

FROM KEEPING TOGETHER IN TIME, TO KEEPING TOGETHER IN MIND:
BEHAVIORAL SYNCHRONY AND THEORY OF MIND

by

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Abstract

Human cultural practices are, and have always been, profoundly ritualistic. Yet, only recently has the study of ritual practices gained favor in the psychological sciences. Specifically, there is great intrigue in exploring why certain ritual forms consistently emerge across cultural and historical boundaries as they often exert potent effects on human sociality, cooperation, and cohesion. For instance, culturally evolved collective rituals often involve some form of synchronized behavior. However, little is known about specific social cognitive effects of synchrony – the act of keeping together in time with others. Here, I hypothesized that synchronizing with others engages, and fosters, our everyday cognitive processes for reasoning about other minds – our theory of mind. To test this hypothesis, I first demonstrated that participation in a synchronous ritualized task in the lab produced increases on a measure of theory of mind. In a second study, I replicated this effect and demonstrated that it could not be accounted for by general increases in sociality. In a third experiment, I tested the hypothesis that synchrony would foster ability as well as tendencies towards mental state reasoning. The results of which suggest that synchronizing with others produces a willingness to take on others’ perspectives, but not necessarily greater ability to actually do so. Results are discussed in terms of how turning to culturally evolved practices, such as ritual, can greatly contribute to our understanding of human psychological processes.

Preface

The work presented in this thesis was covered by the UBC Behavioral Ethics Board certificate number H13-02524. With the permission of all involved parties, sections of the Introduction and Discussion are presented here as published in Baimel, Severson, Baron & Birch (2015). These sections have been elaborated upon substantially for this thesis. The three experiments presented in this thesis were designed and implemented by the author of this thesis, Adam Baimel. The analyses of all collected research data was conducted entirely by the author of this thesis, Adam Baimel.

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Dedication

To my friends, family, and colleagues who have probably heard much too much about the contents of this document.

Introduction

Humans are extremely strange, and they do extremely strange things for extremely strange reasons. If this isn't directly obvious, consider for a moment the 'sour toe ritual' of Dawson City, Yukon. After surviving a first Yukon winter, newly settled Dawson City residents head to the Sourdough Saloon for their true initiation into the local community. There, they will pledge the 'sour toe oath' amongst their peers before taking a shot of their preferred spirit. What makes this shot *so* special is that while individuals recite the oath – a blackened, dehydrated human toe is submerged into their glass. The ritual ends only when the shot has been finished, *and* the sour toe has made contact with the lips of the initiate. Local legends say that the original sour toe belonged to a 1920s rum-runner who lost his toe to frostbite while being pursued by police. Even more strikingly bizarre than the fact that over 100 000 individuals have completed this ritual since its inception in 1973, the Sourdough Saloon has since received at least ten replacement toes from individuals around the world that were keen to have their amputated digits become part of this local ritual (Pfieff, 2014).

One could argue that the strangeness of human life takes its quintessential form in widespread belief in legends, superstitions, religion, and perhaps, most strikingly, the ritualized behaviors and practices humans perform as expressions of those beliefs. Within and across the many domains of human cultural life, there exists immense diversity in the forms and functions of ritual behaviors. Much like in the case of the sour toe, humans use ritual to mark rites of passage, and other sorts of important life events – births, comings of age, marriages, and deaths, just to list a few. Humans use ritual to commemorate and

mark the passing of time with, for example, harvest festivals, equinoxes, solstices, and days of remembrance of past events and shared history. Furthermore, humans use ritual as a means to communicate and interact with the supernatural. Amongst many other motivations, be it to appease, to venerate, or to call forth some supernatural force or a specific supernatural agent – ritual stands as a foundational feature of religious life (e.g., Legare & Watson-Jones, 2015; Rappaport, 1999; Whitehouse, 2004).

Above and beyond their secular or religious contexts, collective ritual, that is participation in ritual actions *with* other people, is a pervasive and importantly, a psychologically interesting feature of human cultural life. By their very nature of being communal, collective rituals bring individuals together into a shared space and experience – creating a joint, and often sacred, purpose (Eliade, 1987). In as early as the 14th century, Muslim scholar Ibn Khaldûn observed that collective ritual, and especially that which is infused with religious ideology is particularly capable of creating, and with regular participation, sustaining social bonds between individuals (Khaldûn, c.1406/2004). Later in the West, Durkheim (1912/2008) made similar observations, and attributed ritual's ability to strengthen interpersonal relationships to the collective effervescence, or shared joy, experienced by those who participate. More generally, collective rituals have been demonstrated to have the curious ability to exploit our evolved social cognition in myriad ways that often foster a sense of affiliation, trust, cooperation and generally increase group solidarity (Henrich, 2015b; Norenzayan et al., 2014).

As such, the systematic study of the psychological foundations of human ritual practices can only enlighten our understanding of humanity's 'strangeness'. At one level

of explanation, documenting and accounting for the diversity in ritual practices can be of the utmost interest as the forms religious beliefs and rituals take are not fashioned ex-nihilo, they often emerge as solutions to local ecological concerns (e.g., Purzycki, 2013b). However, perhaps more important to the field of social psychology in particular, is accounting for the *invariance* amongst ritual practices – that is understanding why certain features of ritual regularly emerge across religious and secular domains, cultures, and consistently throughout the historical record. One such recurring feature of ritual is that of behavioral synchrony – the act of keeping together in time with others.

Behavioral synchrony and cooperation

In their seminal works, Ehrenreich (2006) and McNeill (1995) highlight the ubiquity of synchrony in music, dance and drill across various forms of collective ritual throughout the anthropological and historical records. From army drills, prayer prostrations, gospel singing, morning calisthenics in large Japanese corporations, circling the Hajj, circling the hearth, dancing the hora, to doing the wave at modern day sporting events – collective ritual practices the world over, and throughout time, are often marked by the presence of some form of synchronized behavior.

Specifically, Ehrenreich (2006) and McNeill (1995) propose that collective rituals involving synchronous actions are efficient cultural innovations for two primary reasons. Firstly, incorporating synchronized behaviors into collective ritual solves the problems of managing the physical bodies of increasingly large groups of individuals while simultaneously solving the problem of how to have these increasingly large groups of individuals remain involved in the ritual itself. Secondly, the authors propose that the act of synchronizing with others, in and of itself, has the peculiar effect of fostering a sense

of group solidarity, and promoting interpersonal cooperation. McNeill (1995) goes as far as to argue that the synchronicity of the army drill is one of humanity's greatest cultural innovations in terms of warring technologies – muscular bonding solidifies the ties between individual soldiers so that they can better fight whatever enemy is at hand.

In their now foundational studies, Wiltermuth & Heath (2009) empirically tested the core hypothesis laid out by Ehrenreich (2006) and McNeill (1995) that behavioral synchrony promotes cooperation. Wiltermuth & Heath (2009) cleverly manipulated synchrony by having participants take part in what they refer to as the 'cups and music task'. In this task, participants were instructed on how to ritualistically move cups across a table in groups of three while keeping to the beat of and singing along with a song. In the synchronous conditions, participants were all plugged into the same music player, and thus would hear the same beat at the same time. In the asynchronous conditions, participants were plugged into different music players – each loaded with a different tempo-ed version of the same song. Thus, in keeping to the beat of the music, only participants in the synchronous conditions would indeed synchronize in both their movements and the singing of the lyrics. Furthermore, across conditions participants were explicitly referred to as a group and told that their performance on the task would be assessed at the group level – instilling a sense of common identity and shared fate amongst all participants. Following this task, cooperation was assessed using a public goods game.

In a standard public goods game, participants are given a set of 10 tokens at the start of each round. Individuals can then choose to keep as much or as little of these tokens for themselves or they can decide to contribute them to the public goods account.

In this instance, a token in hand was worth 0.50\$ to the individual and nothing to the other players, where as any single token contributed to the public account would be worth 0.25\$ to all players. Given these configurations, the surest way to walk away with money at the end of five rounds of play is to keep all tokens for one's self. However, the *most* money can be earned if all players contribute consistently to the public goods account – from which all players can reap the rewards. Without any sort of interventions, cooperation, as measured by contributions to the public account, usually starts relatively high and decreases significantly throughout the rounds (Fehr & Fischbacher, 2003).

The synchronous groups, in this study, significantly out-cooperated the asynchronous groups as demonstrated by contributions made to the public account. Furthermore, those in the synchronous conditions reported feeling more committed to the group as well as scoring significantly higher on measures of liking of, similarity with and trust in one's fellow group members. Importantly, this heightened sense of group cohesion did not emerge when participants completed the cups task in an asynchronous manner – pointing to the effectiveness and specificity of behavioral synchrony in cultivating social cohesion above and beyond the effects of simply being part of a group (Wiltermuth & Heath, 2009).

Attesting to the robustness of the effect of synchrony on cooperative behaviors, this result has since been replicated in more naturalistic settings (Cohen, Ejsmond-Frey, Knight, & Dunbar, 2010) and amongst diverse cultural groups (Cohen, Mundry, & Kirschner, 2013; Fischer, Callander, Reddish, & Bulbulia, 2013). Further, the reported sensitivity to synchrony amongst conspecifics in promoting prosocial behaviors develops early (Kirschner & Tomasello, 2010) and emerges in infants as young as fourteen months

(Cirelli, Einarson, & Trainor, 2014). These converging lines of research provide strikingly clear evidence of how culturally evolved collective ritual practices around the world have galvanized this reliably emerging cognitive connection between synchronous action and sociality.

However, there remains little consensus in this rapidly growing literature regarding the precise mechanisms by which these effects occur. For instance, Wiltermuth & Heath (2009) proposed that synchrony fosters cooperation amongst previously unrelated others by fostering a sense of similarity and liking between group members. Although, there have been a number of alternative explanations for the effects of synchrony on cooperation: increased feelings of compassion and moral concern for those with which we have synchronized (Valdesolo & DeSteno, 2011); self-other blurring via multisensory integration (Paladino, Mazzurega, Pavani, & Schubert, 2010); integration and/or fusion of the other into the self (Miles, Nind, Henderson, & Macrae, 2010; Whitehouse & Lanman, 2014); increased affiliation and associated motivations (Hove & Rise, 2009); a sense of collective effervescence (Cohen et al., 2010; Haidt, Seder, & Kesebir, 2008); and perceived entitativity (Lakens, 2010; Lakens & Stel, 2011).

These proposed accounts of how synchrony fosters cooperation find empirical support within each of these respective studies. However, the existence of a potentially unifying mechanism that accounts for these distinct, albeit related mediating variables, has yet to be investigated. That is, what is it about synchrony that motivates these various effects? The answer to this question might be found in exploring what is often ignored across the now widely published literature documenting the effects of behavioral synchrony on cooperation. That is, the fairly substantial literature regarding the very

nature of behavioral synchrony itself as well as, more broadly, considering why it is that humans have the capacity *to* synchronize (and why we do it so often).

Why do we synchronize?

Synchronizing is a complex multimodal integration problem that humans are particularly capable of solving; we've got a knack for synchronizing our behavior with others and with signals in our environments (Konvalinka, Vuust, Roepstorff, & Frith, 2010; Overy & Molnar-Szakacs, 2009). Establishing synchrony, through spatiotemporal coordination to an external stimuli, is in and of itself a complicated dynamic task (Phillips-Silver, Aktipis, & Bryant, 2010). Yet, children within their first few years of life develop the ability to synchronize with others (Feldman, 2007; Kirschner & Tomasello, 2010). Early experiences of socially-contingent, imitative, and synchronous behaviors help define the boundaries between self and other, while simultaneously allowing for effective navigation of those boundaries in fostering efficient interpersonal coordination (Nadel, Prepin, & Okanda, 2005).

Across the lifespan, the ease with which we synchronize with others helps solve even the most mundane of joint coordination problems. Consider the complexity of the seemingly simple task of two separate minds and bodies figuring out how to lift and transport a heavy object. This requires those individual minds and bodies to perceive and react to each other, their respective movements and the constraints of the external world (Allport, 1924). Thus, sensory-motor coordination deficits can be problematic in everyday life. Interestingly, movement abnormalities in spatiotemporal coordination are some of the earliest known precursors to diagnoses along the autism spectrum (Grossberg & Seidman, 2006; Williams, Whiten, & Suddendorf, 2001) and are correlated to later

deficits in empathic ability (Piek & Dyck, 2004). This connection between synchronous action and shared mental experiences – from keeping together in time, to keeping together in mind – is one that we are only recently beginning to understand.

The mirror neuron system may play an important role in this connection between shared physical and mental experiences. The mirror neuron system, first discovered in non-human primates, is activated by both the perception and execution of actions (Iacoboni, 2009). This system is thought to play a critical role in allowing for efficient behavior-reading, as we, at least through neurological simulation, directly experience what the other is experiencing (Whiten, 1996). Interestingly, the human mirror neuron system is thought to be involved in much more than just behavior reading. Humans also engage this system, or at least correlates of this system, to *mentalize*. That is, the human mirror neuron system may play a role in the reverse engineering of the intentions and mental states of others from observable behavior through simulation (Frith & Frith, 2006). Synchronizing then, in the act of behaviorally keeping together in time with others, may put individuals in both the behavioral and mental shoes of others (Gallese, 2007).

A brief introduction to theory of mind

Philosophers have long debated the means by which we can, with any certainty, know of the mental worlds of others. This problem of *other* minds – that is *how* it is we think we know what other people know, feel and think – is not one that we can easily solve with logic alone (Dennett, 1981). However, throughout our evolution, humans have been endowed with the sufficient cognitive architecture that allows us to, at the very

least, reason about the minds of others – our ‘theory of mind’ (Baron-Cohen, 1999; Premack & Woodruff, 1978; Wimmer & Perner, 1983).

This capacity for understanding others’ behaviors in terms of underlying mental states allows us to be empathic (Schnell, Bluschke, Konradt, & Walter, 2011), makes us adept cultural learners (Chudek & Henrich, 2011; Herrmann, Call, Hernández-Lloreda, Hare, & Tomasello, 2007), and is involved in our moral reasoning (Moran et al., 2011; Young, Scholz, & Saxe, 2011), our ability to coordinate and cooperate (Sally & Hill, 2006), as well as our ability to compete with, or manipulate other individuals (Sher, Koenig, & Rustichini, 2014; Ybarra et al., 2010). Although this list is far from exhaustive, it should be clear that being an efficient mindreader facilitates successful navigation of the many challenges humans face in their socio-cultural environments. Indeed, those who are sometimes described as ‘mindblind’ – individuals diagnosed along the autism spectrum – often experience tremendous hardships in everyday social interactions (Baron-Cohen, Leslie, & Frith, 1985).

Notably, being *able* to reason about other minds does not necessarily equate to being *accurate* at mindreading. Specifically, our reasoning about other minds is often inaccurate in one of two ways. For instance, when thinking about others’ minds could be most informative, such as when taking directions, we often fail to do so all together (Keysar, Lin, & Barr, 2003; Samson & Apperly, 2010). Further, it is (extremely) common for individuals to think about and ascribe minds to entities when there is little to no evidence of a mind (at least not in the typical sense). For example, people frequently think about their computers as intentional beings with ‘minds of the own’, and people the world over ascribe mental states such as knowledge and intentions to bodiless spirits,

ghosts, and gods (Purzycki et al., 2012; Purzycki, 2013a; Waytz, Gray, Epley, & Wegner, 2010). This set of inaccuracies represents systematic errors in mind perception and attribution – both true-misses and false-positives. Moreover, our reasoning about the *content* of others' minds is often inaccurate and systematically biased by our own perspectives and knowledge (Bernstein, Erdfelder, Meltzoff, Peria, & Loftus, 2011; Birch, 2005).

The mismatch between the human propensity for reasoning about other minds and our noted deficits in accurately doing so emerges from the imperfections of our evolved capacities, and the lengthy process of their development across the lifespan (Brüne & Brüne-Cohrs, 2006; Gehlbach, 2004). This gives rise to substantial individual variability in some domains of theory of mind such as emotion recognition and empathic tendencies (Baron-Cohen & Wheelwright, 2004; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), while strikingly less so in others, such as reasoning about false beliefs (Liu, Wellman, Tardif, & Sabbagh, 2008). As such, what we refer to more generally as 'theory of mind' is better understood as a placeholder for a suite of related systems that function at different levels of cognitive processing. Implicit, automatic, and inflexible systems for agency detection, face recognition, gaze following, emotion processing, joint attention, and our naïve theories of causality motivate a reflexive understanding of others' behavior as resulting from underlying mental states (Apperly & Butterfill, 2009). This reflexive reasoning is elaborated with explicit, verbal, and flexible thought (Epley & Caruso, 2008), only when we have the cognitive resources and motivation to do so (Rhodes & Brandone, 2014).

Given the benefits of efficient mindreading, one would expect that we have discovered myriad ways to foster our social perspective taking skills, although this is not the case. What we do know is that practice works – at least some kinds – some of the time. Adolescent students, but not younger students, who underwent a high intensity one-year acting course in which they received specific training in embodying the roles and associated perspectives of others, showed increases in both their ability and tendency to empathize accurately when compared with students enrolled in non-acting arts courses. However, despite statistically significant interactions between group and time of testing in predicting theory of mind, mean differences between the groups were minimal (Goldstein & Winner, 2012), suggesting that, despite such rigorous explicit training, robust improvement in theory of mind related reasoning may be difficult to achieve.

These findings echo attempts to explicitly teach theory of mind relevant skills in a clinical setting. After four to five months of social skills training, children previously diagnosed along the autism spectrum showed improvements on false-belief tasks, but not on teacher or parent reports of their actual social behaviors and abilities (Ozonoff & Miller, 1995). Therefore, although practicing and learning how to infer and engage with the minds of others seems like an elegant solution to the problem of fostering theory of mind – the results remain inconclusive on their practicality and impact. Indeed, the difficulty in ‘teaching’ theory of mind follows from the lack of a clearly defined relationship between experiential input (e.g., learning about mental states through parent-child discourse; Farrant, Devine, Maybery, & Fletcher, 2012; Sabbagh & Callanan, 1998) and related cognitive scaffolding (e.g., executive function; Benson, Sabbagh, Carlson, & Zelazo, 2013) in the ontogeny of a theory of mind. In contrast to explicit instruction,

cultural evolutionary processes may have provided human groups with the innovative solution to the problem of fostering efficient social perspective taking through the normative institution of behavioral synchrony in collective ritual.

In the sections that follow, evidence will be presented for the processes by which behavioral synchrony, that is keeping in time with others, can correct for common inaccuracies in mental state reasoning. Specifically, synchrony might foster theory of mind by (1) motivating directed reflexive mental state reasoning, and (2) decreasing the egocentrism that would otherwise inhibit more explicit reasoning about others' mental worlds. As a result of such processes, synchrony might foster both tendencies towards and accuracy in reasoning about other minds.

Synchrony and reflexive mental state reasoning

Hove & Rise (2009) demonstrated that simply synchronizing with a non-human visual target was not sufficient to induce affiliative motivations with physically present human others; it's really all about *interpersonal* synchrony. That is, the effects of synchrony on cooperation and coordination are not driven by synchronicity in and of itself, but rather the act of synchronizing with other social agents. This connection between synchronizing with others and figuring out with whom to cooperate and affiliate seems to fall out of early developing inferences about our social worlds. In 14-month old infants, for example, synchronous actions function as both motivator and cue for directing later, non-generalized, prosocial behaviors (Cirelli, Wan, & Trainor, 2014). In a study of joint-music making, Kirschner & Tomasello (2010) have argued that in keeping in time with others, synchrony leads pre-school aged children to hold a representation of others in mind with a specific focus on the collective intention and shared attention that

emerges from synchronous action. This capacity for sharing attention and intention emerges early in life and is a critical feature of the developing child's theory of mind (Baillargeon, Scott, & He, 2010; Tomasello, Carpenter, Call, Behne, & Moll, 2005).

In adults, synchronizing with others directs one's attention towards those they have synched up with and in the process increases the likelihood with which they attribute them with personhood and mind (Macrae, Duffy, Miles, & Lawrence, 2008). Notably, synchrony induces greater memory for details of those with whom we synchronize with, but not greater generalized memory capacity (Miles et al., 2010). Thus, in the process of turning our attention towards those we synchronize with while increasing both the likelihood with which we attribute personhood to those individuals *and* hold this representation of the other in mind, behavioral synchrony engages the cognitive systems that ready our minds for reasoning about the mental states of others.

Furthermore, synching up with others makes us better able to infer and predict other's future behaviors, increasing not only cooperative tendencies, but also the *ability* to successfully cooperate. In one study (Valdesolo, Ouyang, & DeSteno, 2010), participant dyads were instructed to either rock in or out of synchrony with each other in chairs, and then worked together in navigating a steel ball through a wooden labyrinth. Success on this task was determined by the ease with which participants could infer and predict their partners' subtle movements, while dynamically adjusting their own, without the use of verbal communication, in order to quickly get the ball through the maze. Synchronous pairs, compared to asynchronous pairs, were significantly quicker at navigating the ball through the labyrinth. Further, success on this task was mediated by a synchrony-induced increase in the ability to detect subtle differences in temporal

movement on an unrelated task. That is, participants were better able to accurately report whether a ball on a screen moved at the same or a different pace (which varied across trials) after passing behind an opaque rectangle. This raises the interesting possibility that moving in synchrony with others promotes a domain-general increase in ability for tracking agency – another early developing feature of our core cognitive capacity for theory of mind (Baron-Cohen, 1999; Gergely, Nádasdy, Csibra, & Bíró, 1995; Johnson, 2000).

Collectively, these lines of research provide convergent evidence for the various ways in which behavioral synchrony prepares us for engaging with the mental worlds of others'. By fostering shared and other-directed attention, individuals in synchrony become acutely aware of what others' perceive, making the jump from what others see to what others think cognitively easier to compute (Sebanz, Bekkering, & Knoblich, 2006). Further, the act of synchronizing, keeping to the beat, in and of itself dictates not only what others should do, but will do. Thus freeing up cognitive resources otherwise spent on predicting others' behaviors, allowing for, as will be described below, more explicit reasoning about others' mental worlds.

Synchrony, egocentrism, and psychological distance

In creating a sense of 'we' amongst previously unrelated individuals, behavioral synchrony has been consistently demonstrated to foster increased liking, feelings of similarity, and affiliation (Haidt et al., 2008; Hove & Rise, 2009; D Lakens & Stel, 2011; Valdesolo & DeSteno, 2011; Wiltermuth & Heath, 2009). Synchrony actually makes us less able to distinguish our own faces from those of whom we have synched up with (Paladino et al., 2010) – blurring the boundaries between self and other. In this act of

getting over one's self, behavioral synchrony may engage and foster explicit mental state reasoning through a reduction of our egocentric biases that otherwise hinder our ability to reason about another's perspective.

Further, psychological distance can inhibit the social cognitive processes involved in mental state reasoning. The larger the psychological distance between two individuals or entities (e.g., the greater the perceived dissimilarity), the less likely they would believe they shared any meaningful connections, attitudes, traits, and of particular interest here, the less likely they would be to attribute minds to each other (Waytz, Epley, & Cacioppo, 2010). When asked to think about others who are perceived as psychologically distant (e.g., the homeless), individuals dehumanize others and fail to even recruit the brain networks used in everyday social cognitive processes (Harris & Fiske, 2006).

Interestingly, naturally occurring synchrony in dyadic interactions occurs significantly less when interacting with psychologically distant others (Miles, Griffiths, Richardson, & Macrae, 2009). Synchrony then, when experimentally induced in the lab or experienced through collective ritual, might aid in decreasing the psychological distance (Vacharkulksemsuk & Fredrickson, 2012), and increase the likelihood with which we explicitly engage with and reason about others' mental worlds.

Predictions and current studies

What emerges from an understanding of the connection between behavioral synchrony and theory of mind is a cohesive framework from which to understand the already well-established effects of synchrony on coordination, cooperation and cohesion – understanding the processes by which joint physical action leads to joint mental connection. This framework provides answers to (or at the very least testable hypotheses

regarding) the question of why behavioral synchrony is so ubiquitous in collective rituals around the world. From army drills to church choirs, culturally evolved collective rituals involving synchrony tune our minds for reasoning about other's mental states. In doing so, individuals become better able to learn from, coordinate, cooperate, and empathize with others – shaping human sociality. Presently, it is argued that we can exploit this culturally galvanized connection between synchrony and mental state reasoning – and apply synchrony as a tool for fostering theory of mind.

Here, this hypothesis, that synchrony fosters theory of mind, was addressed in three experiments. Experiment 1 tested whether experimentally inducing synchronous, as compared to asynchronous, movement produced measurable differences on an individual difference measure of theory of mind. Experiment 2 served as a replication of this basic paradigm and its results while supplementing the findings with a more nuanced understanding of the relationships between synchrony, theory of mind and social cohesion. Specifically, in this second study it was hypothesized that the observed increase in theory of mind would account for the synchrony induced social cohesion observed elsewhere in the literature. Experiment 3 extended the findings of the first two experiments further by testing whether synchrony honed accuracy in as well as self-reported tendencies towards mental state reasoning.

Experiment One

Overview

In this first study, we investigated whether participation in a synchronized task in the lab would produce measurable increases on a self-report measure of theory of mind. Specifically, we manipulated whether participants moved and sang in or out of synchrony with others (replicating the methodology used in Wiltermuth & Heath, 2009) and then measured their responses on the Empathy Quotient (Baron-Cohen & Wheelwright, 2004).

Participants

One hundred and sixteen participants completed this study in exchange for course credit. All participants were recruited through the University of British Columbia's Psychology Department's Human Subject Pool. As part of the current manipulation involved singing along with an outgroup's national anthem (specifically, that of the United States), American UBC students on the Human Subject Pool were not eligible to sign up for this study. Participants ranged in age from 17 to 35 ($M = 20.07$, $SD = 2.61$). There were 82 female and 32 male participants, as well as 2 participants who chose not to indicate their gender. Participants were predominantly of Asian cultural heritage (62%) and Caucasian (33%) or of mixed cultural heritage (5%). Participants in this study were randomly assigned to either the synchronous ($n = 54$) or asynchronous condition ($n = 62$). An additional two groups of three participants each were excluded from the synchronous condition, and further analyses, due to experimenter error in instructing participants on how to perform the ritualized task.

On average, participants rated themselves as being more spiritual ($M = 3.9$, $SD = 1.86$) than religious ($M = 2.96$, $SD = 1.85$). 58% of participants indicated that they had been raised in a religious tradition, and 50% of the sample indicated that they currently believed in god. Participants of Asian cultural heritage ($M = 3.32$, $SD = 1.95$) rated themselves as being more religious than non-Asian participants ($M = 2.35$, $SD = 1.51$), $t(113) = 2.80$, $p = .006$. However, Asian participants ($M = 3.96$, $SD = 1.85$) and non-Asian participants ($M = 3.80$, $SD = 1.90$) did not statistically differ in their self-reported levels of spirituality, $t(114) = 0.46$, $p = .65$. Males ($M = 2.97$, $SD = 1.86$) and females ($M = 2.98$, $SD = 1.86$) in this sample did not differ in their reported religiosity. However, females ($M = 4.11$, $SD = 1.84$) reported themselves as being significantly more spiritual than males ($M = 3.31$, $SD = 1.84$), $t(113) = 2.08$, $p = .03$. Responses to these demographic variables were collected at the end of the study session.

Methods and materials

Participants were scheduled for the current study in groups of three. Upon arrival at the laboratory, the three participants were seated, facing each other around a table, and positioned in an equidistant manner from the other participants. After reading through and signing the consent form, the experimenter instructed the participants that they would be participating in two tasks: (1) a musical performance task, followed by (2) a series of questionnaires.

Synchrony manipulation – ‘Cups Task’

The experimenter then proceeded to provide instructions as to how to complete the musical performance task. This task was the critical manipulation in the current study, and was adapted directly from studies 2 and 3 as described in Wiltermuth & Heath

(2009). The experimenter began by stating that, “You [the participants] will be participating in a group musical performance task. In this task, you will move cups across the table in a specific fashion while singing along to the United States’ national anthem – The Star-Spangled Banner.” In their work, Wiltermuth & Heath (2009) had participants sing along to the Canadian national anthem, as their participants were from the United States. The idea here was to stack the deck against their hypothesis, as they sought to explore whether synchrony could foster cooperation even when the soundtrack to the synchrony experience was that of an out-group anthem. Here, in an attempt to replicate their synchrony manipulation as closely as possible, we followed the same protocol but with the USA national anthem, as participants were non-American students – even though here we were not specifically testing for cooperation effects.

The experimenter then demonstrated the protocol for moving the plastic cups. The experimenter, seated at the table with the participants, laid out three plastic cups in a row to her right, with the top-end of the cups placed down on the table. The experimenter then explained that the song they would be listening to would be in three-quarter measure, e.g., there would be three beats per measure. As such, they would perform three sequential movements per measure of the song.

The first movement consisted of placing one’s right hand on the cup closest to them on their right – grasping the cup with an open palm from its upright base. The second movement was to take the cup and tap it on the palm of their left hand, which was to remain in front of their torsos and held open towards the ceiling for the entire duration of the task. The third movement was to then place the cup down on the table to their left (e.g., moving the cup, one at a time from one side of the participant to the other). On the

next beat, participants were instructed to do all of the above again with the next cup that lay to their right, until all three cups had been moved to the left side. After all three cups had been moved to the other side, the task continued with the same movements but this time moving from left to right – always moving the cups with the same hand, and tapping them onto the other. Participants that were left handed were instructed that they could start the task on the left side, and use their left hand to move the cups, while keeping their right hand open in front of them. The movements of the cups described here are illustrated visually in Figure 1.

After three instances of demonstrating how the cups should be moved from side to side in the specified manner, the experimenter then distributed three of the same plastic cups to each participant. Participants were given a few moments to practice the movements on their own without any music, during which the experimenter corrected any errors in their movements (e.g., holding the cups from the wrong place, switching hands, double tapping, etc.). Once all participants indicated that they were comfortable with the movements, the experimenter insured that the participants had learned the proper movements by watching them, one at a time, move the cups in the specific manner for at least 2 rounds (that is, moving the cups from side to side and back again, at least twice). The experimenter made use of this time to make any final corrections to the participants' movements.

The experimenter then stated the goals of the task, “Focus on keeping to the beat of the song you are listening to – moving the cups and singing the appropriate words at the appropriate times. Remember, all participants may or may not be listening to the same version of the song. As such, it is extremely important that you keep to the beat of the

music *you* hear.” Following this, lyric sheets containing the words to the Star-Spangled Banner were passed around to each individual participant. Participants were instructed that they were to sing aloud (or read, if they were not comfortable attempting to sing) the last few words of every second line of the song, which were indicated in bold and underlined on the sheet. At this point in time, the experimenter asked each participant to place a pair of headphones over their ears. Everyone was then given the opportunity to listen to the track once without moving cups or singing, in order to get a feel for the beat, as well as to provide an opportunity to hear the song in full. After listening to the song once, the experimenter reminded participants to, “Focus on keeping to the beat of the song you hear over your own headphones, and to start the cups movement when the lyrics begin”. Following which, the experimenter would hit play on concealed MP3 players, starting the song and thus the task – which would last for just under three minutes (the length of the Star-Spangled Banner).

Critical to the current manipulation and unbeknownst to the participants, the group had been randomly selected into either the synchronous or asynchronous condition prior to their arrival in the laboratory. In the synchronous condition, the experimenter had all three participants connected to a single MP3 player with the use of a 3.5mm headphone splitter. Thus, all participants in the synchronous condition listened to the same, standard 128 beats-per-minute (BPM) version of the US national anthem. As such, when keeping to the beat they were hearing over their headphones, individual participants were most likely to synchronize in both their movements of the cups and the singing of the lyrics in this condition. In the asynchronous condition, participants were wired to individual MP3 players; all of which had different versions of the Star-Spangled Banner

preloaded onto them: 128 BPM (standard), 90 BPM (slower) and 165 BPM (faster). As such, when keeping to the beat that they heard over their headphones, individual participants would not synchronize with each other in either their movements of the cups *or* the singing of the lyrics of the anthem. While the participants completed this manipulation, the experimenter watched carefully, and made detailed comments regarding the extent to which groups synchronized and did not synchronize across both conditions. Following the manipulation, the experimenter told the participants that they had as a group performed well on the task and then distributed a package of questionnaires to each individual participant.

Measuring theory of mind – ‘Empathy Quotient’

As the primary measure of interest in the current study, participants were then asked to fill out the Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004). This 40-item self-report measure was developed to capture individual differences in empathic tendencies. Specifically, this measure was designed to assess cognitive and affective features of individual empathic tendencies, as well as general social skills. Each of these constructs can be assessed independently in the EQ by dividing scores into three subscales: cognitive empathy, affective effective and general social skills (following Lawrence et al., 2004). Cognitive empathy, or perspective taking, is most closely related to the construct of mentalizing, and involves one’s tendency towards and efficiency at predicting and engaging with the mental states of others. This is measured in the EQ with items such as, “I am good at predicting how someone will feel.” Affective empathy reflects one’s tendency to emotionally react and engage with the mental states of others. This is assessed in the EQ by items such as, “Seeing people cry doesn’t really upset me.”

Lastly, the EQ also assesses self-reported social skills with items such as, “I find it hard to know what to do in a social situation”. Participants responded to the questionnaire by indicating their level of agreement with the items on a four-point, “Strongly disagree,” to, “Strongly agree” scale. Following Baron-Cohen & Wheelwright (2004), participants’ responses are then scored as a 2, 1, or 0 depending on the strength of their endorsement of the items. These scores are then summed across items creating the individual’s EQ-score. This measure has been demonstrated to reliably discriminate between typically developed individuals and individuals diagnosed along the autism spectrum that is characterized by a marked reduction in the capacity for theory of mind. Furthermore, this measure is known to capture gender differences, specifically males tend to score significantly lower in measures of theory of mind. Finally, the EQ has been shown to have good reliability and validity across both clinical and typical samples (Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004).

After completing the EQ, participants were asked to respond to questions regarding their age, gender, and cultural background. Upon completion of these questionnaires, the experimenter inquired as to whether any of the participants detected or suspected the purpose of the study by asking, “Can anyone guess what was going on here today?” In responding to this question, no participants made any mention of the effects of synchronizing. The majority response (78%) was, “I don’t know”. Otherwise (22% of the time), participants guessed in some form or another that we were evaluating team performance and behavior in relation to personality. With these responses, we can be confident that participants were not aware of the main hypothesis and purpose of the current study. Following this, participants were given a full verbal debriefing as to the

purpose of the study, and were given the opportunity to ask any further questions about the research before being thanked for their participation, rewarded their course credits and sent on their way.

Results

Individuals in the synchronous condition ($M = 46.00$, $SD = 9.86$) scored significantly higher on the Empathy Quotient than those in the asynchronous condition ($M = 42.21$, $SD = 10.45$), $t(114) = 2.01$, $p = .04$. To more robustly test the primary hypothesis of this study, that participation in synchronous ritualized action with others fosters theory of mind, we conducted a linear regression analysis predicting scores on the EQ from condition (synchronous or asynchronous), age, gender, and ethnicity, $F(4, 109) = 5.07$, $p = .001$, $R^2 = .16$, $R^2_{adj} = .13$. Following our predictions, being in the synchronous condition was significantly and positively predictive of EQ scores, $\beta = .20$, $CI_{.95} = [.03, .38]$, $p = .02$. Males ($\beta = -.18$, $CI_{.95} = [-.35, -.01]$, $p = .04$) scored significantly lower on the EQ, as did individuals of Asian cultural heritage ($\beta = -.26$, $CI_{.95} = [-.44, -.07]$, $p = .01$), replicating previous work (Willard & Norenzayan, 2013). Age, in this model, was not a significant predictor of EQ scores ($\beta = .01$, $CI_{.95} = [-.18, .19]$, $p = .95$). The synchrony manipulation had no measurable effects on other collected variables (e.g., reported religiosity and spirituality).

Following Lawrence et al. (2004), scores on the EQ were then divided into three subscales: affective empathy, cognitive empathy, and social skills. The results of modeling the above regression by each subscale are presented in Table 1. Here, we can see that synchrony was most effective in increasing scores on the cognitive empathy subscale. The observed gender and ethnicity effects on theory of mind also emerged on

this subscale, and not that of the affective empathy subscale. Finally, there was no effect of condition on reported social skills. Furthermore, the negative association between Asian cultural heritage and EQ scores seems to be most strongly accounted for by Asian participants scoring lower on the social skills subscale.

Discussion

These initial results suggest that participation in synchronized ritual acts with others fosters increases in theory of mind, as measured by the EQ. Specifically, as this measure captures self-reported cognitions regarding one's tendencies towards mentalizing, we argue that these results provide first evidence of how synchrony increases the self-reported ease and willingness with which individuals engage with the mental worlds of others. Furthermore, this effect seems to be predominantly driven by increases in cognitive empathy (e.g., perspective taking). The null effect on the social skills subscale of the EQ is interesting given the ample evidence from past research that synchrony fosters interpersonal motivations. Thus, the question of how this observed increase in EQ relates to possible increases in sociality more generally following synchrony was addressed in Experiment 2.

Experiment Two

Overview

In this second experiment, we set out to replicate our initial findings, that participation in synchronous ritual activity with others fosters increases in theory of mind. Further, we wanted to extend these findings in two ways. First, we wanted to test the hypothesis that this observed increase in theory of mind might actually account for the increases in social cohesion as a result of synchrony observed across the literature. Simultaneously, we wanted to insure that the observed increases in theory of mind were not a result of increased social cohesion, but could be attributed to the synchrony manipulation itself. As such, we ran a modified version of the synchrony manipulation from Experiment 1, had participants respond to the Empathy Quotient (Baron-Cohen & Wheelwright, 2004) and then three self-report measures of social cohesion assessing individual perceptions of the group and participants' feelings towards them.

Participants

One hundred and forty-nine participants completed this study in exchange for course credit. All participants were recruited through the University of British Columbia's Psychology Department's Human Subject Pool. Participants ranged in age from 18 to 42 ($M = 20.67$, $SD = 3.22$). There were 113 female and 36 male participants. Participants were predominantly of some Asian cultural heritage (58%) or Caucasian (42%). Participants in this study were randomly assigned to either the synchronous ($n = 72$) or asynchronous condition ($n = 77$).

While 50% of participants indicated that they had been raised in a religious tradition, participants rated themselves as being slightly more spiritual ($M = 3.94$, $SD = 2.01$) than religious ($M = 3.09$, $SD = 1.98$). Contrary to Experiment 1, in this sample there were no measurable differences between ethnicities (specifically, Asian or Caucasian participants) or gender in terms of reported religiosity or spirituality.

Methods and materials

For this experiment, participants were brought into the lab in groups of three or four at a time. Again, participants were seated around a table, in an equidistant fashion from one another. The experimenter distributed consent forms, which participants read and signed after any of their questions were answered regarding participation in the study.

Synchrony manipulation – modified ‘Cups Task’

The experimenter then followed much the same protocol as in Experiment 1, although the Cups Task itself underwent a few changes. Instead of listening and singing along with the USA’s national anthem, participants listened to a simple three-quarter measure metronome beat that was preloaded onto four MP3 players at 65, 90, 128, and 165 BPM. As such, the singing portion of the manipulation was removed, thus making the task slightly less complicated for participants and allowing us to test for the effects of a more stringent form of synchrony, that of movement alone. Furthermore, this provided us with manipulation of synchronous or asynchronous movement that did not require any verbal participation from the participants.

In the synchronous condition, participants were discretely wired to a single MP3 player and listened to the same 128 BPM metronome beat. In the asynchronous

condition, participants were individually wired to MP3 players. In the case that there were three participants present, we used the 90, 128, and 165 BPM tracks. If there were four participants present, we also used the 65 BPM metronome beat. In both conditions, the wires connecting headphones to MP3 players were concealed underneath a cardboard box, as to prevent participants from knowing whether or not they were all connected to the same MP3 player.

Before providing the participants with a demonstration and detailed lesson on how to move the cups, the experimenter said the following to set up the task, “You will be listening to a metronome beat while moving cups in a specific way. The goal here is to keep to the beat that you are hearing as closely as you possibly can for 3 minutes. Remember, that you may or may not be listening to the same beat as your fellow participants, so pay particular attention to what it is you are hearing over your headphones.” These modified instructions removed the sense of shared identity and fate from the manipulation, again to more stringently test the effects of synchrony without explicit reference to the group as being a group.

The experimenter then demonstrated the movement of the cups following the same instruction protocol as was detailed in Experiment 1. Prior to beginning the task itself, participants were given the opportunity to practice the movements without the metronome beat for as long as was necessary (as deemed by the present experimenter) until all participants demonstrated that they were able to move the cups in the specified manner.

Once all participants were ready to begin the task, the experimenter said, “You are to start the cups’ movement when the beat starts playing. And, remember, you are to

focus on the beat you hear over your own headphones for the entire duration of the task.” During the Cups Task, the experimenter made sure to pay close attention to the groups’ movements and made detailed notes regarding the efficacy of the manipulation in both conditions. Following the three-minute task, the experimenter told participants that they had all individually done well on the task and then distributed the package of questionnaires for the participants to fill out. Participants were first given the Empathy Quotient (Baron-Cohen & Wheelwright, 2004) as in Experiment 1.

Measuring social cohesion – ‘Social Environments Questionnaire’

The second questionnaire was titled the ‘Social Environment Questionnaire’. This consisted of three independent measures of individual perceptions of the group: (1) Relational Ties, (2) Fusion, and (3) Group Identification. The Relational Ties measure (Gómez et al., 2011) consisted of 4-items (Chronbach’s $\alpha = .91$) that assessed the extent to which individuals felt they shared a connection with the other participants in their group on a 0 (not at all) to 5 (very much) scale, e.g., “Do you feel like you know any of the other participants very well?” The Group Fusion measure (Swann, Gómez, Conor, Francisco, & Huici, 2009) assessed, using a pictorial depiction of increasingly overlapping circles, the extent to which the self felt close to, or ‘fused’ with that of the group. The Group Identification measure (Hogg, Sherman, Dierselhuis, Maitner, & Moffitt, 2007), consisted of 8-items (Chronbach’s $\alpha = .93$) that assessed the extent to which individuals felt committed to the other participants in their group on a 1 (not at all) to 9 (very much) scale, e.g., “How much do you feel you belong to the group?”

Once the Social Environment Questionnaire was completed, participants were asked to provide answers to the demographic items that were administered in Experiment 1. Following which, the experimenter again insured that participants had not guessed the

purpose of the study and the main hypotheses. Finally, participants were verbally debriefed, thanked and awarded their course credit for participation and sent on their way.

Results

In this second experiment, we replicated the main findings of Experiment 1. Thus, providing further support for our primary hypothesis that participation in synchronous ritual activities with others fosters increases in theory of mind. Those in the synchronous condition ($M = 46.68$, $SD = 10.43$) scored significantly higher on the EQ than those in the asynchronous condition ($M = 40.55$, $SD = 8.47$), $t(147) = 3.95$, $p < .001$. In replicating the linear regression model from Experiment 1 with this second set of data, we find very similar results, $F(4, 140) = 7.26$, $p < .001$, $R^2 = .17$, $R^2_{adj} = .15$. Being in the synchrony condition significantly and positively predicted scores on the EQ, $\beta = .21$, $CI_{.95} = [.06, .37]$, $p = .006$. In this model, being male ($\beta = -.13$, $CI_{.95} = [-.28, .02]$, $p = .09$) and Asian ($\beta = -.25$, $CI_{.95} = [-.40, -.10]$, $p = .001$) predicted lower scores on the EQ. Further, there was no effect of age on EQ scores in this model, ($\beta = -.08$, $CI_{.95} = [-.23, .07]$, $p = .31$). Again, the synchrony manipulation was not related to any other measurable differences on other collected measures (e.g., religiosity, spirituality).

Subsequent regression analyses of the subscales of the EQ provided comparable outcomes as to what was found in Experiment 1 (see Table 2). These models demonstrate that the synchrony manipulation was specifically effective in increasing scores on the cognitive empathy (perspective-taking) subscale of the EQ. We again find that the observed gender differences are attributable to the perspective taking subscale. That is, the observed overall gender difference in EQ scores can be accounted for by males

scoring significantly lower than females on the perspective taking subscale. In this sample, Asian participants showed a more robust tendency towards scoring lower on the EQ across its three subscales, however this negative relationship was strongest on the social skills subscale, much like in Experiment 1.

Furthermore, the observed increases in EQ scores following synchrony could not be attributed to increases in social cohesion, as measured here by the items in the Social Environment Questionnaire. In fact, we failed to replicate previous findings that synchrony fosters social cohesion. On a 5-point scale, across conditions participants scored quite low on the Relational Ties measure ($M = 0.79$, $SD = 1.13$). A similar result, that is very little reported social cohesion, was found in regards to the Fusion measure ($M = 2.98$, $SD = 1.41$), and the Group Identification measure ($M = 4.16$, $SD = 1.62$), which were scored out of 7 and 9 respectively. There were no differences in these measures between conditions (see Table 3). Further, these measures of social cohesion, although interrelated, were not significantly related to the EQ (see Table 4).

The addition of these social cohesion measures into a linear regression model predicting EQ scores produced no changes to our primary findings, $F(7, 137) = 4.54$, $p < .001$, $R^2 = .19$, $R^2_{adj} = .15$. Synchrony predicted increased EQ scores, $\beta = .22$, $CI_{.95} = [.06, .37]$, $p = .006$. Similarly to in our previous models, being male ($\beta = -.14$, $CI_{.95} = [-.29, .02]$, $p = .08$) and Asian ($\beta = -.26$, $CI_{.95} = [-.41, -.10]$, $p = .001$) were negative predictors of participant's EQ scores. Further, age ($\beta = -.07$, $CI_{.95} = [-.22, .08]$, $p = .35$), Relational Ties ($\beta = -.04$, $CI_{.95} = [-.21, .13]$, $p = .61$), Fusion ($\beta = -.04$, $CI_{.95} = [-.28, -.08]$, $p = .26$), and Group Identification ($\beta = .16$, $CI_{.95} = [-.03, .35]$, $p = .11$) were not significantly predictive of EQ scores.

Discussion

In this second experiment, we replicated our primary findings that synchrony fosters self-reported tendencies of mental state reasoning. Again, this effect was specifically related to the cognitive empathy (perspective-taking) subscale of the EQ. Further, this effect was independent of feeling more connected, similar to and committed to the group. However, there was a weak, but trending effect of Group Identification predicting EQ. In other work (e.g., Lawrence et al., 2004), the EQ has been demonstrated to correlate with measures of general sociality. As such, it is possible here that the more social one is at a trait level, the more likely they would be to identify with the group following this fairly brief interaction (regardless of condition), as well as being more likely to score high on the EQ. Importantly, given that condition had no measurable effect on these measures of social cohesion, there is no evidence for suspecting that the observed increases in EQ scores following synchrony are best accounted for by increases in social cohesion. However, the null effects of synchrony on social cohesion observed here prevent us from making any inferences about how theory of mind could possibly mediate the relationship between synchrony and social cohesion. Thus, the hypothesis that increases in theory of mind would mediate the relationship between synchrony and social cohesion did not receive support in the current data.

In sum, this second experiment provides a replication of the initial findings that participation in a synchronized task with others fosters theory of mind, and specifically self-reported ease and tendencies towards perspective taking. Furthermore, this effect persists when controlling for social cohesion.

Experiment Three

Overview

In this third experiment, we set out to both replicate and extend our previous findings. As such, this third experiment followed the procedure of Experiment 2, but with the addition of a second measure of theory of mind. Primarily, we sought to further replicate our findings that participation in a synchronous ritualized task fosters increased reported tendencies for mental state reasoning. Furthermore, we hypothesized that, above and beyond increases in self-reported tendencies towards mental state reasoning, synchrony might foster increases in individual ability for *accurate* mental state reasoning. Specifically, after completing the synchrony manipulation, participants completed the Reading the Mind in the Eyes Test, which measures how accurately participants match mental state terms to emotional expressions in photos of eyes (Eyes Test; Baron-Cohen et al., 2001), in addition to the EQ and the social cohesion measures utilized in Experiment 2.

Participants

One hundred and forty-seven participants completed this study in exchange for course credit. All participants were recruited through the University of British Columbia's Psychology Department's Human Subject Pool. Participants ranged in age from 17 to 27 ($M = 20.61$, $SD = 1.95$). There were 109 female and 38 male participants. Participants were predominantly of some Asian cultural heritage (61%) or Caucasian (39%). Participants in this study were randomly assigned to either the synchronous ($n = 72$) or asynchronous condition ($n = 75$).

In this sample, 49% of participants indicated that they had been raised in some religious tradition. Again, participants rated themselves as being more spiritual ($M = 4.07$, $SD = 1.88$) than religious ($M = 3.04$, $SD = 1.89$). Non-Asian participants ($M = 4.35$, $SD = 2.11$) rated themselves as slightly more spiritual than Asian participants ($M = 3.90$, $SD = 1.70$). This was not the case for reported religiosity, which did not differ by ethnicity. Note, however, that this trend is the reverse of what was found in Experiment 1 (e.g., there, Asian participants reported themselves as being more religious, not spiritual). Female participants ($M = 3.28$, $SD = 1.91$) reported higher levels religiosity as compared to males ($M = 2.37$, $SD = 1.68$), $t(145) = 2.59$, $p = .01$. Whereas on average, females ($M = 4.20$, $SD = 1.86$) reported being only slightly more spiritual than males ($M = 3.71$, $SD = 1.89$), $t(145) = 1.39$, $p = .17$.

Methods and materials

Measuring theory of mind – ‘Reading the Mind in the Eyes Test’

This third experiment was conducted in exactly the same manner as Experiment 2. The only modification made in the procedures and materials was the addition of a measure of theory of mind – the ‘Reading the Mind in the Eyes’ Test (hereafter, Eyes Test; (Baron-Cohen et al., 2001). The Eyes Test is a 36-item measure in which participants must correctly match mental states terms to pictures of eyes. That is, the Eyes Test is a measure of *accuracy* in emotion recognition, a correlate of individual capacities for theory of mind. Forming two subscales, the items of the Eyes Test can be classified into two categories of mental states – those most closely related to ‘thinking’ (e.g., fantasizing, suspicious, reflective) and those most closely related to ‘feeling’ (e.g., uneasy, worried, hostile). The ‘correct’ answers are provided by Baron-Cohen et al.

(2001), and were established based on normative (modal) responses of participants in a large validation study. This measure has been demonstrated to reliably discriminate amongst clinical and typical samples in terms of diagnoses along the Autism Spectrum, and is treated as an effective individual differences measure of theory of mind.

Furthermore, this measure provides us with a means to test the primary hypothesis of this third study. That is, its inclusion allowed us to test the hypothesis that synchrony might foster accuracy in mental state reasoning in addition to self-reported tendencies.

Although the EQ and the Eyes Test are reported to positively correlate ($r = .29$; Lawrence et al., 2004), they are designed to capture distinct facets of mental state reasoning. The EQ, as described earlier, assesses self-reported tendencies for taking on other's perspectives (cognitively and emotionally) as well as more generalized social skills. The Eyes Test, however, is more specifically targeted at a single facet of theory of mind – mental state attribution. Specifically, the Eyes Test measures one's actual ability to correctly attribute relevant mental states to those who are experiencing them. As such, the Eyes Test should be much less susceptible to measurement error associated with the cognitive reflection of one's own answers, as well as providing a more subtle, approaching implicit, measure of the cognitive faculties underlying theory of mind. The inclusion of this measure here will allow for inferences regarding synchrony's effects on theory of mind beyond individual self-reported willingness to consider other minds (as measured by the EQ). This measure was distributed to participants directly after the synchrony manipulation, followed by the EQ, the Social Environment Questionnaire and demographic items.

Results

In this third experiment, we replicated the effects of the two previous experiments. That is, the synchrony manipulation produced measurable increases in individual scores on the EQ. Those in the synchronous condition, ($M = 47.08$, $SD = 9.28$) scored significantly higher on the EQ than those in the asynchronous condition ($M = 42.71$, $SD = 9.31$), $t(140) = 2.16$, $p = .03$. Furthermore, we, again, failed to replicate previous findings that synchrony fosters social cohesion. Condition had no effect on responses to the Relational Ties, Fusion, and Group Identification measures. In fact, much like in Experiment 2, across conditions participants generally scored well below the midpoints on all three of these measures of social cohesion (see Table 5).

In this third experiment, social cohesion did not account for the observed increases in EQ following synchrony, much like in Experiment 2. In a linear regression model predicting EQ scores, we replicated the findings from experiment two, $F(7,127) = 5.20$, $p < .001$, $R^2 = .22$, $R^2_{adj} = .18$. That is, controlling for all other variables, being in the synchronous condition was again significantly predictive of EQ scores, $\beta = .21$, $CI_{.95} = [.06, .37]$, $p = .008$. Further, we again find that being male ($\beta = -.19$, $CI_{.95} = [-.34, -.04]$, $p = .01$) and of Asian cultural descent ($\beta = -.24$, $CI_{.95} = [-.40, -.08]$, $p = .004$) predicted significantly lower scores on the EQ. Age, in this model, was not significantly related to EQ scores, ($\beta = .01$, $CI_{.95} = [-.16, .15]$, $p = .97$). The extent to which participants felt fused with their group was not related to their EQ scores, $\beta = -.08$, $CI_{.95} = [-.26, .10]$, $p = .40$. However, endorsements of Relational Ties ($\beta = .19$, $CI_{.95} = [.02, .37]$, $p = .03$), and Group Identification ($\beta = .16$, $CI_{.95} = [-.03, .34]$, $p = .09$) were positively predictive of EQ scores in this model, the latter effect being only marginally significant.

Much like in the previous two studies, regression modeling of the subscales of the EQ revealed that the observed increases in EQ scores could be attributed specifically to increases in the cognitive empathy subscale (see Table 6). Furthermore, subscale analyses again replicated our findings that the observed gender and ethnicity effects in overall EQ scores are best accounted for by the cognitive and social skills subscales respectively. The measures of social cohesion were not related to the cognitive or social skills subscales of the EQ. However, there was a slight, trending effect of greater perceived fusion with the group ($\beta = .18$ $p = .07$) and increased emotional closeness (Relational Ties; $\beta = .18$, $p = .08$) predicting increased scores on the affective empathy subscale of the EQ.

Contrary to our second hypothesis, scores on the Eyes Test did not differ between the two conditions. Those in the synchronous condition ($M = 25.50$, $SD = 3.65$), and the asynchronous condition ($M = 24.97$, $SD = 3.75$) scored similarly on the Eyes Test, $t(145) = .86$, $p = .39$. Furthermore, synchrony had no other measurable effects on any of the other collected variables (e.g., religiosity and spirituality).

Participants' total EQ scores were not significantly correlated to scores on the Eyes Test, $r(140) = .09$, $p = .19$. Indeed, this might suggest, as was hoped in their implementation here, that the EQ and the Eyes Test tap into measurably different aspects of theory of mind – that is tendencies towards mental state reasoning and accuracy in emotion recognition. However, the 'feeling' subscale of the Eyes Test was modestly correlated to the EQ and specifically the affective empathy subscale in a theoretically justified and previously demonstrated direction (Lawrence et al., 2004). Further, the Eyes Test was positively related to the social skills subscale of the EQ. Neither the Eyes Test,

nor its ‘thinking’ and ‘feeling’ subscales correlated with our measures of social cohesion (see Table 7).

We did not find any gender differences on the Eyes Test. Although, we do find a comparable effect of ethnicity on the Eyes Test as was found on the EQ. Specifically, participants of Asian cultural heritage ($M = 24.64$, $SD = 3.95$) scored slightly lower than non-Asian participants ($M = 26.16$, $SD = 3.06$) on the Eyes Test, $t(145) = 2.46$, $p = .02$. This difference emerged in both the ‘thinking’ and ‘feeling’ subscales of the Eyes Test.

Discussion

In this third experiment, we replicated the findings of our previous studies. That is, synchronous movement produced measurable increases in participants’ self-reported tendencies towards mental state reasoning. Further, we again found that this increase was specific to the cognitive empathy subscale of the EQ. The synchrony manipulation was not sufficient, as in Experiment 2, in motivating increased perceptions of social cohesion. However, the observed increases in theory of mind occurred above and beyond any such change in social cohesion. Furthermore, we did find a more robust relationship between our measures of social cohesion and theory of mind. Again, we argue that this is a result of the highly social nature of the items of the EQ. Thus, those who are more socially oriented should score higher on the EQ and might also be more likely to feel socially connected to group members, regardless of condition, even after this brief interaction. As evidence for this, it is the social skills subscale of the EQ that is most strongly, and robustly related to the measures of social cohesion discussed here.

In three studies, we have demonstrated that synchronized movement fosters self-reported tendencies towards perspective taking. However, the additional question

addressed in this third study was whether synchrony fosters actual ability for perspective taking in addition to these self-reported tendencies. Here, we find no support for this hypothesis. Specifically in that, scores on the Eyes Test, a measure of accuracy in emotion recognition, did not differ across conditions.

General Discussion

The act of keeping together in time with others, participation in synchronous collective ritual has been hypothesized to bind individuals into cohesive groups (Ehrenreich, 2006; McNeill, 1995). This is but one culturally evolved solution to the problem of sustaining large-scale cooperation in groups (Henrich, 2015b; Henrich & Henrich, 2007). Here, it has been argued that synchrony fosters cooperation by exploiting our everyday social cognitive reasoning about other minds. That is, by directing attention to others and their mental states, while decreasing the perceived psychological distance between individuals, behavioral synchrony makes us better able to reason about other minds and thus coordinate and cooperate.

Behavioral synchrony then, like the human propensity for imitation, should be considered as part of a larger suite of processes that allow for effective interpersonal coordination between physical bodies *and* minds (Chartrand & Lakin, 2013). The human capacity for interpersonal coordination and cooperation is remarkable, and known to reliably recruit neurological systems involved in mental state reasoning (Balslev, Nielsen, Lund, Law, & Paulson, 2006; Lissek et al., 2008; McCabe, Houser, Ryan, Smith, & Trouard, 2001). In turn, the ease with which one reasons about others' mental states has been linked to the ability to successfully coordinate in joint-action paradigms (Curry & Chesters, 2012; Humphreys & Bedford, 2011).

The connection between behavioral synchrony and the cognitive systems we use to engage with others' mental worlds underscores the interconnectedness of our behavior- and mind-reading abilities. Theory of mind is not telepathy – it is a complex inferential and predictive process that attempts to make sense of real cues that exist out there in our

environments – behaviors (Whiten, 1996). Following a simulationist perspective on the mechanisms underlying theory of mind processes (Frith & Frith, 2006; Gallese, 1998), when we move together in time with others, understanding their behavior becomes a much simpler task as the behavior of others is matched in our own, making it cognitively less demanding and less difficult to reason about their mental states (Keller, Novembre, & Hove, 2014).

Here, across three studies, first direct evidence is provided for the existence of such a relationship between synchronous action and theory of mind. In Experiment 1, it was examined whether we could measurably detect increases in theory of mind following participation in a synchronized ritual task with others. Experiment 2 explored whether an increase in theory of mind following synchrony could account for the widely published effects of synchrony on social cohesion. Finally, Experiment 3 investigated whether increases in theory of mind following synchrony extended beyond tendencies towards mental state reasoning to actual ability for reasoning about other's mental worlds.

The recent emergence of interest in studying ritual in psychology has led to important findings that have refined our understanding of why humans are *so* persistently ritualistic (Henrich, 2015a). The more we study the diversity of ritual practices, the more we discover that they often exert peculiar, yet similar, effects of fostering interpersonal coordination and cooperation. The treatment of ritual as a psychological phenomenon equips us with the tools necessary for understanding the mechanisms by which ritual and sociality are connected. Specifically, it arms us with the methodological and theoretical grounding upon which we can understand the effects rituals can have on human

psychology. Here, I have presented evidence for one such effect of one such type of ritual action – specifically, behavioral synchrony and its effects on theory of mind.

Summary of results

In each of the three experiments presented here, I predicted that having participants take part in a synchronized ritual task in the lab would generate observable differences on measures of theory of mind. In Experiment 1, I tested this hypothesis at its most basic level in the lab. With the Empathy Quotient as the primary tool for assessing self-reported tendencies towards mental state reasoning, I demonstrated that moving and singing in time with others caused participants to rate themselves as being more willing and able to reason about other minds. Specifically, I found that synchrony led participants to feel more attune to and willing to take on the perspectives of others. I did not, however, observe changes in participants' willingness to report being more generally socially able, or increases in ratings of affective empathy (feeling for others). This general pattern of results was replicated in both of the studies that followed. That is, those in the synchronous condition scored higher on a measure of theory of mind, a result that was limited consistently and specifically to its perspective taking subscale.

In Experiment 2 and 3, I predicted that this observed increase in perspective taking would account for the increased social cohesion that follows from synchronous action. However, I found no measurable differences in reported social cohesion (e.g., liking, feelings of similarity, identification, closeness, fusion) between the synchronous and asynchronous groups. Thus, this hypothesis could not be properly tested. However, given the synchrony manipulation produced increases in measured perspective taking without inducing a sense of social cohesion, I can be confident that the results cannot be

explained by social cohesiveness itself. That is, individuals were not more strongly endorsing items on the perspective taking subscale of the EQ because they were feeling more socially connected, but because of the experience of synchronizing with others.

Given the widely published findings that synchrony increases social cohesion, the null effects in the current experiments beg for an explanation. One major difference between the studies presented here and those in the literature is the extent to which participants were explicitly referred to as a group. Wiltermuth & Heath (2009) did this to instill a sense of common identity and shared fate amongst participants. In other words, they wanted to make all individuals feel like they were part of a group, so that they could test whether or not synchrony had an additive effect on social cohesion and cooperation, over and above any effect of simply belonging to a group. In the first study, we did the same as we were closely following their protocol. Moreover, although we did not directly assess social cohesion in this first study, it is indeed the only of the three studies where we can see any trending movement on the affective and social skills subscales of the EQ based on condition (compare models in Table 1, to those in Tables 2 and 3).

At face value, these two subscales are more closely related to social cohesion than is the perspective taking subscale. Thus, it is possible that in modifying the task for Experiment 2 and 3 (e.g., removing the explicit labeling of participants as a group) we failed to instill any base level of groupishness upon which synchrony could have exerted its effects. Thus, testing the boundary conditions of precisely when and where synchrony exerts its own or has additive effects on social cohesion could be a particularly interesting research program. Simultaneously however, this more stripped down version of the cups

task provided us with a more rigorous test of how synchronizing one's behavior, specifically physical movement in this instance, with others fosters perspective taking.

In Experiment 3, I predicted that synchrony would produce increases in both tendencies towards mental state reasoning and actual ability to accurately do so. However, I failed to find any differences in a measure of accuracy in emotion recognition between conditions. Although this is a null effect, there are a number of reasons why this hypothesis is worth pursuing further. For instance, although the Eyes Test is commonly used to assess correlates of theory of mind ability – this task was specifically created to distinguish between high-functioning individuals on the autism spectrum and the general population, and not as an individual differences measure per se. As such, it may lack the sensitivity needed to detect subtle differences following an experimental manipulation. Moreover, the Eyes Test has recently come under some notable scrutiny. Although their study was conducted with a child sample, Cassels & Birch (2014) demonstrated that the forced-choice response format of the Eyes Test failed to reliably predict dispositional empathy, and that only an open-ended version of the task was able to reliably discriminate between typically and atypically developing children (which is functionally the purpose of the task in its original form). The null relationship between more dispositional mental state reasoning tendencies (EQ) and the Eyes Test found here in Experiment 3 adds to the growing literature surrounding the inadequacy of the field's current measures of theory of mind.

Furthermore, there are many ways in which one could be accurate at mental state reasoning, emotion recognition being just one of them. Given that the robust effect of synchrony on EQ scores was specific to the perspective taking subscale and not that of

affective empathy, the emotion-laden nature of the Eyes Test items might not be a suitable proxy for tapping into this same perspective taking system. Further, these data fit with the growing consensus that ‘theory of mind’ is no single monolithic process (e.g., passing a false-belief task), but the outcome of multiple interrelated cognitive systems (Schaafsma, Pfaff, Spunt, & Adolphs, 2015).

In this vein, the data presented here suggests that physically moving in time with others is sufficient to induce a self-reported willingness to take on other’s perspectives. However, perhaps any effect on increasing actual accuracy in mental state reasoning requires the extra step of reducing the perceived psychological distance between individuals. Given that the synchrony manipulation employed here did not effectively make individuals feel more or less connected to others between conditions, it may not have been able then to foster any increases in accuracy. Alternatively, it is also entirely plausible that synchronizing would not make individuals more accurate at reasoning about others’ minds generally, but better able to reason about the minds specifically of those they have synchronized with. As such, having participants associate mental state terms with photos of eyes (mostly from old black and white movies) may not be the ideal measure of any potential effect. Moving forward, finding novel ways to assess perspective taking would have significant implications on this research program, as well as for the ‘theory of mind’ field of research more broadly.

Across these three studies, the analyses presented here replicate known gender differences in theory of mind (e.g., Baron-Cohen, 2009; Lawrence et al., 2004). Interestingly, the effect of synchrony held for both males, who often score significantly lower on theory of mind measures, and females. Indeed, when averaging means across

studies, men in the synchronous conditions ($M = 43.77$, $SD = 8.79$) start to look more like females in the asynchronous conditions ($M = 43.19$, $SD = 9.30$), effectively eliminating this effect of gender. This suggests that gender differences in theory of mind, at least as measured by the Empathy Quotient, may be motivational differences. As men, following synchrony, seem perfectly able to report being just as willing or likely to take on others' perspectives as females generally do at a base level.

Moreover, although they have been reported elsewhere (e.g., Prevost et al., 2014), we find robust negative effects of ethnicity on theory of mind. Specifically, Asian participants consistently scored lower on the measures of theory of mind utilized here. Prevost et al. (2014) argue that this difference reflects actual theory of mind ability. However, there are a number of reasons for thinking otherwise. For instance, much like in the case of gender, this may be a motivational story more than it is one of ability. When averaging means across our three studies, Asian participants in the synchronous condition ($M = 43.48$, $SD = 9.24$) scored similarly to non-Asian participants in the asynchronous condition ($M = 44.58$, $SD = 9.93$). Furthermore, as reported earlier, the items clustering around social skills (and not affective or cognitive empathy) most robustly accounted for this effect of ethnicity on theory of mind. That is, the primary driver of this difference at a base level is that of reporting how great one is at dealing with social situations. These sorts of items may be particularly sensitive to cultural differences in humility in self-reporting as well as reference group effects (Heine, Lehman, Peng, & Greenholtz, 2002). Furthermore, other work (e.g., Adams et al., 2010) has demonstrated that individuals of Asian cultural descent are indeed, on average, *better* than Caucasians at accurately reading the mind in the eyes of others, as long as the actual

eyes presented to them are also of Asian individuals (which was not the case in the current study; or in Prevost et al., 2014).

Challenges and future directions

Given that in these three studies there was no true control condition, that is one where participants simply did nothing but respond to the questionnaires, one concern is that it cannot be directly assessed whether synchrony fosters perspective taking, or whether asynchrony impedes it. However, mean scores in the asynchronous conditions were more closely related to mean scores of non-experimental data collected elsewhere than were the mean scores in the synchronous conditions (e.g., Lawrence et al., 2004; Willard & Norenzayan, 2013). Thus, although in future work having a true, no movement, control condition would be beneficial, the results that synchronizing with others does indeed foster, at least self-reported, perspective taking can be interpreted with confidence.

The current result, that synchrony fosters perspective taking, is an interesting one. However, given this basic finding is found in self-report measures of theory of mind, the framework presented earlier (and in Baimel, Severson, Baron, & Birch, 2015) would be even better supported by findings regarding *behavioral* perspective taking measures. That is, although it is interesting to demonstrate that synchrony fosters self-reported tendencies or willingness to take on others' perspectives, the theoretical framework from which the current hypotheses were drawn would benefit from work demonstrating that synchrony actually makes individuals more likely to take on others' perspectives (and not just self-reported tendencies).

Moreover, although a robust and consistent effect on the Empathy Quotient was found across these three studies, there is more to ‘theory of mind’ than just perspective taking or feeling empathy. Specifically, there is great interest in exploring whether synchrony has any effect on other widely-studied correlates of mental state reasoning – e.g., anthropomorphism/mind perception (Waytz, Epley, et al., 2010). Moving both out of the realm of self-report measures, and to measures of other correlates of theory of mind would greatly broaden the implications of the current research findings.

The capacity to take another’s perspective, and really engage with it, is often held as one of the definitive features of human social-cognition. Despite its implications in myriad domains of human life, from learning to moral reasoning, we are generally inefficient at, and often incapable, of taking on the perspectives of others (e.g., Birch, 2005; Keysar et al., 2003). Given the difficulties in teaching ‘theory of mind’, the robust effect of synchrony on perspective taking evidenced here offers important avenues for future research both in terms of interventions for those who are deficient at or might lack ‘theory of mind’, in addition to simply fostering better social perspective taking in typically developed individuals.

The current findings can help shed light on work being done in the field of dance-movement therapy. In clinical settings, there has been a recent emergence in the study of interventions involving musical group interactions with individuals diagnosed along the autism spectrum. Diagnoses along the autism spectrum are often characterized by deficits in mentalizing which greatly hinder the successful navigation of everyday social interactions (Baron-Cohen et al., 1985). These interventions, and dance-movement therapy more broadly, often involve synchronous interactions with others, and have been

reported to increase capacities over time for imitation, joint-attention and gaze following (Landa, Holman, O'Neill, & Stuart, 2011). As discussed earlier, these are some of the critical building blocks in mental state reasoning, and play an important role in the successful navigation of everyday social interactions. Thus, systematically exploring whether synchrony can be used as a tool for fostering early and efficient mental state reasoning developmentally in both clinical and typical populations would be of the utmost interest.

Generalizability

This research project was conducted entirely amongst undergraduate university students. However, synchrony has been consistently demonstrated to foster interpersonal cooperation and coordination in infants as young as 14-months (Cirelli, Wan, et al., 2014), outside of the controlled setting of the psychological laboratory (Cohen et al., 2010) and in diverse societies around the world (Fischer et al., 2013). Thus, there are grounds to reason that this connection between synchronous action and sociality is cognitively deep, and perhaps less sensitive to cultural moderation. As such, if the effects of synchrony on perspective taking are as structurally or even neurologically related as is currently hypothesized, it is also possible that this general pattern of results would replicate well beyond the confines of the minds of Canadian undergraduate students. Of course, this is a hypothesis that only future research can address.

Studying ritual is important

Cultural evolutionary processes have 'caught onto' to this connection between synchrony and sociality, long before any single human could explicitly relate these phenomena. This has likely lead to the widespread prevalence, and often

institutionalization, of behavioral synchrony in ritual practices around the world and through out time (Ehrenreich, 2006; Henrich, 2015a; McNeill, 1995). More generally, the work presented here provides evidence for how turning to cultural practices such as ritual can provide answers to important questions about human psychological processes.

Specifically, turning to cultural evolution provides us with the framework for understanding how human psychology shapes culture, and how in turn, evolved cultural norms and institutions shape, and often exploit aspects of human psychology.

One of the greatest, and longstanding, puzzles in understanding the origins of human societies is accounting for the origins of interpersonal cooperation. That is, how is it that humans have come to live in such highly social environments, and not only to successfully live amongst others, but to *flourish* amongst others (Haidt, 2012). Some accounts argue that tit-for-tat, reciprocal altruism, amongst individuals could effectively solve the problem of free riding; we only cooperated with those that we trusted enough to return the favor in the future (Trivers, 1971). However, solely an evolved or even a learned sensitivity to reciprocity may not be sufficient in explaining how ever-increasingly large societies maintain levels of cooperation that are defined by high degrees of *impersonal* trust, that is with no expectations of reciprocity (Henrich, 2015a).

One such cultural innovation that may have played an important role in sustaining cooperation in large societies is collective ritual. Collective ritual comes in many forms across the world and throughout time. However, pinpointing the common features of ritual actions has lead us to understand how through various pathways, participating in collective ritual solidifies interpersonal bonds and fosters cooperation. Furthermore, here it has been presented how synchronized ritual actions tune our minds for reasoning about

others' mental states. This is a psychological phenomenon that could not have been hypothesized without turning to our cultural evolutionary history. Surely, there is much else to be learned about the strange things humans do from this perspective.

Tables and Figures

Table 1. Regression model predicted Empathy Quotient subscale scores (affective, cognitive and social skills) from condition, age, gender, and ethnicity in Experiment 1.

	<i>DV: EQ Subscales</i>		
	Affective Empathy	Cognitive Empathy	Social Skills
Condition	0.132 (-0.050, 0.315)	0.192** (0.020, 0.364)	0.136 (-0.040, 0.313)
Age	0.034 (-0.155, 0.222)	-0.001 (-0.179, 0.177)	-0.026 (-0.209, 0.157)
Male	-0.022 (-0.204, 0.160)	-0.301*** (-0.473, -0.129)	0.005 (-0.172, 0.182)
Asian	-0.163* (-0.353, 0.026)	-0.197** (-0.375, -0.018)	-0.334*** (-0.517, -0.150)
Constant	-0.001 (-0.181, 0.178)	0.017 (-0.153, 0.186)	0.014 (-0.160, 0.187)
Observations	114	114	114
R ²	0.050	0.185	0.128
Adjusted R ²	0.016	0.155	0.096
Residual Std. Error (df = 109)	0.976	0.921	0.946
F Statistic (df = 4; 109)	1.449	6.187***	4.005***

Parentheses are 95% confidence intervals

*p<0.1; **p<0.05; ***p<0.01

Table 2. Regression model predicting Empathy Quotient subscales (affective, cognitive, and social skills) from condition, age, gender, and ethnicity in Experiment 2.

	<i>DV: EQ Subscales:</i>		
	Affective Empathy	Cognitive Empathy	Social Skills
Condition	0.086 (-0.074, 0.245)	0.269*** (0.121, 0.418)	0.080 (-0.079, 0.240)
Age	-0.005 (-0.163, 0.153)	-0.093 (-0.240, 0.054)	-0.169** (-0.326, -0.011)
Male	-0.026 (-0.184, 0.133)	-0.196** (-0.344, -0.048)	-0.075 (-0.234, 0.083)
Asian	-0.215*** (-0.374, -0.055)	-0.205*** (-0.354, -0.057)	-0.273*** (-0.432, -0.114)
Constant	-0.003 (-0.158, 0.152)	0.011 (-0.133, 0.155)	-0.012 (-0.166, 0.143)
Observations	145	145	145
R ²	0.064	0.213	0.123
Adjusted R ²	0.037	0.191	0.098
Residual Std. Error (df = 140)	0.951	0.886	0.949
F Statistic (df = 4; 140)	2.396*	9.487***	4.915***

Parentheses are 95% confidence intervals

*p<0.1; **p<0.05; ***p<0.01

Table 3. Means and standard deviations of the measures included in the ‘Social Environments Questionnaire’ by condition in Experiment 2.

	Relational Ties	Group Identification	Fusion
Synchronous	0.78 (1.24)	4.14 (1.52)	2.96 (1.37)
Asynchronous	0.80 (1.03)	4.18 (1.72)	3.00 (1.45)

Table 4. Correlation matrix of the social cohesion and theory of mind measures variables from Experiment 2, ($N = 149$).

	GI	RT	Fusion	EQ-Total	Affective	Cognitive	Social
Group Identification	1						
Relational Ties	0.467***	1					
Fusion	0.554***	0.316***	1				
EQ Total	0.082	-0.005	-0.024	1			
Affective Empathy	-0.039	0.103	-0.062	0.778***	1		
Cognitive Empathy	0.105	-0.094	0.031	0.805***	0.447***	1	
Social Skills	0.033	0.031	-0.065	0.572***	0.468***	0.293***	1

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 5. Means and standard deviations of the measures included in the ‘Social Environments Questionnaire’ by condition in Experiment 3.

	Relational Ties	Group Identification	Fusion
Synchronous	0.61 (0.80)	4.02 (1.75)	2.87 (1.52)
Asynchronous	0.53 (0.71)	4.04 (1.61)	2.81 (1.19)

Table 6. Regression modeling of the Empathy Quotient subscales (affective, cognitive, and social skills) from condition, age, gender, ethnicity, and social cohesion measures in Experiment 3.

	<i>DV: EQ Subscales</i>		
	Affective Empathy	Cognitive Empathy	Social Skills
Condition	0.054 (-0.117, 0.225)	0.210*** (0.054, 0.366)	0.059 (-0.098, 0.216)
Age	-0.026 (-0.201, 0.149)	-0.008 (-0.168, 0.152)	-0.027 (-0.187, 0.134)
Male	0.028 (-0.138, 0.195)	-0.323*** (-0.475, -0.171)	0.027 (-0.125, 0.180)
Asian	-0.158* (-0.333, 0.018)	-0.131 (-0.291, 0.029)	-0.352*** (-0.512, -0.191)
Relational Ties	0.175* (-0.018, 0.368)	0.038 (-0.138, 0.214)	0.124 (-0.053, 0.300)
Group Identification	0.139 (-0.064, 0.341)	0.137 (-0.048, 0.322)	0.033 (-0.153, 0.219)
Fusion	0.184* (-0.383, 0.014)	-0.076 (-0.258, 0.105)	0.076 (-0.106, 0.258)
Constant	0.005 (-0.164, 0.173)	0.018 (-0.135, 0.172)	0.001 (-0.153, 0.156)
Observations	135	135	135
R ²	0.081	0.192	0.176
Adjusted R ²	0.030	0.147	0.131
Residual Std. Error (df = 127)	0.995	0.909	0.912
F Statistic (df = 7; 127)	1.592	4.309***	3.874***

Parentheses are 95% confidence intervals

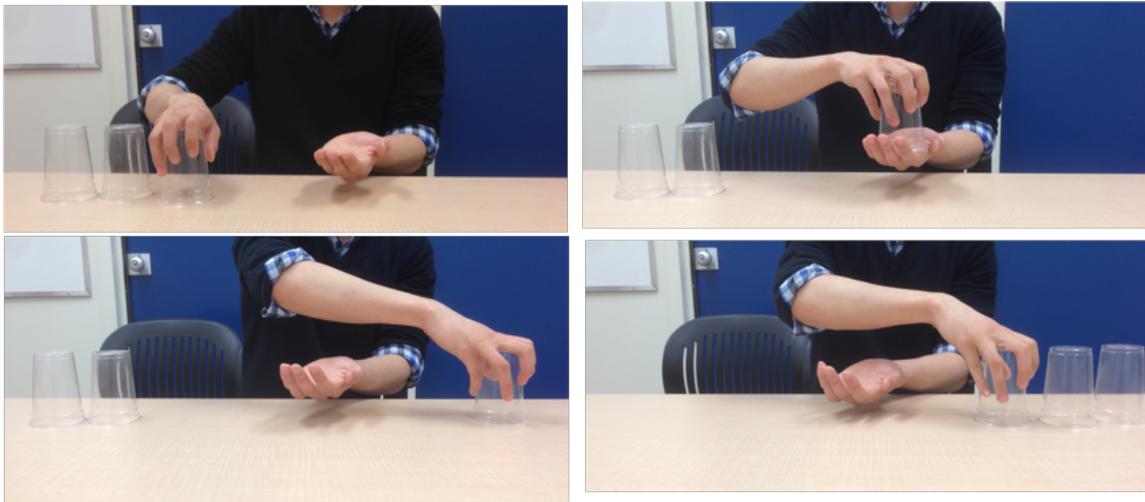
*p<0.1; **p<0.05; ***p<0.01

Table 7. Correlation matrix of the social cohesion and theory of mind variables from Experiment 3 ($N = 138$).

	EQ	Aff.	Cog.	Soc.	Eyes	E-C	E-A	RT	Fus.	GI
EQ	1									
EQ Aff.	0.642***	1								
EQ Cog.	0.768***	0.225**	1							
EQ Soc.	0.503***	0.399***	0.089	1						
Eyes	0.087	0.061	0.035	0.269***	1					
Eyes Think	0.025	-0.029	-0.012	0.192**	0.790***	1				
Eyes Feel	0.111*	0.118*	0.064	0.246**	0.851***	0.350***	1			
Relational Ties	0.234**	0.150*	0.075	0.146*	-0.017	-0.005	-0.021	1		
Fusion	0.102	-0.038	0.020	0.170**	0.046	0.058	0.020	0.411***	1	
Group Ident.	0.230**	0.137*	0.131*	0.160*	-0.059	-0.009	-0.082	0.455***	0.474***	1

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Figure 1. The movement of the cups in the synchrony manipulation used in the experiments presented here. Step 1 is in the top-left, followed by Step 2 in the top-right, Step 3 is in bottom-left, Step 4 is in the bottom-right. These steps were then conducted in reverse order, and over and over again, for a total of three minutes. This task was adapted from Wiltermuth & Heath (2009).



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