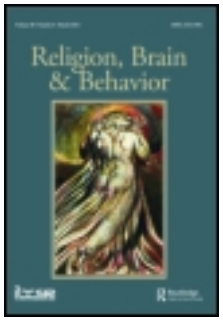

Religion, Brain & Behavior

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rrbb20

Religion, synchrony, and cooperation

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Version of record first published: 01 Feb 2013.

To cite this article: Emma Cohen , Roger Mundry & Sebastian Kirschner (2013): Religion, synchrony, and cooperation, Religion, Brain & Behavior, DOI:10.1080/2153599X.2012.741075

To link to this article: http://dx.doi.org/10.1080/2153599X.2012.741075

Religion, Brain & Behavior, 2013
http://dx.doi.org/10.1080/2153599X.2012.741075

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Taylor & Francis Group

Religion, synchrony, and cooperation

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Shared beliefs about supernatural agents and joint engagement in ritual activities are often proposed to engender cohesion and cooperation within religious communities. We report the results of an experiment that investigated the effects of religious-concept priming and synchronous activity among Brazilian drummers. Participants were divided into two between-subjects narrative priming conditions: religious and secular. Within each priming condition, we applied a within-subjects design to investigate effects of solo, group synchronous, and group non-synchronous drumming on endorphin release and cooperation. We found an effect of priming conditions, such that there was a trend toward higher cooperation in the religiously primed group compared to the secularly primed group. We found neither a main effect of the drumming condition nor a drumming-priming interaction effect. Results suggest that behavioral synchrony alone is insufficient to increase cooperation. In light of previous findings, we propose that high levels of physical exertion or social-cognitive mechanisms, such as overlapping task-representation or intentional coordination, are also required for cooperation.

Keywords: Brazil; cooperation; drumming; endorphin; music; synchrony

1. Introduction

Religion is universal and ancient in human culture. The persistence, spread, and cohesion of religious communities are often attributed to shared beliefs about supernatural agents. For example, Shariff and Norenzayan (2007) proposed that cooperation among community members is maintained through concerns about reputation and fear of supernatural sanctions regarding social-moral infractions. Recent empirical studies have also reported that religiously primed individuals contribute significantly more in anonymous dictator games and accept additional costs in order to punish unfair behavior of others (McKay, Efferson, Whitehouse, & Fehr, 2010; Shariff & Norenzayan, 2007; see also Atkinson & Bourrat, 2011).

Alternative approaches prioritize the role of joint activity, proposing that joint participation in regular religious practices brings community members physically and mentally close together and decreases the likelihood of selfish behavior (e.g., Dunbar, 2004; Durkheim, 1912/1965; Turner, 1969/1995; Whitehouse, 2004). Forms of synchronized group behavior, often encountered in religious practices cross-culturally, such as collective dancing, singing, and drumming, appear particularly effective at heightening feelings of well-being through the activation of pleasure mechanisms such as the opioidergic system (see Dunbar, 2004). Accordingly,

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McNeill (1995) and Dunbar (2008) have proposed that the resulting altered psychopharmacological states (i.e., "endorphin highs") potentially promote a sense of trust and commitment toward fellow-participants, providing fertile ground for the development of cooperative social interaction. In a recent study, Cohen, Ejsmond-Frey, Knight, and Dunbar (2010) showed that, compared with solo rowing, group-synchronous rowing activity heightened opioidergic activity (measured using a pain-threshold proxy). Another study reported a significant positive effect of synchronous singing and movement on group economic game contributions (Wiltermuth & Heath, 2009; see also Hove & Risen, 2009). Kirschner and Tomasello (2010) further showed that the prosocial effects of joint singing and synchronized dancing are already evident in preschoolers.

In the current empirical study, we aimed at disentangling the hypothesized proximate mechanisms behind the social bonding effects of human religious practice. In particular, we investigated the relative effects of religious narrative and behavioral synchrony on within-group cooperation and cohesion. We hypothesized that both belief and behavior work together to promote cooperation among participants. Specifically, motivational effects of religious belief and behavioral synchrony jointly produce stronger positive effects on cooperation than either factor in isolation.

To test our hypothesis, we conducted a mixed-design experiment with a population of drummers in Northern Brazil. Drumming is a salient component of both secular and religious Afro-Brazilian culture. For example, while Samba and *Axé* rhythms come from secular culture, the Candomblé and Umbanda rhythms come from Afro-Brazilian religions (see Johnson, 2002). Recruiting from this population thus allowed us to equalize the plausibility of the religious and secular contexts within which drumming activities were framed in our study. Participation was restricted to males because normally only males drum in Afro-Brazilian religious rituals (see Cohen, 2007). Although we did not target individuals specifically associated with religious communities, this allowed us to avoid potential confounds of gender and religious background.

We subdivided the participants into two between-subjects narrative priming conditions—religious and secular—and applied a within-subjects design to investigate the effects of solo, group synchronous, and group non-synchronous drumming on cooperation (measured via a weak-link coordination exercise) and endorphin release (measured indirectly via pain thresholds). We predicted main effects and an interaction effect from the Priming Condition and Drumming Condition, such that cooperation would be highest after synchronous group drumming with a religious prime. We did not have any strong predictions about the relative effects of solo vs non-synchronous drumming on cooperation, or concerning the interaction of religious vs secular priming across these two conditions. Following our hypothesis that synchrony effects on cooperation are mediated by opioidergic activity, we additionally predicted higher pain thresholds in the group synchronous condition than in the solo and group non-synchronous conditions.

2. Materials

2.1 Narrative prime

Religious and secular narrative primes were recorded by a male of local origin (unknown to the participants) and played back via a stereo system. Both narratives

contained well-known historical and cultural references to the *atabaque* drums used in the study (see supplementary material available online), and were controlled for structure, length, and thematic content. The secular narrative focused on the use of *atabaques* in African-influenced Brazilian culture, such as Samba, Axé, and Capoeira. The religious narrative emphasized their use in African-influenced Brazilian religion such as Candomblé and Umbanda.

2.2 Drumming technology

To ensure that drummers maintained their rhythms at a steady tempo throughout test sessions, we trained participants to use a software program hereafter referred to as "Cascade." This program presented the rhythms as series of vertically moving blocks on a computer screen. The blocks moved down a light grey background along a left and right channel until they coincided with a thick, dark grey line at the bottom of the screen, indicating the proposed drum strikes (see "CohenVideoS1.mov" and accompanying legend in the supplementary material available online). An audio stimulus was also created using synthetic beeps played through headphones to each participant. The stimulus volume was sufficiently low enough that it could not be heard while drumming, but loud enough to help participants recover the correct tempo after pausing or being interrupted.

2.3 Rhythms

We created four simple drumming rhythms, two of which were based on 8 quavers per bar (see supplementary material) and two based on 12 quavers per bar. As in Candomblé and Samba drumming, the rhythms were highly repetitive, consisting of five notes distributed across one bar, which was repeated over and over again. During Solo and Synchronous group drumming, one out of the four rhythms was played at a tempo of 150 beats per minute. In the Non-Synchronous condition—to implement tempo disparity and to prevent accidental entrainment—two participants per group played an 8/8 rhythm and the other two participants a 12/8 rhythm, and were positioned in alternating order across the four drums (see below). Furthermore, in the Non-Synchronous condition, Cascade presented the four rhythms at slightly different tempi, ranging from 145 to 155 beats per minute. We counterbalanced distribution, presentation order, and playback tempo of the rhythms.

2.4 Economic game

Cooperation was measured using a "weak link" coordination game (Weber, Camerer, & Knez, 2004). Each participant received 10 Brazilian Real coins, which they could freely distribute across both communal and personal pots. The money was ostensibly part of their compensation and participants were informed that this exercise afforded an opportunity to increase its value: "The coins you put in your private pot are definitely yours. However, the lowest value placed in the communal pot by any of the four participants in your session will be doubled and distributed evenly among all of you." Participants were trained in this economic game procedure at an introductory meeting at the outset of the study, and a pencil-and-paper revision task was provided at the beginning of each session (see the supplementary material).

Participants made their decisions alone and anonymously in private rooms (see supplementary material for set-up). To avoid experience effects and to motivate participation during all testing days, payoffs were reserved until the end of the eight-day study period.

2.5 Pain threshold

Following Cohen and colleagues (2010), the pain threshold was measured using a MDF 848XP Aneroid Palm Sphygmomanometer (i.e., blood pressure cuff). The cuff was inflated on the participants' non-dominant arm, above the elbow. Ischaemic pain was induced through controlled pumping and participants were instructed to indicate the point at which they felt discomfort by saying "now." The level of pressure at which discomfort was reported (measured in mmHg units) was recorded and the cuff deflated immediately.

2.6 Mood questionnaire

We used a 16-point Visual Analogue Mood Scale (VAMS) to evaluate subjective mood states (see Guimarães, 1998; Norris, 1971; Brazilian Portuguese translation validated by Zuardi & Karniol, 1981; Zuardi, Cosme, Graeff, & Guimarães, 1993). The scale uses a 100 mm line that separates adjectives indicating opposite extremes of a particular mood dimension (e.g., sad–happy, tense–relaxed, etc.). Participants expressed their mood by marking one of the lines, and each mark was recorded to the nearest mm. Prior training in scale use was provided (following instructions from Guimarães, 1998) and instructions were reiterated on a cover sheet accompanying the test questionnaire. Item order was randomized across participants and sessions. Items were grouped for analysis into four pre-validated categories (Guimãraes, 1998): Anxiety, Physical Sedation, Mental Sedation, and Other (see supplementary material).

2.7 Social rapport

At the end of each session, participants answered three questions relating to social rapport (after Wiltermuth & Heath, 2009): 1. *How connected did you feel with the other participants during the drumming?* 2. *How much did you trust the other participants going into the "10 Reals exercise"?* 3. *How similar are you to the other 3 participants?* Participants marked their responses on a 100 mm line (from "Not at all" to "Very much") and these were measured to the nearest mm. Finally, participants indicated how many people in the session they knew as "friends."

3. Method

3.1 Participants

Thirty-five adult males (mean age: 33.2 years, range: 17.7–58.8 years) from Belém, Brazil, were recruited by word of mouth from a diffuse community of amateur drummers. Each participant received 30 BRL per session (cca. 18 USD), 10 of which were used in the economic game. A background questionnaire was used to assess drumming experience. Four participants reported Afro-Brazilian religious drumming

experience and they were evenly distributed across the two between-subjects conditions (i.e., religious vs secular priming). Three participants with all-day availability served as reserve drummers in case of "no-shows." Their data were not included in the final analysis. The remaining 32 participants were randomly assigned an identity number that determined the schedule of their three experimental sessions.

3.2 Procedure and materials

Participants attended one solo drumming session and two group sessions (synchronous and non-synchronous) in counterbalanced order. There were four participants per session. For each participant, testing took place on alternate days, and group composition and individual drumming position varied across sessions.

On arrival, each participant was shown to his private waiting room. At the scheduled start-time, the four participants gathered in a communal space where they received further information and instructions from a trained, local assistant. They returned to their private rooms where they completed the mood questionnaire. Two male assistants were available at all times to answer any questions and to ensure that participants did not talk to one another. On completion of mood scales, the assistants then measured each participant's pain threshold.

Next, participants were led in turn to the testing room for training. They were assigned to one of four identical *atabaque* drums (purpose-built by a local specialist). Drums were positioned two feet apart on a horizontal line, each facing an 18.5-inch LCD screen. Participants were instructed to stand directly behind their drum, facing their screen (see "Drumming SetUp" images in the supplementary material).

E1 (Emma Cohen) demonstrated the novel rhythm on an adjacent drum and invited the participant to copy her rhythm. All participants acquired the rhythms easily. After the participant drummed solo for 15 seconds, E1 instructed him on how to follow the visual and audio stimuli presented by the Cascade program to maintain a steady tempo. After the participant showed confidence in drumming at least four uninterrupted bars of the rhythm, he returned to his private waiting room. The training procedure was repeated across all participants.

For testing, participants returned to the drums on which they were trained. At the start of the test, the religious or secular narrative prime (depending on the condition) was played. E1 then indicated that she would start the Cascade program and thereafter instructed the participants to begin drumming along and continue doing so until the program stopped (for a duration of three minutes). After drumming, participants returned to their private rooms where a second pain threshold test was immediately administered, followed by the economic game. Participants then completed a post-test mood scale and answered three questions relating to social rapport (for full procedure, see supplementary material).

At the end of the eight-day data collection period, and after receiving their compensation and economic game pay-offs, participants completed a final exit questionnaire that probed their interpretation of the study's purpose.

4. Data processing

Each participant's drumming was recorded by piezo elements, which were glued underneath the drumhead, and was saved as individual audio tracks using an

external USB soundcard (Tascam US-1641) and a multitrack recording software (Reaper V3.52). The stimulus beats presented by the Cascade program were also recorded separate as audio tracks (see "Recording Tech" images in the supplementary material).

Using circular statistics (see supplementary material), we calculated each participant's synchronization accuracy according to the stimulus beat presented by Cascade ("Video Sync"). We also calculated each participant's synchronization accuracy with each of the three co-drummers separately. Third, we averaged the latter three values as a measure for this participant's average synchrony with his drumming group ("Group Sync"). In four out of twenty-five sessions, one out of the four piezo elements malfunctioned. Consequently, the Group Synch variable could only be calculated from two of the three co-drummers.

5. Results

Results of the Welch test (Ruxton, 2006) comparing Group Sync across the group conditions (Synchronous and Non-Synchronous) confirmed that the synchrony manipulation was successfully implemented. Inter-participant synchrony was significantly higher in the Synchronous condition ($M = .79$, $SD = .12$) than the Non-Synchronous condition ($M = .28$, $SD = .23$, $t(44.75) = -11.18$, $p < .001$).

The participants' economic game contribution (Figure 1) was not influenced by the priming condition, the drumming condition, or their interaction (likelihood ratio test comparing full with respective null model: $\chi^2(5) = 4.04$, $p = 0.54$. Details on all models and analyses are provided in the supplementary material). Regarding individual effects, we found neither an interaction between the priming and drumming conditions ($\chi^2(2) = 0.11$, $p = 0.94$) nor an effect of the drumming condition on the participants' contribution in the economic game ($\chi^2(2) = 0.34$, $p = 0.85$). Only the priming condition revealed a trend (estimate $= -0.38$, $z = -1.91$, $p = 0.056$). However, this should be treated with caution because it might reflect a Type I error due to multiple testing.

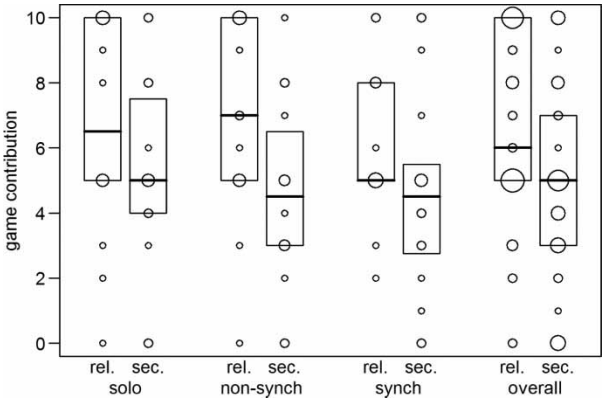

Figure 1. Median economic game contribution per participant (BRL) across Drumming and Priming Conditions. Horizontal lines show medians and box quartiles; the area of the circles corresponds to the number of participants with the respective game contributions.

Pain thresholds were not influenced by the drumming condition, the priming condition, or their interaction (likelihood ratio test comparing full with respective null model: $\chi^2(5) = 4.31$, $p = 0.51$). Considering individual effects, we found neither an interaction effect (MCMC analysis, $p = 0.47$) nor significant main effects of the drumming condition ($p = 0.33$) or priming condition ($p = 0.92$).

Modeling economic game contributions as a response to Group Sync did not reveal any obvious effect on the drumming condition, Group Sync, or their interaction (likelihood ratio test comparing full with respective null model: $\chi^2(3) = 5.0$, $p = 0.17$). Regarding individual effects, we found no interaction ($z = -0.26$, $p = 0.79$), and no effect for Group Sync (estimate $= -0.16$, $z = -0.82$, $p = 0.41$). The Priming Condition appeared to be significant (estimate $= -0.38$, $z = -2.00$, $p = 0.045$). However, this should again be treated cautiously because it might reflect a Type I error due to multiple testing.

The pain threshold difference was not influenced by Group Sync, the Priming Condition, or their interaction (likelihood ratio test comparing the full with the respective null model: $\chi^2(3) = 0.44$, $p = 0.93$). Considering individual effects, we did not find an obvious interaction effect (MCMC analysis, $p = 0.79$), and there was no significant effect for Group Sync ($p = 0.82$) or the Priming Condition ($p = 0.63$).

Neither Similarity nor Connectedness had an obvious effect on economic game contribution (respectively: estimate $\pm$SE $= -0.045 \pm 0.076$, $z = -0.597$, $p = 0.55$; estimate $\pm$SE $= -0.006 \pm 0.061$, $z = -0.092$, $p = 0.927$). However, we found a clear positive effect of Trust on the economic game contribution (estimate $\pm$SE $= 0.196 \pm 0.072$, $z = 2.729$, $p = 0.006$). Yet, combining the p-values revealed that it was only a trend (Fisher's omnibus test: $c^2 = 11.58$, $df = 6$, $p = 0.072$).

We found no effect of Group Synch on Similarity (estimate $\pm$SE $= -0.37 \pm 2.146$, $pMCMC = 0.869$) or Trust (estimate $\pm$SE $= 0.63 \pm 2$, $pMCMC = 0.892$). While there was a clear positive effect of Group Synch on Connectedness (estimate $\pm$SE $= 7.126 \pm 3.091$, $pMCMC = 0.01$), Fisher's omnibus test did not reveal any significance ($c^2 = 9.72$, $df = 6$, $p = 0.14$), suggesting that the one significant finding might be due to multiple testing.

In religiously primed individuals, there was no correlation between median measures of Similarity and Trust ($rho = 0.22$, $N = 16$, $p = 0.421$), but there were clear positive correlations between Similarity and Connectedness ($rho = 0.72$, $N = 16$, $p = 0.001$) and also between Trust and Connectedness ($rho = 0.68$, $N = 16$, $p = 0.003$). In the secular condition, we found clear positive correlations between both Similarity and Trust ($rho = 0.56$, $N = 16$, $p = 0.024$) and between Similarity and Connectedness ($rho = 0.83$, $N = 16$, $P < 0.001$), but no obvious correlation between Trust and Connectedness ($rho = 0.36$, $N = 16$, $p = 0.176$). However, combining these results by using Fisher's omnibus test did reveal clear significance ($c^2 = 51.91$, $df = 12$, $p < 0.001$). Specifically, using means per session, we found a significant correlation between Similarity and Connectedness for the secularly primed individuals only ($rho = 0.78$, $N = 12$, $p = 0.005$). None of the other correlations revealed such significance (Secular–Similarity and Trust: $rho = -0.14$, $N = 12$, $p = 0.667$; Trust and Connectedness: $rho = -0.33$, $N = 12$, $p = 0.297$. Religious–Similarity and Trust: $rho = 0.02$, $N = 13$, $p = 0.957$; Similarity and Connectedness: $rho = 0.39$, $N = 13$, $p = 0.192$; Trust and Connectedness: $rho = -0.31$, $N = 13$, $p = 0.307$). Correspondingly, Fisher's omnibus test did not reveal significance ($c^2 = 19.58$, $df = 12$, $p = 0.075$).

6. Discussion

To our knowledge, this is the first systematic and controlled investigation regarding the effects of two essential components of human religious practice—that is, joint activity and joint belief—on prosocial attitudes and cooperative behavior. Specifically, we investigated the effects of religious and secular priming on cooperative behavior during a weak-link cooperation exercise, which followed drumming in a range of drumming conditions: solo, group synchronous, and group non-synchronous. We found that the Drumming Condition did not influence economic game contribution. However, results suggest a trend toward higher communal-good investments in the religiously primed group compared to the secularly primed group. This trend was not apparently influenced by opioidergic activity or mood changes, as measured by the methods we applied (i.e., pain threshold and questionnaire). We discuss the priming effect below after considering the apparent absence of synchrony effects on economic game and opioidergic activity.

In contrast to our findings, previous research has supported a causal link between synchronous activity and cooperation. Wiltermuth and Heath (2009) found that synchronous marching, singing, and gesturing significantly enhanced cooperation among group members compared to non-synchronous activity. Using a simple measure of dyadic tapping synchrony between participant and experimenter, Hove and Risen (2009) demonstrated a positive effect of synchrony on subsequent affiliation ratings. McNeill (1995) and Dunbar (2008) have suggested that the synchrony effect accounts for the widespread appeal and incidence of cultural rituals involving singing, dancing, marching, and drumming. Such cultural practices, proximate motivations, and skills may play an important role in bonding large human social groups, serving a "social glue" function similar to that of dyadic grooming in primates (Dunbar, 2008; Keverne, Martensz, & Tuite, 1989).

However, it remains unclear how synchronous activity precisely influences social cohesion and cooperation. Wiltermuth and Heath (2009) cleave synchronous activities into those that involve gross motor movement, collective effervescence, and euphoric joy (e.g., rave dancing) and those that don't (e.g., marching), suggesting that the two may constitute distinct routes to synchrony-based cohesion. Cohen and colleagues (2010) stress the role of opioidergic activity in physical exercise, claiming that group synchronous exercise enhances endorphin surges and associated feelings of well-being. Further, these surges and feelings, in turn, positively influence participants' willingness to behave cooperatively. Hove and Risen (2009) and Miles, Nind, Henderson, and Macrae (2010) consider an interpretation in terms of self-other representation: in highly synchronous activity, perceptions of actions produced by the self versus the other closely overlap, blurring the self-other distinction. Kirschner and Tomasello (2010) emphasize the importance of having a collective intention or shared goal during coordinated and synchronous activities (e.g., music). Because these theories have previously received empirical support using comparable sample sizes (e.g., 15 per condition in Study 1 from Wiltermuth & Heath, 2009), the null findings of the present research merit consideration.

6.1 Drumming conditions

Motor movement and physical exercise in the current study were highly constrained in a controlled laboratory setting. Participants performed a simple and repetitive

rhythm that demanded only small hand movements over a three-minute period. The Cascade program maintained a steady, rhythmic pace, enabling control of energetic output across conditions and participants within any particular session, and also facilitating the implementation of both synchronous and non-synchronous drumming within group conditions. The trade-off of such control, however, is that participants did not have the liberty to "get into" or "lose themselves" in the rhythm. If any opioidergic or collective euphoric effect of drumming is driven by gross and sustained physical exercise (as in the "runner's high" phenomenon: see Boecker et al., 2008), the experimental set-up of this exercise did not afford conditions to achieve such effects.

Nevertheless, the experiment successfully generated and manipulated synchrony among participants and may therefore have activated mechanisms related to self-other overlap, if not joint attention and collective intention. In line with the findings of Hove and Risen (2009), where synchrony increased interpersonal affiliation, we observed a positive correlation between group synchrony, connectedness, and trust. Unlike Wiltermuth and Heath (2009), we did not find that synchrony influenced cooperation. In our experiment, as in their Study 3, synchrony and non-synchrony were manipulated as a by-product of individual activity, rather than a direct product of joint intention and inter-individual entrainment. However, a crucial difference in our study was the novelty of the stimulus materials presented. By eliminating possible influences of prior (social) experiences and associations with particular rhythms, the use of novel stimuli may have demanded considerably more attention from participants than in previous studies. By maintaining a fixed forward focus on the Cascade program, eye contact and active inter-individual communication among participants was largely prevented. This also minimized the possibility of "attentional union" (Macrae, Duffy, Miles, & Lawrence, 2008) and the relative shift from *self*-unit to *we*-unit, which, according to Kirschner and Tomasello (2010), underlies synchrony-induced heightened cooperation. Further research comparing novel versus familiar stimuli, and also the differential effects of self versus other perception during synchronous activity, is required to better interpret these mixed results and disentangle the hypothesized mechanisms.

6.2 Priming conditions

Although most participants (31 of 35) did not profess any active involvement in Afro-Brazilian religion, hearing the priming narrative and its explicit reference to the *atabaque* drums from the Afro-Brazilian religious tradition heightened communal contributions during the economic game. The apparent effect of religious priming on economic game behavior corroborates a growing empirical literature supporting a link between religion and prosociality (Atkinson & Bourrat, 2011; Graham & Haidt, 2010; McKay et al., 2010; Preston, Ritter, & Hernandez, 2010; Shariff & Norenzayan, 2007). Shariff and Norenzayan, for example, primed religious concepts using a sentence-unscrambling task. Compared to controls, religiously primed participants shared significantly more money in a subsequent Dictator game. Other recent studies have found evidence that religious priming reduces cheating and promotes costly punishment (Bering, McLeod, & Shackelford, 2005; McKay et al., 2010).

These various findings have been interpreted as reputational concerns activated by cues to "supernatural watchers" implicit in the primes, the threat of supernatural

punishment for non-cooperation, and behavioral priming via semantic association (e.g., religious word primes and associated behavioral norms). Shared belief does not explain the effect found in our study, since participants in the Religious Priming condition did not trust one another more or feel more connected than participants in the Secular Priming condition. Indeed, co-drummers reported feeling significantly more connected in the Secular Priming condition than in the Religious Priming condition. Similarly, internalized norms or threat of punishment does not explain the effect—at least at a conscious level. Afro-Brazilian theology does not portray its deities as infallible moral arbitrators, whose behavior is necessarily consistent with cultural norms of fairness and cooperation (see Cohen, 2007). Nevertheless, even though participants may agree with this portrayal in the abstract, it is possible that the religious prime was sufficient to activate a low-level sense of being watched and that this was a more salient guide to real-time behaviours than abstract, culturally rich narratives specific to supernatural agents of Afro-Brazilian theology (e.g., see Barrett & Keil 1996).

7. Conclusion

The results of this study make an important contribution to the growing literature on religion, synchrony, and cooperation. They raise questions about the precise mechanisms underpinning the apparent causal links among these domains. Pure "mechanical" synchronous group movement may not be sufficient to increase cohesion and cooperation among participants. Rather, high levels of physical exertion or social-cognitive mechanisms, such as overlapping task-representations and shared intentions, may also be required. Future work should therefore identify the variable effects of "incidental" synchrony, jointly intended synchrony, and high-energy synchrony on social affiliation preferences and cooperative behavior.

Acknowledgements

We especially thank Andrezza Barbosa and Mauritz van Butler for their invaluable assistance. The Cognition, Religion and Theology Project at the University of Oxford, funded by the John Templeton Foundation, supported this research. The views expressed are not necessarily those of the Cognition, Religion and Theology Project, the University of Oxford, or the John Templeton Foundation.

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