Mechanisms and Explanatory Models of Interpersonal Synchronization in Promoting Cooperative Behavior

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Abstract

Synchronization, as a core element of collective rituals, is of great significance to group survival and development. Interpersonal synchronization is a special form of coordinated behavior characterized by time-locked and phase-locked features. Recent research has found that synchronization can promote prosocial behaviors such as cooperation. The specific facilitating mechanisms include neurophysiological activation, enhancement of social connectedness, increased cognitive sensitivity, and evocation of positive emotions. Scholars have also proposed three different explanatory models from various perspectives: the self-other overlap model, the cooperation enhancement model, and the collective effervescence model. Future research needs to further dissect the prosocial functions of synchronous behavior and clarify the moderating mechanisms, specificity, and universality of synchronization effects.

Full Text

Mechanisms and Explanatory Models of Interpersonal Synchrony in Promoting Cooperative Behavior

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Abstract

Synchrony, as a core element of collective rituals, holds significant importance for group survival and development. Interpersonal synchrony represents a special

form of coordinated behavior characterized by time- and phase-locked features. Recent studies have found that synchrony can promote prosocial behaviors such as cooperation, with the underlying mechanisms involving activation of neurophysiological systems, enhancement of social connectedness, increased cognitive sensitivity, and evocation of positive emotions. Scholars have proposed three distinct explanatory models from different perspectives: the self-other overlap model, the cooperation reinforcement model, and the collective effervescence model. Future research should further analyze the prosocial functions of synchrony and clarify the moderating mechanisms, specificity, and universality of synchrony effects.

Keywords: interpersonal synchrony, cooperation, perception of social bonding, group identity, self-other representational overlap

Preamble

From the uniform marching of ceremonial soldiers to synchronized bowing during religious prayers, from choral singing in unison to synchronized square dancing, synchrony represents a common behavioral feature in human social life, where individuals in sync often share consistent movement rhythms. Lakens (2010) proposed that movement rhythm serves as an important source of information for individuals to infer whether someone belongs to a social group. Research has demonstrated that synchrony effectively promotes social bonding (Tunçgenç & Cohen, 2016), and synchronizing with others constitutes an effective means for strangers to establish social connections (Ehrenreich, 2007). The study of synchrony can be traced back to explorations of religious rituals. Rituals are markers of cultural transmission and human behavior, with synchrony forming an essential component and synchronized movements representing a core element of collective rituals (Zou Xiaoyan et al., 2018). Fischer et al. (2013) suggested that behavioral synchrony and the sacred value of rituals serve as potential mechanisms through which collective rituals enhance cooperative motivation and behavior. Current research on synchrony has evolved from anthropology and religious studies to social psychology and cognitive neuroscience, focusing on the emergence and mechanisms of synchrony.

As a prerequisite for smooth social interaction, both interpersonal synchrony and behavioral matching belong to the broader domain of interpersonal coordination (Bernieri & Rosenthal, 1991). While both involve consistency in bodily movements between individuals, they differ in temporal precision and action accuracy (Chartrand & Lakin, 2013). Behavioral matching, also known as behavioral mimicry, involves imitating others' actions and can tolerate brief temporal delays, with the interval between initiated and copied behavior generally not exceeding 5 seconds (Chartrand & Lakin, 2013). Interpersonal synchrony refers to the temporal overlap of actions between two or more people, involving time-locked movements performed by two or more individuals (Cirelli, 2018). Zou Xiaoyan et al. (2018) defined synchronized action as a tendency to match periodic behaviors at the same frequency and/or cycle, emphasizing coordinated

consistency among group members. Narrow synchrony refers to precise matching of individual actions in both time and phase with another person (exact rhythmic matching of actions) (Mogan et al., 2017), emphasizing simultaneous and in-phase occurrence. Broad synchrony can include both in-phase and anti-phase synchrony. For example, when two people simultaneously raise their right arms at the same speed and then simultaneously raise their left arms at the same speed, this constitutes in-phase synchrony. However, if both maintain the same rhythm but one raises the left arm while the other raises the right arm, they exhibit different phases but identical frequencies, representing anti-phase synchrony. Although both in-phase and anti-phase are stable coordination patterns, in-phase synchrony proves more stable (Rennung & Göritz, 2016).

1 The Influence of Interpersonal Synchrony on Cooperation

A growing body of research demonstrates that interpersonal synchrony promotes cooperative behavior. Anshel and Kipper (1988) first observed the positive effects of group singing on trust and cooperation, finding that listening to music together enhanced interpersonal trust, while synchronized activities increased cooperative behavior in prisoner' s dilemma games. Wiltermuth and Heath (2009) designed three experiments examining synchrony' s impact on cooperation. Their first two experiments, using walking tasks and a "cups and music" task to manipulate interpersonal synchrony, revealed that individuals in synchronized conditions showed significantly higher expectations of others' cooperation in Weak Link Coordination Exercises compared to asynchronous groups. Their third experiment found similar promoting effects of synchrony manipulation on cooperative behavior in public goods dilemmas, where individuals who synchronized with others maintained high levels of cooperation even when personal sacrifice was required.

Reddish, Fischer, and Bulbulia (2013) extended cooperative behavior measurement from public goods games to stag hunt games, further identifying the importance of shared intentionality in promoting cooperation within synchronized groups. They found that the highest cooperation levels emerged when synchronized actions combined with shared intentionality, suggesting that synchrony driven by collective goals more powerfully promotes cooperation. Previous research on the relationship between interpersonal synchrony and cooperation indicates that dyadic synchrony (Cross et al., 2019; Rabinowitch & Meltzoff, 2017; Valdesolo et al., 2010), group synchrony involving three or more people (Good et al., 2017; Reddish, Fischer, & Bulbulia, 2013; Sullivan et al., 2015), and even large-scale group synchrony (Jackson et al., 2018; von Zimmermann & Richardson, 2016) can all enhance cooperative behavior. Moreover, this promoting effect appears in both classic cooperative experimental paradigms (such as prisoner' s dilemma and public goods games) (Cross et al., 2019; Fischer et al., 2013; Good et al., 2017; Sullivan et al., 2015) and real-life cooperative behaviors (such as collaboratively completing a task) (Jackson et al., 2018; Rabinowitch & Meltzoff, 2017; von Zimmermann & Richardson, 2016). Meta-analyses reveal

that synchrony' s promoting effect on cooperative behavior can reach an effect size of 0.25 (Vicaria & Dickens, 2016).

From a developmental perspective, when does synchrony' s promoting effect on cooperation begin? Research shows that 12-month-old infants already display preferences for synchrony, showing greater liking for toys that move in synchrony with themselves (Tunçgenç et al., 2015). Four-year-old children exhibit more voluntary helping and spontaneous cooperative behavior following synchronized music-making activities (Kirschner & Tomasello, 2010). Compared to asynchronous movement or no-movement groups, prior experience with synchronized movement enhances cooperative capacity in 4-year-old children, with synchronized groups completing cooperative tasks (joint button-pressing tasks and "give-and-take" tasks) with unfamiliar peers more rapidly. Synchronized experience increases intentional communication between partners, thereby generating more coordination and cooperation (Rabinowitch & Meltzoff, 2017).

2 Process Mechanisms of Synchrony Promoting Cooperation

How does synchrony promote cooperation? Existing literature suggests researchers have explained this promoting process from four main aspects: neurophysiological system activation provides the physiological foundation; enhanced cognitive sensitivity establishes the psychological basis; strengthened social connectedness and evoked positive emotions facilitate positive interpersonal interactions.

2.1 Activation of Neurophysiological Systems

First, physiological synchrony resulting from behavioral synchrony contributes to group bond formation. Research comparing electrocardiogram data and self-reported group cohesion during three-person synchronized versus asynchronous drumming found that both behavioral and physiological synchrony predicted perceived group cohesion, but only physiological synchrony predicted subsequent cooperation (Gordon et al., 2020). Different types of physiological synchrony may serve distinct functions. During face-to-face prisoner' s dilemma games, both heart rate and skin conductance synchronized between dyads, yet only skin conductance synchrony predicted cooperation (Behrens et al., 2020).

Second, the brain's reward system, including neural structures involved in desire and motivation, creates a positive feedback loop that plays a role in synchrony effects. fMRI research examining synchrony' s impact on cooperative behavior found that after drumming in synchrony with others, individuals showed greater willingness to help their drumming partners, with the caudate nucleus activated during synchronized drumming, indicating reward system involvement. In other words, synchronized behavior activates the brain' s reward system, thereby prompting individuals to help companions more frequently (Kokal et al., 2011).

Finally, neurobiological theories hypothesize that modulation of the endogenous opioid system influences social responses (Mogan et al., 2017). The β-endorphin release hypothesis suggests that synchrony activates the endogenous opioid system, leading to increased affiliation and social reward behaviors (Loseth et al., 2014). Pain threshold commonly serves as an indicator of endorphin levels, as elevated endorphins increase pain thresholds. Increased pain thresholds following synchrony indicate endogenous opioid system activation. Several studies on interpersonal synchrony, including collective rowing (Cohen et al., 2010), synchronized singing (Weinstein et al., 2016), drumming (Dunbar et al., 2012), and dancing (Tarr et al., 2016), have all found increased pain thresholds after synchronizing with others. Lang et al. (2017) distinguished between attitudinal effects (synchrony promoting increased liking) and behavioral effects (synchrony promoting trust-based cooperative behavior) of synchrony' s prosocial impact, finding significant positive correlations between pain threshold increases and prosocial indicators such as liking and cooperation. In other words, synchrony may increase cooperative behavior in trust games by elevating pain thresholds. However, Sullivan et al. (2015) found no mediating effect of pain thresholds, possibly because their study used synchronized movement on treadmills, where pain threshold measurement (via non-invasive blood pressure cuffs) was limited in such activities.

2.2 Enhancement of Social Connectedness

Synchronized behavior serves as an important source of social information. Interpersonal synchrony possesses specific kinematic properties that can promote social bonding and shape social perceptions (Macpherson et al., 2020). Social bonding represents an individual' s self-perception of intimacy in interpersonal relationships and constitutes an important component of belongingness (Zou Xiaoyan et al., 2018). Existing research has measured social bonding through dimensions including trust, entitativity, interconnectedness, intimacy, attractiveness, similarity, liking, affiliation, rapport, cohesion, sense of belonging, and identification. Meta-analyses reveal small positive effects of synchrony on perceived social bonding (Mogan et al., 2017; Rennung & Göritz, 2016). Specific effects can be categorized into three aspects:

First, synchrony can increase liking, affiliation, or closeness between partners. Hove and Risen (2009) invited participants to tap the same rhythm or different rhythms with an experimenter, finding that participants preferred experimenters who synchronized with them. Synchrony can also reduce prejudice and increase closeness, making individuals more eager to see their companions again (Atherton et al., 2019). A study using immersive virtual reality found that participants in synchronized conditions reported significantly higher social intimacy with virtual co-participants than those in asynchronous conditions, demonstrating that synchrony' s positive effects remain robust even in virtual environments (Tarr et al., 2018).

Second, synchrony can promote empathy or trust toward others. Valdesolo and

DeSteno (2011) found that individuals showed greater empathy toward synchronized others compared to asynchronous others, with perceived similarity mediating this effect. Synchrony makes individuals feel more similar to and trusting of other group members (Wiltermuth & Heath, 2009). This suggests that synchrony may form a fundamental signal through which the brain interprets similarity or unity between the self and synchronized others, subsequently adjusting emotional responses and moral behavior.

Third, synchrony can promote collective social identity. Synchronized movement with others enhances collective social identity, thereby increasing within-group cooperation (Good et al., 2017). However, high levels of synchrony may also produce negative effects. Highly synchronized participants made more lenient judgments about synchronized others' illegal behaviors compared to low-synchrony or asynchronous participants, with perception of group unity mediating this pathway (Chvaja et al., 2020). Additionally, the "mutual social attention system" between companions, involving temporoparietal junction connectivity and/or prefrontal cortex coupling between individuals, can facilitate social interaction and integration, enhancing the ability to adapt to specific interactions, partners, and goals (Gvirts & Perlmutter, 2019).

2.3 Enhanced Cognitive Sensitivity

Synchrony' s influence on cognitive processes involves attention, memory, theory of mind, perceptual sensitivity to tasks, and perceived freedom, but its promoting effects related to cooperation manifest primarily in two aspects. First, synchrony can improve perceptual sensitivity. Valdesolo et al. (2010) found that synchronized swaying enhanced individuals' perceptual sensitivity to other entities' movements, thereby facilitating success in cooperative tasks using a wooden maze experiment. Perceptual sensitivity fully mediated synchrony' s effect on cooperative tasks, suggesting that synchronizing with others can increase the likelihood of future cooperative success by enhancing perceptual sensitivity to and responsiveness toward companions' activities. Second, interpersonal synchrony can promote mentalizing—the inference of others' mental states. In social interactions, inferring and attending to others' psychological needs and states facilitates prosocial behaviors like cooperation. However, this promoting effect only applies to inferences about synchronized others and does not generalize (Baimel et al., 2018).

Current research has devoted limited attention to cognitive processes in synchrony' s promotion of cooperative behavior. However, according to self-other representational overlap theory, which conceptualizes self-other overlap as a cognitive phenomenon (Zi Hongyan & He Jiamei, 2019), interpersonal synchrony can promote the fusion of conceptual representations of self and others. Therefore, the role of attention and cognitive sensitivity in synchrony' s promotion of cooperation requires further investigation.

2.4 Elicitation of Positive Emotions

Interpersonal synchrony promotes the elicitation of positive emotions. Synchronizing with others makes individuals feel good and generates positive emotions (Galbusera et al., 2019; Mogan et al., 2017, 2019; Tschacher et al., 2014), with meta-analyses revealing moderate positive effects of synchrony on positive emotions (Mogan et al., 2017). Existing literature typically measures positive emotions through dimensions including positive affect, general life satisfaction, and well-being. Synchrony positively correlates with positive emotions and negatively correlates with negative emotions, with this relationship being stronger when all synchronizers are female (Tschacher et al., 2014). Positive emotions play important roles in social interactions and can positively predict individuals' cooperative behavior (Rand et al., 2015), suggesting that synchrony may also promote cooperation by enhancing positive emotions. However, some studies have found that synchrony with others does not increase pleasure (Reddish, Fischer, & Bulbulia, 2013; Wiltermuth & Heath, 2009), or that individuals show increased positive emotions and decreased negative emotions regardless of whether they synchronized or moved asynchronously (Tarr et al., 2016). This indicates that the activity itself rather than synchrony may promote positive emotions, though this speculation requires further empirical support.

In summary, synchrony' s promotion of cooperation manifests not only in cognitive and emotional changes but also in physiological responses and social bonding. However, because each empirical study explores different target questions and focuses, most findings can only be presented in parallel, unable to reveal associations between factors, compare differences in their modes of action, or uncover potential interactive influences. Given the complexity of interpersonal interaction, synchrony' s influence on cooperation constitutes a complex process that single studies cannot fully elucidate.

3 Explanatory Models of Synchrony Promoting Cooperation

Based on process analyses of synchrony's promoting effects, previous researchers have proposed three model hypotheses from different perspectives: the self-other representational overlap model suggests that individuals develop connectedness through perceiving similarity between self and others' representations and behaviors, thereby promoting cooperation; the cooperation reinforcement model posits that emphasizing common goals and increasing joint attention enhances individuals' positive expectations, thus promoting cooperation; and the collective effervescence model proposes that synchronizing with others creates a positive emotional atmosphere in which individuals generate positive emotions and identity, thereby promoting cooperation. Building on these three models and integrating relevant literature on synchrony and cooperation, this paper proposes a comprehensive model (see Figure 1) that incorporates different process mechanisms and potential boundary conditions through which synchrony promotes

cooperation.

3.1 Self-Other Representational Overlap Model

Temporal coordination of individual behavior involves constructing and guiding boundaries between self and others (Baimel et al., 2018). Aron et al. (1991) first proposed the concept of self-other overlap, also known as the blurring-of-self model. This model suggests that as people engage in synchronized activities, boundaries between self and others become blurred. Individuals may gradually reduce distinctions between themselves and others, even incorporating others into the self and treating others' resources, perspectives, and traits as their own, resulting in overlapping information representations when representing others and the self (Zi Hongyan & He Jiamei, 2019). Self-other overlap can promote helping behavior, with higher degrees of overlap corresponding to longer helping durations and greater willingness to help (Zhong Yiping et al., 2015). Precise synchrony, with its time- and phase-locked properties, more strongly inhibits self-other boundaries.

Extensive neural encoding can be amplified by synchronized behavior, and after a certain degree of cognitive processing, may lead to mixing of other-generated and self-generated behaviors (Paladino et al., 2010). According to the Perception Action Model, synchrony drives social perception (Behrens et al., 2020), and perceiving interaction partners as part of oneself may result in feeling psychologically closer to them (Fischer et al., 2013; Overy & Molnar-Szakacs, 2009). Synchrony' s impact on bonding perception supports this notion (Atherton et al., 2019; Chvaja et al., 2020). While direct evidence from cooperation research remains limited, studies have found that self-other overlap importantly explains synchrony's influence on prosociality. In trust games, self-other overlap mediates the effect of synchrony on liking of synchronized others (Lang et al., 2017). Feng et al. (2020) further used fNIRS to examine synchrony' s impact on prosocial behavior in dictator games, finding that compared to control groups, synchronized dyads showed higher behavioral synchrony, interpersonal neural synchronization (INS) in the right prefrontal cortex, self-other overlap, perceived similarity, and affinity. Both self-other overlap and INS served as serial mediators in the effect of behavioral synchrony on prosocial behavior.

3.2 Cooperation Reinforcement Model

Social bonding originates from group-centered social cognition. Synchronized action increases social allocation of attention, making individuals more attentive and responsive to group members' behaviors (Macrae et al., 2008), thereby strengthening social bonds between group members (Wolf et al., 2015) and transforming perceived social cohesion into joint action. Reddish, Fischer, and Bulbulia' s (2013) reinforcement of cooperation model posits that when synchronized action combines with common goals, it raises cooperation expectations and further enhances cooperative behavior. When forming a common goal of synchrony, the perception of synchrony provides immediate feedback for successful

cooperation—the more synchrony perceived, the stronger the feeling of cooperative success, which further reinforces cognition of group solidarity. Individuals consequently experience greater trust and confidence from the group, believing that other group members will choose cooperation, thereby strengthening the group' s cooperative tendency.

Reddish, Fischer, and Bulbulia (2013) verified that synchrony's effects are indeed driven by perceptions of successful cooperation, which increase confidence and trust that then transfer to future cooperative tasks. The researchers compared cooperative behavior across four conditions: synchrony, asynchrony, passive observation, and shared intentionality (treating synchrony as a group common goal). They found that shared intentionality produced the highest cooperation levels, with participants in the common goal condition feeling closer to group members compared to other conditions. This indicates that jointly striving to create synchrony makes individuals feel more integrated with the group, and when synchrony combines with shared intentionality, individuals' cooperativeness significantly increases. Subsequent research demonstrated that perceived cooperation levels importantly mediate the relationship between synchrony and liking of interaction partners, such that interpersonal synchrony increases individuals' perceptions of others' cooperation, which in turn increases liking of cooperative partners (Lang et al., 2017).

3.3 Collective Effervescence Model

Synchronized behaviors in human life, such as square dancing or group singing, often generate uplifting emotions and even excitement. The concept of collective effervescence first appeared in Durkheim' s (1915/1968) description of collective rituals, referring to the process of increasing positive emotions and social cohesion through energetic group activities (Jackson et al., 2018). Collective effervescence can evoke individuals' group identity consciousness. Durkheim stated, "Once individuals gather together, a kind of electricity is generated from their proximity that quickly launches them to an extraordinary height." Building on this, the Hive Hypothesis proposes that when a person immerses themselves in a social group, their well-being increases (Haidt et al., 2008). Interpersonal synchrony involves individuals moving with identical rhythm and amplitude, during which individuals easily immerse themselves in the synchronized group, generating emotions or feelings such as pleasure and happiness. Since positive emotional experiences positively predict cooperation (Dou Kai et al., 2018), individuals may become more cooperative and dedicated to the collective after synchrony, prioritizing group interests. Although few studies have validated the collective effervescence model, and some have even found no emotional differences (Tarr et al., 2016; Wiltermuth & Heath, 2009), many researchers acknowledge this model' s plausibility (Gelfand et al., 2020; Mogan et al., 2017; Tunçgenç & Cohen, 2016). First, according to the definition of collective effervescence, this collective excitement serves adaptive functions for society. Second, laboratory synchrony differs substantially from real-world

synchrony (Mogan et al., 2017), as experimental manipulations of synchrony often deliberately control for other factors (e.g., emotion), making laboratory synchrony (such as walking or mechanical arm movements) more monotonous, whereas real-life synchrony, particularly collective rituals, may inherently possess rich emotional coloring.

These three models both differ from and contain internal connections with each other. Some researchers suggest that group size may affect different models' roles by influencing attentional dispersion, with small groups being more suitable for the self-other representational overlap model, while large groups may be better explained by the collective effervescence model (Mogan et al., 2017). Although the three models each emphasize different aspects of synchrony effects, their core involves viewing synchronizers as a unified whole. During interpersonal synchrony, individuals experience not only behavioral similarity but also gradual cognitive and emotional connection and integration with synchronizing partners, psychologically forming approach, identification with, and belonging to the new group. This resembles Michael et al.' s (2020) description of mechanisms through which coordination promotes prosociality. First, coordination generates prosocial motivation through concern for others' well-being, trust, and a sense of commitment to perform an action. Second, coordination helps individuals identify targets for prosocial behavior at both group and individual levels, strengthening prosocial motivation and thereby promoting prosocial behavior. At the group level, an important function of coordinated behavior is expressing similarity among individuals, which can occur at three levels: behavioral (doing the same thing simultaneously), goal (common goals), and attentional focus (joint attention). Regardless of the level, coordination' s prosocial effects arise from group identification. At the individual level, coordinated behavior conveys important cues about companions' capabilities and willingness, with successful coordination indicating high capability and willingness to adjust one' s behavior for others. Inspired by Michael et al. (2020), this paper integrates and constructs a psychological process model of synchrony promoting cooperation (see Figure 1).

Figure 1. Psychological Process Model of Synchrony Promoting Cooperation

According to this model, synchrony can promote cooperation both directly by generating cooperative motivation and indirectly by clarifying cooperative targets and thereby strengthening cooperative motivation. Synchrony' s creation of common behavior, common goals and attention, and positive emotional atmosphere can promote group identity identification. Simultaneously, synchrony conveys important cues about companions' capabilities and their degree of willingness to change for others. Perceiving someone as a group member and receiving positive cues from others may evoke individuals' concern, liking, trust, and sense of commitment, thereby increasing cooperative motivation and behavior. Although interpersonal synchrony' s promoting effect on cooperative behavior has been verified across different laboratory and real-world contexts—indicating

certain universality of this effect—synchrony' s promoting effect on cooperation remains influenced by numerous variables related to individuals, synchronizing partners, and contexts. Cooperative motivation does not equal cooperative behavior, and the same motivation may differently trigger cooperative behavior across cooperation types. Trust forms the foundation of cooperation and stably predicts different cooperation types. Concern for others'well-being reflects attention to others' interests central to cooperation concepts and may thus promote different cooperation types, especially cooperation in situations where personal and collective interests conflict. Liking and commitment show less stability and may be more susceptible to cooperation context and other factors, thus functioning differently across cooperation types, though this requires further verification. Therefore, future research must validate different psychological pathways and their boundary conditions in the proposed model.

4 Future Research Directions

The causal link between synchrony and cooperation was established relatively recently (Anshel & Kipper, 1988; Wiltermuth & Heath, 2009), and existing research remains limited with inconsistent findings. For instance, in a replication of Wiltermuth and Heath (2009), Schachner and Garvin (2010) employed single-blind manipulation of experimenters and found no promoting effect of synchrony on cooperation. Cohen et al. (2013) examined the interaction between synchrony and secular/religious priming on cooperative behavior, finding that only religious priming promoted cooperation while synchrony had no effect. The reason may be that their study used drumming as a synchrony manipulation with simple, repetitive, small-amplitude movements of short duration, producing insufficient synchrony intensity to generate conditions for promoting cooperation. This study also found no increases in pain thresholds, similarity feelings, or positive emotions following synchrony. Tarr et al. (2016) similarly found no increase in donations in economic games after synchrony, possibly because participants learned synchrony movements individually before acting according to music and instructions through headphones, thereby reducing attention to others. These results all indicate that synchrony' s promoting effect on cooperative behavior is susceptible to interference from other factors, warranting further exploration in future research.

First, the durability and generalizability of synchrony's promoting effect on cooperative behavior require further verification. Current measurements of prosocial behaviors like cooperation and helping are implemented immediately after synchrony (Atherton et al., 2019), and some studies have examined synchrony' s promoting effects on social-emotional and cognitive functions in counseling and intervention contexts (Feniger-Schaal et al., 2020; Keisari et al., 2020). However, how long synchrony' s influence on cooperation lasts and whether it can serve as an effective means to promote cooperation levels and abilities still requires more research evidence. Additionally, can synchrony' s prosocial effects generalize? Some researchers argue that synchrony' s prosocial effects are specific in direc-

tion, with individuals showing prosociality only toward ingroup members (Tarr et al., 2015). However, others have found that when third parties are shown to have specific connections with synchronized others (e.g., being friends), they receive more help even without synchronizing with participants (Cirelli et al., 2016). Synchrony can even induce generalized prosociality toward nonsynchronized individuals or groups (Reddish, Bulbulia, & Fischer, 2013; Reddish et al., 2016).

Second, mechanisms underlying synchrony' s influence on cooperation may coexist complementarily, and synchrony' s effects may be moderated by other factors. For example, self-other overlap and perceived cooperation moderate synchrony' s effect on interpersonal liking, while trust behavior is moderated by changes in pain thresholds (Lang et al., 2017). Different neurocognitive and affective psychological mechanisms may mediate synchrony' s effects on different responses, with such mediation moderated by group size (Mogan et al., 2017). Research manipulating both synchrony and physiological arousal found that synchrony and arousal jointly predicted future formation of larger, tighter group gatherings and higher cooperation levels in dilemmas (Jackson et al., 2018; von Zimmermann & Richardson, 2016). Other studies found that people from different cultural backgrounds showed higher cooperation after synchrony, while those from the same cultural background did not (Cross et al., 2019). This may suggest that synchrony' s promoting effect on cooperation may be masked in certain situations—when synchronized individuals already possess obvious and strong social connections, synchrony' s prosocial effects may become nonsignificant. Future research must further explore moderating mechanisms of synchrony effects, revealing influences of multiple factors including social identity, group size, cooperation behavior type, and cultural background.

Third, few studies have examined differences between types of synchrony and between synchrony and other coordinated movements in their effects on cooperation. Do synchrony types (e.g., behavioral synchrony vs. emotional state synchrony, unintentional vs. intentional synchrony) influence cooperation promotion? Research has found that jointly experiencing the same negative emotional events promotes cooperative behavior—shared adversity strengthens alliances (Miao Xiaoyan et al., 2021)—and even when individuals share the same clothing status, group cohesion and coordination increase (Yang et al., 2020). Additionally, mimicry can also promote social cohesion through increased liking, connection, and rapport, but may serve different social functions than synchrony. Previous research found that synchrony can occur under fully conscious, explicit instructions, whereas in mimicry, only when the mimicked person is unaware of being mimicked do positive social consequences emerge in interpersonal interactions (Valdesolo et al., 2010). Therefore, future research must further clarify the specificity of synchrony effects.

Finally, interpersonal synchrony may also have antisocial effects, such as weakening individuals' emotion regulation abilities (Galbusera et al., 2019), damaging connections with outgroups and causing intergroup bias (Zou Xiaoyan et al.,

2018), and stimulating group conflict, reducing group creativity, and increasing harmful obedience (Gelfand et al., 2020). High synchrony amplifies ingroup preferences, leading to unjust application of moral norms (Chvaja et al., 2020). Future research should focus on how to effectively increase synchrony's prosocial functions while reducing antisocial risks. For instance, synchronized activities in interpersonal interactions may help overcome the initial pain of interacting with strangers and ultimately increase social bonding and trust-based cooperation.

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Figures

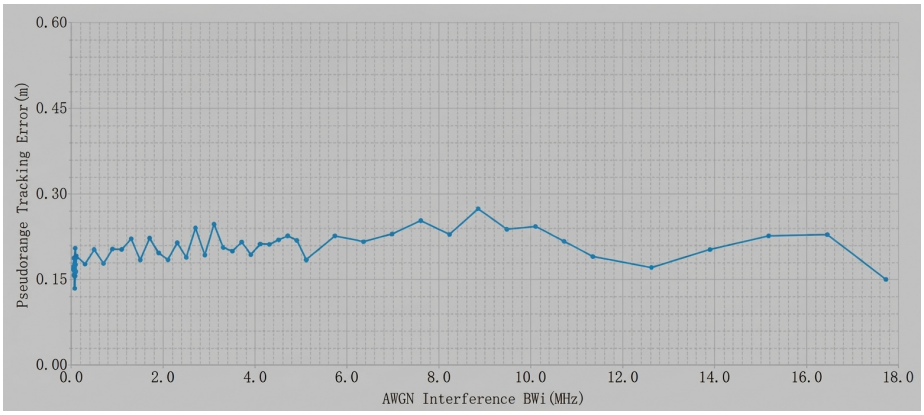

Figure 1: Figure 1