = 2.60$) without musical training participated in the study after providing informed consent.

Design and procedure

Participants were assigned to one of four groups: tapping with a partner who tapped synchronously or asynchronously during listening to music or a metronome. The resulting between-subject design consisted of two independent variables: *interpersonal synchrony* (sync vs. async tapping) and *musical quality* (music vs. metronome).

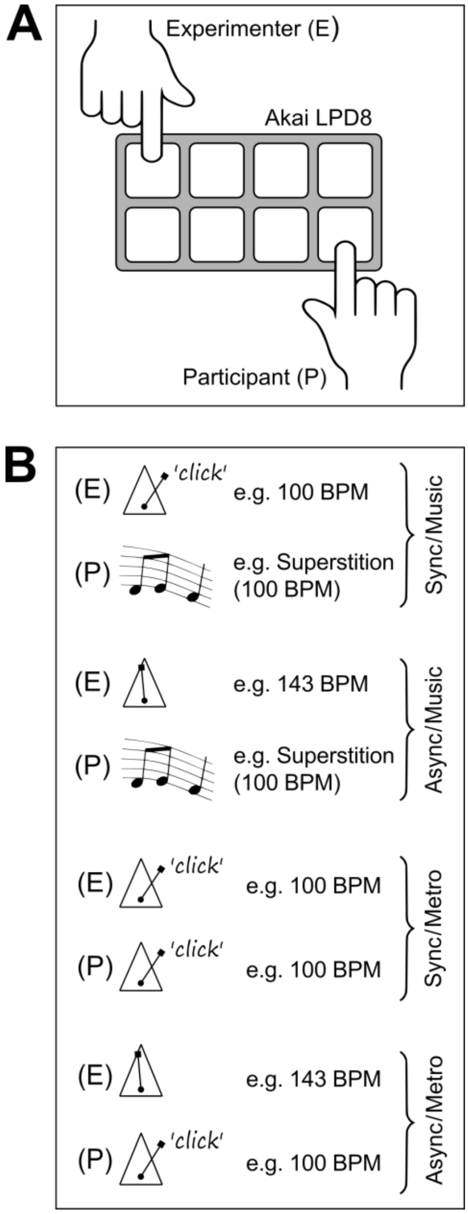

Figure 1. A) Setup for the tapping task. Participants (P) and the experimenter (E) tapped their right index finger on two different pads on the same tapping device (Akai LPD8). Both wore head-phones. B) Visualization and examples of the four experimental groups.

Both, participant and experimenter tapped their right index finger on two different pads on a MIDI tapping device (Figure 1A).

Each group of participants (*sync/music*, *async/music*, *sync/metro*, and *async/metro*; Figure 1B) consisted of five females and five males. The tapping partner was one of two female experimenters (psychology students, 22 and 25 years old) who did not know the participants. In the *sync/music* group participants tapped at the music's beat rate and the experimenter tapped at the same rate given by a metronome that was slightly adjusted for minimal tempo changes. In the *async/music* group participants tapped at the music's beat rate and the experimenter tapped at a 30% faster rate given by a metronome. In the *sync/metro* group participants and the experimenter tapped in time with the same metronome. In the *async/metro* group the experimenter tapped with a 30% faster metronome than the participants. Participants were instructed to tap in time with the stimuli and to focus on their own tapping.

Material

Acoustic Stimuli

To facilitate sensorimotor synchronization in the tapping task with music, we used three music clips that were rated high on groove (i.e., highly movement inducing) in a recent study (Janata, Tomic, & Haberman, 2012; see also Stupacher, Hove, Novembre, Schütz-Bosbach, & Keller, 2013; Stupacher, Hove, & Janata, in press; Table 1). A metronome count-in with a length of one measure (4 sounds in 4/4 time) was used to indicate the beat rate. In the metronome conditions isochronous snare drum sounds were presented with the same beat rate as the three music clips. The clips lasted between 31 and 33 seconds, were randomized, and repeated 4 times, resulting in 12 clips in total. Before tapping with the experimenter, participants completed practice trials to ensure that they understood the task. The tapping part of the experiment lasted approximately 8 minutes.

Self-reports

Participants rated their current mood (very bad vs. very good), the friendliness of the experimenter (very unfriendly vs. very friendly), and the interaction with the experimenter (very unpleasant vs. very pleasant) on a 9-point Likert scale before and after the tapping task. After the tapping task they additionally reported their interest to generally participate in another test run by the same experimenter (no interest vs. strong interest).

Prosocial orientation

After the tapping task the experimenter stood up to get the questionnaires and a cup with eight pencils stored in a cupboard near the participant's chair. She pretended to accidentally drop the pencils and took about five seconds to place the questionnaires on a desk giving the participant enough time to help. Afterwards she started collecting the remaining pencils with or without the participant's help. Prosocial orientation toward the experimenter was assessed by the number of pencils the participants collected.

Results

Tapping data

Inter-tap-intervals (ITIs) were computed by subtracting the absolute time of a tap n from the absolute time of the following tap n+1. Doubled or missing taps and outlier ITIs (+/- 2 *SD* from the mean ITI for each participant and trial) were excluded (5.5%). Mean ITIs indicated that participants tapped at the beat rate of the stimuli (see Table 1). Three separate ANOVAs – one for each tempo – on the mean ITIs with the factors *interpersonal synchrony* (sync vs. async) and *musical quality* (music vs. metronome) revealed no main effects (ps > .07) and no interactions (ps > .17). No main effects of *interpersonal synchrony* and *musical quality* and no interaction were found in an additional ANOVA on the standard deviations of ITIs (ps > .5), indicating that the stability of the tapping rate did not differ between groups.

Self-reports

Chi-squared tests were used for the analysis of self-reports since all variables suffered from a ceiling effect (skewness between -0.50 and -1.93, all Kolmogorov-Smirnov ps < .01). Seven individual tests (for each pre- and post-tapping rating) with the factors *interpersonal synchrony* and *musical quality* on the sum of ratings per cell revealed non-significant results (ps > .5). Main effects of *interpersonal synchrony* and *musical quality* were also non-significant (ps > .2).

Prosocial orientation

Nonparametric tests were used since the assumption of normal distribution was not met. A chi-squared test with the factors *interpersonal synchrony* and *musical quality* on the total number of collected pencils was significant, $\chi^2(1) = 7.16$, $p = .007$. Further comparisons showed that participants collected more pencils after synchronous tapping compared to asynchronous tapping $\chi^2(1) = 5.45$, $p = .020$. This result was completely driven by the effect of *interpersonal synchrony* during listening to music, $\chi^2(1) = 12.26$, $p < .001$ (38 pencils [$M = 3.80$, $SD = 3.29$] after *sync/music* compared to 13 pencils [$M = 1.30$, $SD = 2.67$] after *async/music*, see Figure 2B). No effect of *musical quality* on the number of collected pencils was found, $\chi^2(1) = 1.47$, $p > .2$.

Discussion

We tested the hypothesis that interpersonal synchronization has a stronger effect on sympathy and prosocial orientation when listening to music compared to a metronome. The results of an implicit test confirmed our hypothesis and showed that participants were more helpful toward a person who tapped synchronously compared to asynchronously.

Table 1: Features of the acoustic stimuli used for tapping with music and the corresponding mean inter-tap-intervals (ITI) of participants.

Title	Artist	Meter	Groove rating *	Tempo	ITI in ms (*SD*)
Superstition	Stevie Wonder	4/4	108.7	100 BPM / 600 ms	590.89 (26.49)
Flash Light	Parliament	4/4	105.1	105 BPM / 571 ms	561.28 (27.12)
Look-Ka Py Py	The Meters	4/4	92.5	87 BPM / 690 ms	678.26 (34.84)

* Janata et al., 2012 (MIDI scale from 0 to 127)

Importantly, this was only true when participants tapped in time with music, but not with a metronome. The results of explicit ratings of the experimenter's friendliness, however, did not confirm this effect.

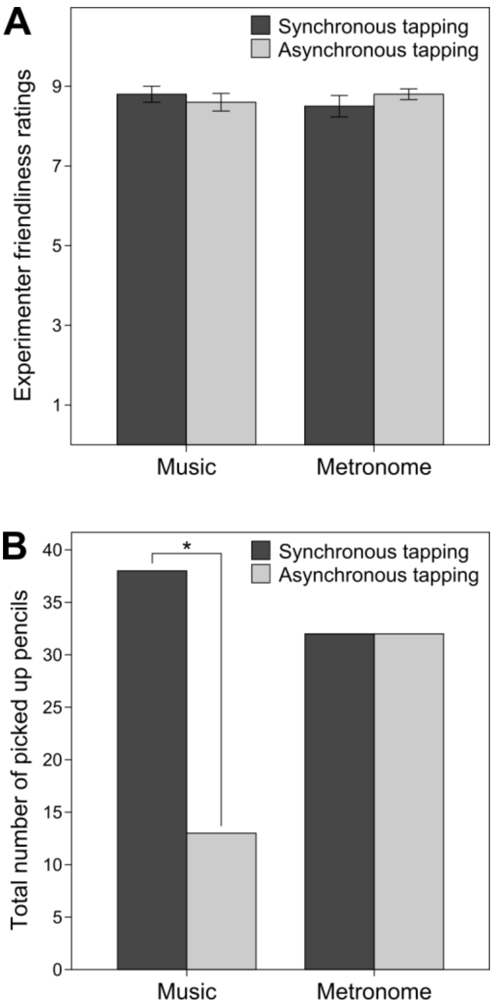

Figure 2. A) Mean ratings of the experimenter's friendliness given by participants in each experimental group after the tapping task. B) Total number of pencils that the participants in each experimental group collected after the experimenter "accidentally" dropped them (* $p < .001$).

Music evokes a variety of emotions, some of them related to attachment and the fulfillment of social needs, such as trust, cooperation or the prevention of isolation (Freeman, 2000; Koelsch, 2010; Vuilleumier & Trost, 2015). This emotional and social power of music might even be the result of evolutionary adaptation (Cross, 2001; Freeman, 2000; Huron, 2001). Compared to non-musical stimuli, interpersonal synchronization with music might affect social bonding not only via joint action, but also via affective and neurophysiological mechanisms (e.g., endorphins) associated with the music itself (Tarr et al., 2014). When moving together in time with the same music one shares a common experience. This shared experience might facilitate social bonding compared to the experience of just moving in synchrony without music (Demos et al., 2012). Taken together, these findings suggest that, especially during listening to music, interpersonal synchrony or asynchrony can fulfill or violate hard-wired affective and social expectations.

These socio-emotional characteristics of music can explain why we found an effect of *interpersonal synchrony* on helpfulness during tapping with music but not during tapping with a metronome (Figure 2B). But they also raise the question if the difference in helpfulness represents a more prosocial orientation in the synchrony group resulting from greater social bonding or a less prosocial orientation in the asynchrony group resulting from violated social expectations. The comparison of the number of collected pencils between the four groups, especially the comparison between music and metronome, suggests that asynchronous tapping during listening to music might have negatively affected the social orientation toward the experimenter. In contrast, Hove and Risen (2009) found higher experimenter-likeability ratings after synchronized tapping compared to asynchronous tapping and a control condition in which participants tapped alone, but no difference between asynchronous tapping and the control. How can we explain this divergence?

As already mentioned, our experimental design included two experiences that enable social bonding, namely the synchronization of movements and listening to music (Freeman, 2000; Koelsch, 2010; Tarr et al., 2014). It is possible that, during listening to music, asynchronous tapping resulted in discrepancies between these two experiences, leading to violated affective and social expectations. The lower number of collected pencils after asynchronous tapping with music, as compared to synchronous tapping with music, might show how these discrepancies negatively affected prosocial orientation.

From a methodological point of view, prosocial effects of synchronization may not be as robust as previous research suggested (Schachner & Garvin, 2010). This might partly be due to the fact that the effect sizes depend on the measures used. Our study showed that in contrast to the indirect measure of prosocial orientation, the direct measures (i.e., self-reported ratings of experimenter-friendliness and interaction-pleasantness) did not differ between groups.

It is important to note that sympathy-related ratings of the experimenter and helpfulness toward the experimenter represent different partial aspects of social bonding. However, since previous research suggests that interpersonal synchronization affects a wide range of feelings, judgments, and behaviors, including connectedness, likeability, co-operation, helpfulness, and conformity (Demos et al., 2012; Hove & Risen, 2009; Kokal et al., 2011; Wiltermuth & Heath, 2009) these aspects seem to be tightly related. We therefore expected to find comparable results of explicitly assessed experimenter-friendliness and implicitly assessed helpfulness.

The null result of self-reports are due to a ceiling effect. Without this ceiling effect we potentially would have been able to detect differences in ratings of the *sync/music* group and the *async/music* group. Please note that we still found a ceiling effect in self-reports when changing the 9-point Likert scale to a continuous scale from 0 to 100, rephrasing the extreme values of the scales, and training the tapping partner (i.e., the experimenter) to act reserved (Stupacher, Witte, & Wood, unpublished data). A possible explanation for the ceiling effect in self-reports is the individual need for self-consistency (Robins & John, 1997), i.e., high post-tapping ratings could have been driven by high pre-tapping ratings.

In contrast to the implicit assessment of prosocial orientation, self-reports might have been more strongly influenced by social desirability or related motivational distortions. Even though the questionnaires were anonymous, the fact that the experimenter would look at the ratings at some point could have led to more positive ratings than expected. However, the extent to which social desirability can explain differences between explicit and implicit measures is still under debate (Hofmann et al., 2005). Here, we could show that an implicit measure successfully detected changes in prosocial orientation related to interpersonal synchrony, whereas self-reports failed to detect similar effects. We conclude that although, or even because, self-reports suffered from methodological limitations, the use of implicit measures can enrich our understanding of social bonding, interpersonal synchronization, and music.

Acknowledgements

We would like to thank Michael Hove and Johanna Reichert for helpful comments and discussions. Jan Stupacher is supported by a DOC fellowship of the Austrian Academy of Sciences at the Department of Psychology, University of Graz.

References

Ashton–James, C., van Baaren, R. B., Chartrand, T. L., Decety, J., & Karremans, J. (2007). Mimicry and me: the impact of mimicry on self–construal. *Social Cognition, 25*, 518–535.

Bernieri, F. J., & Rosenthal, R. (1991). Interpersonal coordination: behavior matching and interactional synchrony. In R. S. Feldman & B. Rime (Eds.), *Fundamentals of Nonverbal Behavior: Studies in Emotion & Social Interaction* (pp. 401–432). Cambridge, England: Cambridge University Press.

Carpenter, M., Uebel, J., & Tomasello, M. (2013). Being mimicked increases prosocial behavior in 18-month-old infants. *Child Development, 84*, 1511–1518.

Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: the perception-behavior link and social interaction. *Journal of Personality and Social Psychology, 76*, 893–910.

Chartrand, T. L., & Lakin, J. L. (2013). The antecedents and consequences of human behavioral mimicry. *Annual Review of Psychology, 64*, 285–308.

Cross, I. (2001). Music, cognition, culture, and evolution. *Annals of the New York Academy of Sciences, 930*, 28–42.

Demos, A. P., Chaffin, R., Begosh, K. T., Daniels, J. R., & Marsh, K. L. (2012). Rocking to the beat: effects of music and partner's movements on spontaneous interpersonal coordination. *Journal of Experimental Psychology: General, 141*, 49–53.

Fazio, R. H., Jackson, J. R., Dunton, B. C., & Williams, C. J. (1995). Variability in automatic activation as an unobtrusive measure of racial attitudes: a bona fide pipeline? *Journal of Personality and Social Psychology, 69*, 1013–1027.

Fazio, R. H., Sanbonmatsu, D. M., Poweu, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology, 50*, 229–238.

Freeman, W. J. (2000). A neurobiological role of music in social bonding. In N. Wallin, B. Merkur, & S. Brown (Eds.), *The Origins of Music* (pp. 411–424). Cambridge, MA: MIT Press.

Gawronski, B., & LeBel, E. P. (2008). Understanding patterns of attitude change: when implicit measures show change, but explicit measures do not. *Journal of Experimental Social Psychology, 44*, 1355–1361.

Gawronski, B., LeBel, E. P., & Peters, K. R. (2007). What so implicit measures tell us? Scrutinizing the validity of three common assumptions. *Perspectives on Psychological Science, 2*, 181–193.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: the implicit association test. *Journal of Personality and Social Psychology, 74*, 1464–1480.

Greitemeyer, T., & Osswald, S. (2010). Effects of prosocial video games on prosocial behavior. *Journal of Personality and Social Psychology, 98*, 211–221.

Hofmann, W., Gschwendner, T., Nosek, B. A., & Schmitt, M. (2005). What moderates implicit—explicit consistency? *European Review of Social Psychology, 16*, 335–390.

Holland, R. W., Roeder, U. R., van Baaren, R. B., Brandt, A. C., & Hannover, B. (2004). Don't stand so close to me: the effects of self-construal on interpersonal closeness. *Psychological Science, 15*, 237–242.

Hove, M. J., & Risen, J. L. (2009). It's all in the timing: interpersonal synchrony increases affiliation. *Social Cognition, 27*, 949–960.

Huron, D. (2001). Is music an evolutionary adaptation? *Annals of the New York Academy of Sciences, 930*, 43–61.

Janata, P., Tomic, S. T., & Haberman, J. M. (2012). Sensorimotor coupling in music and the psychology of the groove. *Journal of Experimental Psychology: General, 141*, 54–75.

Keller, P. E., Novembre, G., & Hove, M. J. (2014). Rhythm in joint action: psychological and neurophysiological mechanisms for real-time interpersonal coordination. *Philosophical Transactions of the Royal Society: Series B, 369*, 20130394.

Koelsch, S. (2010). Towards a neural basis of music-evoked emotions. *Trends in Cognitive Sciences, 14*, 131–137.

Kokal, I., Engel, A., Kirschner, S., & Keysers, C. (2011). Synchronized drumming enhances activity in the caudate and facilitates prosocial commitment - If the rhythm comes easily. *Plos One, 6*, e27272.

Lakin, J. L., & Chartrand, T. L. (2003). Using nonconscious behavioral mimicry to create affiliation and rapport. *Psychological Science, 14*, 334–339.

Leighton, J., Bird, G., Orsini, C., & Heyes, C. (2010). Social attitudes modulate automatic imitation. *Journal of Experimental Social Psychology, 46*, 905–910.

Likowski, K. U., Weyers, P., Seibt, B., Stöhr, C., Pauli, P., & Mühlberger, A. (2011). Sad and lonely? Sad mood suppresses facial mimicry. *Journal of Nonverbal Behavior, 35*, 101–117.

Macrae, C. N., & Johnston, L. (1998). Help, I need somebody: automatic action and inaction. *Social Cognition, 16*, 400–417.

Marsh, K. L., Richardson, M. J., & Schmidt, R. C. (2009). Social connection through joint action and interpersonal coordination. *Topics in Cognitive Science, 1*, 320–339.

Paulhus, D. L., & Vazire, S. (2005). The self-report method. In R. W. Robins, R. C. Fraley, & R. F. Krueger (Eds.), *Handbook of Research Methods in Personality Psychology* (pp. 224–239). New York: Guilford.

Phillips-Silver, J., Aktipis, C. A., & Bryant, G. A. (2010). The ecology of entrainment: foundations of coordinated rhythmic movement. *Music Perception, 28*, 3–14.

Reddish, P., Fischer, R., & Bulbulia, J. (2013). Let's dance together: synchrony, shared intentionality and cooperation. *Plos One, 8*, e71182.

Robins, R. W., & John, O. P. (1997). The quest for self-insight: theory and research on accuracy and bias in self-perception. In R. Hogan, J. Johnson, & S. R. Briggs (Eds.), *Handbook of Personality Psychology* (pp. 649–679). San Diego, CA: Academic Press.

Schachner, A., & Garvin, L. (2010). Does synchrony really affect social variables? Effects on cooperation, conformity may not be robust. Poster presented at the *International Conference on Music Perception and Cognition*. Seattle, WA.

Stel, M., van Baaren, R. B., Blascovich, J., van Dijk, E., McCall, C., Pollmann, M. M. H., … Vonk, R. (2010). Effects of a priori liking on the elicitation of mimicry. *Experimental Psychology, 57*, 412–418.

Stupacher, J., Hove, M. J., Novembre, G., Schütz-Bosbach, S., & Keller, P. E. (2013). Musical groove modulates motor cortex excitability: a TMS investigation. *Brain and Cognition, 82*, 127–136.

Stupacher, J., Hove, M. J., & Janata, P. (in press). Audio features underlying perceived groove and sensorimotor synchronization in music. *Music Perception*.

Tarr, B., Launay, J., & Dunbar, R. I. M. (2014). Music and social bonding: "self-other" merging and neurohormonal mechanisms. *Frontiers in Psychology, 5*, 1096.

Valdesolo, P., & Desteno, D. (2011). Synchrony and the social tuning of compassion. *Emotion, 11*, 262–266.

Van Baaren, R. B., Holland, R. W., Kawakami, K., & van Knippenberg, A. (2004). Mimicry and prosocial behavior. *Psychological Science, 15*, 71–74.

Vohs, K. D., Mead, N. L., & Goode, M. R. (2006). The psychological consequences of money. *Science, 314*, 1154–1156.

Vuilleumier, P., & Trost, W. (2015). Music and emotions: from enchantment to entrainment. *Annals of the New York Academy of Sciences, 1337*, 212–222.

Wiltermuth, S. S., & Heath, C. (2009). Synchrony and cooperation. *Psychological Science, 20*, 1–5.