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FlashReport

The rhythm of joint action: Synchrony promotes cooperative ability

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ABSTRACT

Although evidence has suggested that coordinated action enhances rapport and fosters cooperation, the possibility that it might also influence the *ability* to pursue joint goals has yet to be demonstrated. We show that rocking in synchrony enhanced individuals' perceptual sensitivity to the motion of other entities and thereby increased their success in a subsequent joint-action task that required the ability to dynamically detect and respond appropriately to a partner's movements. These findings support the view that in addition to fostering social cohesion, synchrony hones the abilities that allow individuals to functionally direct their cooperative motives.

Introduction

Soldiers march in step because it builds camaraderie. But could it also make them better marksmen? Better at surrounding enemies? Might ritualistic dances preceding hunts or combat serve not only to induce a sense of collective emotion, but also to improve precision in battle skills? Past research has shown that synchronized movement increases rapport, liking, and prosocial behavior (Bernieri, 1988; Miles, Nind, & Macrae, 2009; Valdesolo & DeSteno, submitted for publication; Wiltermuth & Heath, 2009). Yet, the possibility that coordinated action not only facilitates the motivation but the *ability* to pursue joint goals with others remains a tantalizing unexplored question. Beyond interesting us in the well-being of synchronized others, moving together in time might hone the perceptual and motor skills necessary for success in collaborative endeavors.

Past findings have lent support to the theory that moving together in time serves as a cooperation-enhancing mechanism, binding individuals together into adaptive units of reciprocal exchange (Haidt, Seder, & Kesebir, 2008; McNeill, 1995; Wilson, Van Vugt, & O'Gorman, 2008). In combination with research demonstrating the influence of non-conscious mimicry on liking, affiliation, altruism and interdependence, a growing body of evidence supports the role of coordinated action as a "social glue" (Ashton-James, van Baaren, Chartrand, Decety, & Karremans, 2007; Stel, van Baaren, & Vonk, 2007; van Baaren, Holland, Kawakami, & van Knippenberg, 2004). Given this, it is tempting to conclude that the adaptive function of coordinated action lies solely in its ability to induce a collective spirit, as so doing would motivate the mutually beneficial exchanges and collaborations characteristic of reciprocal altruism (cf. Trivers, 1971) However, for certain types of tasks the motivation to cooperate might not be the sole, or primary, determinant of attaining a joint goal. While synchrony may induce a collective spirit, it might also sharpen the individual skills necessary to translate that spirit into success in joint action.

Synchrony has been found to facilitate incidental memory for the speech and appearance of interaction partners (Macrae, Duffy, Miles, & Lawrence, 2008), but perhaps the most obvious dimension of person-perception that it should facilitate is attention and responding toward the physical movement of other entities. As others have argued, sensitivity to the movements of another combined with the ability to generate complementary actions at the appropriate time constitute the essential components required for synchronizing action (Richardson, Marsh, Isenhower, Goodman, & Schmidt, 2007; Sabenz, Bekkering, & Knoblich, 2006; Schmidt & O'Brien, 1997). Given that the same capacities that underlie synchronization are theorized to also support joint action (e.g. cooperative juggling; Sabenz et al., 2006), we believe that engaging in the temporal organization of behavior via synchrony should subsequently enhance the ability to temporally organize movement in tasks requiring joint action. In other words, attending to and coordinating with the motion of another entity in one context might enhance a basic ability to accomplish a similar goal in a different context. Consider two hunters closing in on a prey. They must be able to gauge the speed and trajectory of the other's movement in relation to the prey and adjust their own speed and trajectory appropriately. Accordingly, we hypothesized that synchronization

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with others would improve perceptual sensitivity to the motion of other entities and thus promote performance on a future separate joint-action task.

To examine this hypothesis, we developed a paradigm in which dyads of synchronized or asynchronized participants completed a computerized measure of perceptual sensitivity and then engaged in a joint-action task for which success was determined by the collective ability of the participants to dynamically detect and respond accordingly to the movements of the other participant. To the extent that synchrony allows one to practice attending to the movements of another and coordinate one's movements accordingly, it should predict more general perceptual sensitivity that in turn should facilitate joint action. Measures of connectedness with and similarity to synchronized or asynchronized others were collected as well in order to rule out the possibility that any synchrony-induced facilitation of joint action was a result of feelings of rapport or closeness between members of the dyad, and thus a function of a motivation to collaborate with the other.

Methods

Ninety-two participants were run in pairs and assigned to one of two conditions: synchrony or asynchrony. All participants completed an individual measure of perceptual sensitivity as well as a dyadic measure of joint performance, which served as the primary dependent variables.

Participants were told that the experiment was interested in the effects of heart rate on perceptual ability and motor skills. They first completed a practice version of the computer-based perceptual sensitivity task so as to familiarize them with the procedure. Participants sat in front of a 24-in. display showing a black screen with a blue ball on the left hand side and a solid yellow rectangle in the middle. The blue ball passed from the left side to the right side of the screen at a constant pace, passing behind the yellow rectangle. The task was to determine on each trial whether the ball continued at its pace while obscured behind the rectangle or if it briefly paused, causing a delay for its appearance at the other end. Participants responded "yes" for a delay, or "no" for no delay on individual response sheets. Participants then were told that in order for the experimenters to study the influence of elevated heart rate they would rock in rocking chairs for one and a half minutes. In the synchrony condition, chairs were positioned side-by-side and participants were told to rock in synchrony so as to keep activity level constant. In the asynchrony condition chairs were set up back to back to minimize the possibility of unintentional synchrony (cf. Richardson, Marsh, & Schmidt, 2005) and participants were simply told to rock for a minute and a half. Participants then completed the target version of the perceptual sensitivity task, which included 21 randomized trials varying in delays from 0 to .6 s.[1] This was followed by another round of rocking, and finally the joint-action task.

In the joint-action task, participants held opposite ends of a 12×14 wooden labyrinth with both hands while the experimenter timed how long it took them to collectively move a steel ball from the start of the labyrinth to the finish along a pre-determined path. All but one route from the start to the finish of the labyrinth were blocked by walls such that the ball travelled along the same route for all dyads. Success in this task required the ability to dynamically detect and respond appropriately to the movements of one's partner. Finally, participants were separated and completed personality evaluations of their partners, including questions assessing *similarity, connectedness*, and *liking* on 7-point likert scales.

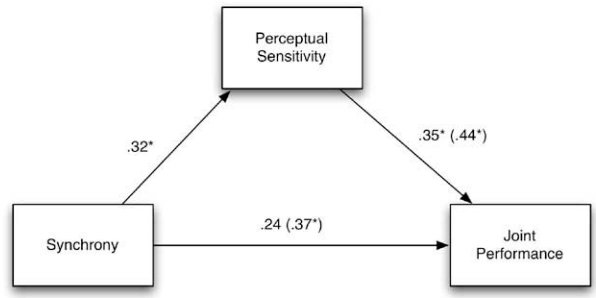

Fig. 1. Path analysis for impact of synchrony on perceptual sensitivity and joint performance. Numbers in parentheses represent zero-order correlations. $^*p < .05$.

Results

Eight dyads were removed due to problems with the synchronization manipulation or highly discrepant scores on the perceptual sensitivity task.[2] Individuals were assigned an accuracy score calculated by summing the number of correct responses across 21 trials of the perceptual sensitivity task. In accord with predictions, synchrony increased perceptual sensitivity of temporal movement ($M_{synchronous} = 13.88$, $M_{asynchronous} = 11.97$, $t(36) = 2.34$, $p = .02$)[3] and decreased the overall time it took dyads to complete the joint-action task ($M_{synchronous} = 27.99$ s, $M_{asynchronous} = 32.75$ s, $t(36) = 2.35$, $p = .02$). In addition, synchrony-induced increases in perceptual sensitivity mediated the relation between synchrony and enhanced success on the joint-action task (see Fig. 1), Freedman–Schatzkin $t(36) = 2.48$, $p < .05$.[4] Including perceptual sensitivity in the model reduced synchrony's ability to predict joint action to non-significance, suggesting that its effect on performance on the labyrinth task is driven by the increased general perceptual ability at the individual level. Although synchrony also increased perceptions of similarity, $t(74) = 2.24$, $p = .03$, and feelings of connectedness, $t(74) = 4.15$, $p < .001$, these measures were not predictive of success on the joint-action task.[5]

Discussion

Evidence of synchrony's influence on perceptual and motor ability adds to the growing literature on the social function of coordinated movement in several important ways. The distinction between the effects on social outcomes of synchrony and other forms of coordinated action such as non-conscious mimicry thus far has remained unclear. Both have been found to facilitate social cohesion by increasing liking, affiliation, and rapport. Indeed, we also found an influence of synchrony on the related variables of

[1] The task included five trials of 0.2, 0.3, and 0.4 s delays and 2 trials of 0, 0.5, and 0.6 s delays. These intervals were determined from pretesting that demonstrated that the most variability in responses for delays occurred from 0.2 to 0.4 s.

[2] Five dyads in the asynchrony condition were removed from analysis as the rocking of their chairs synchronized, most likely due to attention to audible cues of rocking. On occasions when this happened, participants synchronized and remained synchronized for the remainder of the manipulation. Three dyads in the synchrony condition were removed due to highly discrepant scores of one participant on the perceptual accuracy task.

[3] Participants' scores were analyzed using a multilevel model with individuals nested within dyads to control for any intra-dyadic dependencies.

[4] Given that performance on the joint-action task was a dyad-level score, we calculated a dyad-level perceptual sensitivity score by averaging the scores of the members of each dyad.

[5] Though participants were instructed not to sign up with individuals they knew, a dichotomous measure was included to ensure any differences across conditions were not the result of prior familiarity. Excluding dyads that had an individual who reported having met the other before did not affect any of the results.

perceived similarity and connectedness. It is possible, then, that success in achieving joint goals is driven by this enhanced sense of collective spirit, and that mimicry might also predict cooperative ability.

However, there are important phenomenological distinctions between synchrony and mimicry that suggest these two types of coordinated action might serve distinct social functions. Mimicry leads to positive social consequences within the context of an interpersonal interaction and as long as mimickees are not consciously aware of the imitation (cf. Ashton-James et al., 2007). Conversely, previous work on synchrony suggests that its effects are not sensitive to constraints involving temporal delays or awareness of the intent for motor mirroring. Rather, it can occur under conditions of complete conscious direction and explicit instruction (Wiltermuth & Heath, 2009) and can operate without any pretext of a social context. Given that any influence on perceptual sensitivity requires explicitly attending to the motion of other entities, cooperative ability represents a social variable that should be affected exclusively by synchrony. The mediational analysis suggests as much by demonstrating that joint action requires the calibration of perceptual and motor skills, but operates independently from the greasing of social wheels.

Beyond representing a novel contribution to the literature on coordinated action, this finding is also particularly interesting given the considerable body of work showing that perception of an object's state activates corresponding neural representations in an observer (cf. Preston & de Waal, 2002). The output from such shared representations has been shown to proceed directly to motor areas of the brain facilitating the imitation of a perceived action, but also has been implicated in the emergence of prosocial emotional responses such as empathy. Examining the neural correlates of synchrony might elucidate the relationship between the processes underlying the motivation and the ability to cooperate with others.

There are several interesting avenues for future research that follow from this initial finding regarding the impact of synchrony on perception and joint performance. For example, the fact that synchrony enhances perceptual sensitivity on a task detached from any interpersonal interaction suggests that its influence on cooperative ability as mediated by perceptual sensitivity might generalize to performance on joint-action tasks with novel interaction partners. Indeed, any task for which sensitivity and dynamic responding to the motion of another entity is required could be facilitated via this causal path. It is possible, however, that an effect on cooperative ability mediated by the *motivation* to cooperate could be limited to synchronized others, especially given the demonstrated link between synchrony and perceptions of similarity with others. Future research might profitably tease apart the conditions under which synchrony's influence on cooperation generalizes to other interaction partners as a function of mechanism.

Furthermore, given the structure of our design, one might wonder whether cooperative action could have been facilitated by merely observing the motion of other entities absent physically mirroring them. There is reason to predict that merely observing someone engage in an action could facilitate cooperative performance on a joint task that involves *that same action*, given the growing body of work suggesting that the same processes are activated when observing an action and when performing that action (cf. Rizzolatti & Craighero, 2004). But it is less clear how mere observation would influence performance on a joint task that requires attending and responding to a series of novel movements. Past research has suggested that success in joint action does not solely stem from observing others behave but the ability to subsequently generate appropriate complementary actions at the appropriate time (Sabenz et al., 2006). Accordingly, we suspect that generating appropriate complementary actions at appropriate times on novel tasks requires not only practicing perceptual sensitivity to motion but also practicing dynamic responding to that motion. Nevertheless, separating the influence of mere observation from observation and dynamic responding on joint action would further elucidate the precise nature of synchrony's relationship to cooperative ability.

In sum, although synchrony facilitates important facets of social interaction such as rapport and feelings of connectedness, its functional import also derives from its ability to "tune" much more basic processes of the mind. For certain types of joint goals, the motivation to collaborate might not be enough to confer adaptive value. Synchrony equips individuals with the abilities to productively channel their cooperative spirit. This finding provides a window into the frequent use of synchronization in preparations for actions requiring complex motor skills (e.g. military drills, athletic warm-ups, and hunting rituals). Simply put, synchrony might not only bring people together, but also may bring them together to practice the very skills essential to achieving their goals.

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