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Watch me, watch you: Ritual participation increases in-group displays
and out-group monitoring in children

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Abstract

Collective rituals serve social functions for the groups that perform them, including identifying group members and signaling group commitment. A novel social group paradigm was used in an afterschool program ($N = 60$ 4-11-year-olds) to test the influence of participating in a ritual task on in-group displays and out-group monitoring over repeated exposures to the group. The results demonstrate that ritual participation increases in-group displays (i.e., time spent displaying materials to in-group members) and out-group monitoring (i.e., time spent looking at out-group members) compared to a control task across three time points. This study provides evidence for the processes by which rituals may influence children's behaviors toward in- and out-group members and discusses implications for understanding the development of ritual cognition and behavior.

Keywords: group signaling, group monitoring, ritual, social group behavior

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Rituals are a pervasive feature of human social group activity that vary in complexity, intensity, and form within and across populations [1–6]. Examples of rituals range from elaborate religious ceremonies to secular rites of passage. Rituals are socially-stipulated conventions [7] that serve powerful functions for groups. These functions include identifying group members, demonstrating commitment to the group, facilitating cooperation with coalitions, and maintaining group cohesion [8]. We define rituals as conventional, causally opaque procedures, uninterpretable from the perspective of physical causality because they lack an intuitive or observable causal connection between the specific action performed and the desired outcome or effect [7,9].

Engaging in a ritual allows individuals to determine group membership by visually distinguishing those who know the behaviors (the in-group) from those who do not (the out-group). Identifying in-group members allows individuals to determine who is likely to share their beliefs and values, and thus may be a trustworthy reciprocator. Rituals are hard-to-fake group-specific behaviors, often consisting of costly actions that symbolize group commitment [10]. Those who know the ritual rules and actions (the in-group) are easily distinguished from those who do not (the out-group). Thus, rituals serve as reliable signals to group membership. For example, Sosis and Ruffle [11] found that religious adult members of an Israeli kibbutzim were more likely to cooperate with other anonymous members of the kibbutzim if they had greater attendance at the communal prayer. Ritual actions also act as credible behavioral displays that signal adherence to in-group values and shared beliefs, leading to greater transmission and persistence of the shared values of a group among adults [12–14].

Individuals performing rituals demonstrate to other in-group members that they have competency in a shared behavioral repertoire of group-specific information. Engaging in a ritual allows individuals to determine group membership by visually distinguishing those who know the behaviors (the in-group) from those who do not (the out-group). The lack of “insider” knowledge of rituals associated with particular groups, may help identify individuals who are out-group members and thus more likely to be free riders or competitors [15]. Thus, ritual group members should want to display their own knowledge of the ritual to other group members and should pay attention to any differing actions of potential out-group members.

Rituals have a number of social functions [16]. They provide shared experiences among group members, and thus provide a behavioral mechanism for social coordination and cohesion. There are several features of rituals that we hypothesize make them ideal candidates for increasing social group affiliation and cohesion. Rituals are socially scripted, are frequently accompanied by normative or conventional language, and involve behavioral coordination or synchrony within groups [17–20]. Behaviors that are the product of individual-level innovation and done in the context of individual behavior, we would argue are habits. Here, we are interested in group-based collective rituals.

Recent work has demonstrated that the ability to identify and acquire rituals is early-developing [21–24]. Children acquire rituals through the process of imitation [25–29]. Furthermore, children are sensitive to whether rituals are demonstrated by in-group members and are more likely to imitate in-group members [30], particularly when faced with the threat of ostracism [31]. These findings point to an affiliative function of imitation; children imitate others in order to affiliate with in-group members [32,33].

What is the impact of ritual participation on children's social group cognition and behavior? Recent research has demonstrated that participating in a ritual changes children's preferences and attitudes toward the in-group. Ritual participation increases self-reported preferences for in-group members above and beyond group membership alone. For example, children who participate in a collective ritual over a two-week period select the in- over the out-group when allocating privileges, retaining group identity markers, and making group preference choices [34]. While this research provides evidence that children readily engage in and identify cues to rituals, there is a lack of experimental research examining the impact of ritual participation on children's behaviors towards group members.

The aim of the current study was to examine the extent to which ritual participation changes children's behaviors toward in- and out-group members over multiple exposures to a collective ritual. Studies examining both effects of minimal groups in children [35] and the limited studies on children's experience with group-specific rituals [31,36] typically use a single exposure to a minimal group. We aimed to examine behavior—specifically, engagement, in-group displays, and out-group monitoring—over multiple days of exposure to both a novel group and collective activities. To do this experimentally, children were placed in novel groups and participated in either a ritual necklace making task or a matched control task. The purpose was to create a more ecologically valid experiment which more accurately represents children's actual experiences in a real social group and to empirically examine if any initial effects of ritual sustain over time.

Our first objective was to examine the impact of participating in a collective ritual on the extent to which children display markers of group-specific information to other in-group members. To demonstrate in-group membership, we predict ritual participants will be vigilant at signaling their participation to other groups. While anthropological and psychological research on ritual as

a group signal has predominantly sampled adult populations [11–14], information about whether children are sensitive to ritual as a cue to group membership is currently lacking. To measure signaling group membership, we used the time spent displaying group materials to in-group members. We predicted greater time spent displaying materials to in-group members in the ritual versus control condition and that this effect would sustain over time.

Our second objective was to examine whether engaging in a ritual increases attention to or monitoring of out-group members. We predict ritual participants will attend to the actions of the out-group in order to identify out- from in-group members. Children demonstrate in-group biases but don't consistently show out-group biases [34,37,38]. Changes in attitudes toward out-group members may depend on the type of social information (e.g., out-group members deemed as threatening) that is given to children [39–41]. Children's attitudes toward out-group members have typically been examined using self-report measures and scales of group preference and have primarily focused on ethnic or racial prejudice [40,42,43]. Previous research did not show evidence for changes in preferences for or bias toward out-group members after participating in a ritual, however, it is possible that examining this question using behavioral measures may provide a more comprehensive picture of interactions toward both in- and out-group members [34]. We predicted increased looking time at out-group members in the ritual versus control condition that would remain over time.

Method

Participants

Sixty children (40% female, 60% male; $M_{age} = 7$ years, 3 months; range = 4 years, 2 months to 11 years, 5 months) were recruited at two afterschool program locations in the American southwest. Most participants came from working-class families based on school district records

(i.e., eligible for free or reduced-price lunch or other public assistance). The sample was ethnically diverse. See Supplementary Materials Table S1 for a detailed breakdown of demographic information by condition and location.

Sample size was determined prior to data collection via power analysis using a predicted effect size of $f=0.4$. There is no precedent for looking at similar behavioral variables of interest with novel groups paradigms with children, so we chose a conventional sample size that is sufficient to detect a medium effect size. The power analysis suggested a sample size of 26 subjects per group, power $(1 - \beta \text{ err prob}) = .80$. We attempted to consent as many children from the locations as possible and collected data from all consented individuals, so as not to exclude children who wished to participate.

Materials

Across conditions, yellow and green wristbands were used to demarcate novel social groups. We provided each child with a bag of materials including a yellow string, a green string, and 24 yellow, green, and orange beads. Each color of bead included two star-shaped beads, two heart-shaped beads, two circular beads, and two square beads.

Procedure and Coding

In a between-subjects design, children from two locations of the same afterschool program participated in this study. Children were placed in novel groups and participated in either a ritual necklace-making task or a matched control task. The activity across conditions lasted 10 minutes long, six times over a two-week period.

One location participated in the ritual condition and another in the control condition. We ran each condition in different locations to ensure that children did not transmit information between conditions. The afterschool programs were both run by the same company at the different

sites. The curricula, structure of the daily activities, and teacher training were identical across sites ensuring equivalency between conditions. The locations were matched for ethnic diversity, sex, and socioeconomic status. Across conditions, children were randomly assigned to either the yellow or green group.

In each condition, wristbands were introduced, "In this program, we have two groups of children, the green group and the yellow group! You are in the yellow [green] group. Each day you'll put this on to remind you that you are in the yellow [green] group and you'll take it off at the end of the day. Neither group is better than the other; there are just two separate but equal groups. Now each color group is going to use their objects in the special way. I want the yellows to learn together over here, and the greens to learn together over there. Yellow group line up to get your objects, and green group line up to get your objects." In each condition, children were presented with identical bags of beads and string.

Across conditions, children wore in-group colored wristbands daily for two weeks. During this period, they participated in six social group activities of their in-group within their condition. A two-week time period was selected to allow for repeated exposure to the social group activity. In each condition, two confederate adult females (matched for age and ethnicity) acted as group leaders. The group leader was dressed in a yellow or green t-shirt and a corresponding yellow or green visor. In the ritual condition, the group activity was a ritual task (i.e., scripted group necklace-making task). In the control condition, the group activity was a non-scripted necklace-making task with the same materials.

Social Group Activity.

Across conditions, group leaders asked their group to sit in front of them on the corresponding colored lines taped to the floor and passed out materials. In the ritual condition, the

green group leader said, "Okay green group, we are going to play with these beads in a special way, the way the green group does it! Watch what I'm doing!" [Picked up a green star]. "First, hold up a green string. Then, touch a green star to your head. Then, string on a green star." [Touched a green star to head and strung it on. Picked up a green circle]. "Next clap your hands 3 times. Then string on a green circle." [Clapped hands 3 times and then strung the green circle on. Picked up a green square]. "Next, touch a green square to your head. Then, string on a green square." [Touched a green square to head and strung it on. Picked up a green heart]. "Next clap your hands 3 times. Then string on a green heart." [Clapped hands 3 times and then strung the green heart on. Picked up a green star]. "Next, touch a green star to your head. Then, string on a green star." [Touched a green star to head and strung it on. Picked up a green circle]. "Next clap your hands 3 times. Then string on a green circle." [Clapped hands 3 times and then strung the green circle on. Picked up a green square]. "Next, touch a green square to your head. Then, string on a green square." [Touched a green square to head and strung it on. Picked up a green heart]. "Next clap your hands 3 times. Then string on a green heart." [Clapped hands 3 times and then strung the green heart on]. "Now, take the beads off and do it again!" [Removed beads from string and repeated ritual as scripted]. Children were asked to put away the beads and the bags were collected from them. "Okay, we're all done! You did it the way the green group does it! Good job!" The scripted activity was done in synchrony with the children (i.e., verbal instructions were given and the children performed the instructed behaviors simultaneously with the group leader), was modeled twice per session, and took approximately ten minutes to complete. See Supplementary Materials, Table S2 for a detailed description of the scripted tasks by color group. Children participated in this activity six times over a two-week period.

In the control condition, the leaders said, “Okay yellow [green] group, we are going to play with these beads in a special way, the way the yellow [green] group does it!” [Children engaged in unstructured necklace making and bead stringing]. After ten minutes, children were asked to put away their materials. “Okay, we’re all done! You did it the way the yellow [green] group does it! Good job!” Children participated in this activity six times over a two-week period.

Across conditions, children were allowed to interact with the materials during the group activity for ten minutes. After the ten-minute period, they were instructed to put all the materials back into their bags, which the group leader collected. Across conditions, the group leaders always supervised the group activity and children heard the word “group” three times per session.

Coding

Each child’s behavior in their novel social groups was video-recorded and was coded by six independent coders using Datavyu coding software. Different outcome measures collected with these participants only after the six experimental days were previously published [34]. For the purposes of this study, we examined behavior during (rather than after) the experimental days to assess change in behaviors across time. We chose to code the first, third, and sixth (and final) group activities in order to examine behavior across more evenly distributed but distinct time points (at the beginning, middle, and end of the study). The first four minutes of each video was coded in order to assess behaviors during the initial start of the group activities. For all variables, we calculated the proportion of time spent performing any behavior to maintain consistency across variables and time points. This was calculated as the summary of milliseconds spent doing each variable divided by the total amount of milliseconds the child’s head was visible in the frame.

Engagement with In-Group Tasks. To measure children’s engagement with in-group activities, we coded for the proportion of time children spent looking at task-related things. This

was a summary of the total time spent looking at their own materials, at in-group peers, or at in-group leaders divided by the total amount of time the child's head was visible in the frame. Onset of looking at their own materials began when the child looked toward their beads or string and ended when the child shifted focus elsewhere. Onset of looking at in-group peers began when the child looked at an in-group peer and ended when the child shifted focus. Onset of looking at in-group leaders began when the child looked at an in-group leader and ended when the child shifted focus.

In-Group Displays. To measure children's in-group displays, we coded for the proportion of time spent displaying group materials to an in-group member. This was a summary of the total time children made an intentional gesture to demonstrate their materials to an in-group leader or in-group peer divided by the total amount of time the child's head was visible in the frame. Onset of displaying to an in-group leader began when the child held up their materials to the group leader and ended when the child returned the materials to their lap or the floor. Onset of displaying to in-group peer began when the child held up their materials to an in-group peer and ended when the child returned the materials to their lap or the floor. We collapsed proportion of time spent displaying across all in-group members (leaders or peers) because there was inevitable overlap with simultaneous displays to both.

Out-Group Monitoring. To measure children's awareness of the out-group, we coded for the proportion of time children spent looking at out-group members divided by the total amount of time the child's head was visible in the frame. Onset of this behavior began when the child looked toward the out-group and ended when the child shifted focus toward a person or object in another category. At each site, the color groups were seated with the children's backs facing the

out-group, so looking at out-group members was a very salient motion (e.g., the child turning to look over their shoulder).

Interrater Reliability. Six research assistants coded the behaviors and a seventh research assistant independently coded 26% of the dataset (39 of 149 files) for interrater reliability coding. Reliability between coders was calculated across 1-s time steps and the independent coder was in near perfect agreement ($\kappa = 0.98 - 1.00$) with all six of the other coders.

Results

Multi-level linear regressions were performed to determine the effects of condition and time point on the average proportion of time children spent engaging in group tasks, in-group displays, and out-group monitoring. Random intercepts were included for each participant to account for multiple observations per participant. There were no predicted effects of age, sex, color group, and the proportion of days wristbands were worn prior, but these components were retained in the model to control for any variance due to these factors. All analyses reported are two-tailed with $\alpha = 0.05$. We included linear regressions by individual time point in the Supplementary Materials, Table S4 and descriptive statistics by individual time point in the Supplementary Materials, Table S3.

Engagement with In-Group Tasks

There was not a significant effect of condition on the average proportion of time spent engaged with in-group tasks. Children in the ritual condition did not spend a significantly different proportion of time engaged with in-group tasks ($M = .94$, $SD = .05$) than children in the control condition ($M = .94$, $SD = .06$). There was a main effect of sex, indicating that males spent a larger proportion of time engaged with in-group tasks ($M = .95$, $SD = .05$) than females ($M = .92$, $SD = .06$). There was a main effect of color group, with the yellow group spending a larger proportion

of time engaged with in-group tasks ($M = .95$, $SD = .05$) than the green group ($M = .93$, $SD = .06$). We did not have predictions about the effects of sex or color group on engagement and these effects were not consistent across time points (see Supplementary Materials, Table S4 for a breakdown by time point). There was no effect of age, proportion of days wristbands were worn, or time point (Time 1, $M = .95$, $SD = .05$; Time 2, $M = .94$, $SD = .05$; Time 3, $M = .93$, $SD = .07$). See Table 1.

In-Group Displays

There was a significant main effect of condition on the average proportion of time spent displaying materials to an in-group member. Children in the ritual condition spent a larger proportion of time displaying materials to an in-group member ($M = .02$, $SD = .04$) than children in the control condition ($M = .01$, $SD = .02$). There was a marginal effect of the proportion of days wristbands were worn, but no effect of age, sex, color group, or time point (Time 1, $M = .02$, $SD = .03$; Time 2, $M = .01$, $SD = .02$; Time 3, $M = .02$, $SD = .04$). See Table 1 and Figure 1.

Out-group Monitoring

There was a significant main effect of condition on the average proportion of time children spent looking at the out-group. Children in the ritual condition spent a larger proportion of time looking at the out-group ($M = .02$, $SD = .03$) than children in the control condition ($M = .01$, $SD = .02$). There was a main effect of time point where children were less likely to monitor the out-group in Time 3 ($M = .01$, $SD = .02$) compared to Time 1 ($M = .02$, $SD = .03$), as well as Time 6 ($M = .01$, $SD = .03$) compared to Time 1. There was a main effect of the proportion of days wristbands were worn, indicating children were less likely to monitor the out-group the more days they spent in the group. There was a marginal effect of age, but no effect of sex or color group. See Table 1 and Figure 2.

Discussion

This study provides novel evidence for how repeated experience with a collective ritual impacts children's behaviors toward in- and out-group members. Our data build upon previous research demonstrating that participating in a ritual increases children's self-reported in-group preferences [34] by providing behavioral evidence that ritual has social functions in the context of group activity.

Our first objective was to examine the impact of ritual on the extent to which children display markers of group-specific information to other in-group members. Children who participated in a ritual spent more time displaying their materials to the group leader and other members of the group than children in a free-play task, and this effect was sustained over time. This suggests that children in the ritual condition were more concerned with other group members' knowledge of their participation in and knowledge of the ritual task. These results are consistent with the proposal that collective rituals can signal one's group membership and convey evidence of group commitment [10]. In-group display is consistent with another function of ritual: to transmit group norms to new group members [12]. The behaviors found in rituals function as credibility enhancing displays, or as honest signals of commitment to the beliefs and values of the group. This, in turn, increases the rate of adoption and maintenance of those beliefs in others and in future generations [13,14].

Our data provide evidence that participation in low cost rituals (i.e., limited investment of time, resources, and effort) increases in-group display behavior relative to a control condition that was carefully-matched for group experience across multiple time points. It is possible that these effects would be even stronger for costlier rituals; previous research has demonstrated that the more costly rituals are, the more likely they are to signal displays of commitment to group values

and intensify prosocial behaviors and attitudes [44–46]. Future research should systematically examine the impact of the costliness of ritual participation on display behavior in children.

Our second objective was to examine whether engaging in a ritual impacts attention to or monitoring of out-group members. Children in the ritual condition engaged in more out-group monitoring than children who participated in a free-play task, an effect that was sustained over time. The novelty of the scripted-task instructions in the ritual compared to the control condition may explain greater out-group monitoring initially (at the first time point), but is unlikely to explain why these conditional differences persist at later time points when the group activities are no longer novel (Supplementary Materials, Table S4). Notably, in both conditions, children were told that they were engaging in shared behavior that was unique and special to their group, which could have increased interest in out-group behavior across both conditions. Increased monitoring of out-group members could indicate increased salience or awareness of the boundaries between the in- and out-group. Across conditions, children were most likely to monitor out-groups in the first time point compared to the latter time points. Emphasizing group boundaries helps to identify who is more likely to cooperate and who could be a potential free rider or even a threat to the group [15].

We argue that the control condition is an exceptionally strong test of our hypotheses. The instructions, materials, and amount of group experience were identical and children were familiar with one another in both conditions. Detecting these effects between conditions that were carefully matched for group experience among children who were familiar (and friendly) indicates that these effects can be produced even among children who would otherwise be “in-group” members. Differences in children's in-group signaling and out-group monitoring behaviors between conditions cannot be explained by differences in overall engagement. There were no differences in the level of engagement in the group activity by condition.

Our experimental manipulation is meant to simulate the experience of ritual in real world contexts, and we would expect our effects to be smaller than rituals embedded in complex and meaningful group practices. There are a number of theories of ritual, such as Whitehouse's modes of religiosity theory that high-frequency, low arousal rituals have unique psychological effects [47]. We argue that this study provided unique evidence for the effects of repeated exposure and familiarity with rituals on psychological and behavioral outcomes. A key feature of this paradigm is multiple exposures to a collective ritual. Our data demonstrate differences in our variables of interest between conditions across multiple time points, however, more research is needed to examine the robustness of these effects and to further understand how the content and amount of ritualistic activity impacts both cognition and behavior.

We did not find an effect of age on in-group displays, out-group monitoring, nor levels of engagement. This finding may be due to the nature of the sample, which included 100% of classroom participation, resulting in a wide age distribution. Given evidence that children become more sensitive to intergroup biases [42,48] and cues to ritual [25–27] with age, future work should more systematically examine the effects of age on ritual participation and intergroup behaviors.

This research demonstrates that engaging in a ritual increases children's awareness of out-group members, yet we lack evidence for how ritual participation might lead to out-group biases, hostility, or even prejudice. Children show prejudice toward out-group members when in-group norms encourage exclusion or when out-group members are deemed threatening [40]. Future research should examine how ritual influences bias or hostility against out-group members. For example, studies could manipulate whether the rituals presented encourage exclusion and how costly the ritual behaviors are. If greater costliness of ritual behavior leads to increased longevity

of religious groups [46], perhaps costliness also leads to greater in-group cohesion and out-group biases. This could provide additional insight into understanding intergroup conflict.

The development of ritual cognition and behavior is a topic of growing interdisciplinary social scientific study. This study is the first to our knowledge to demonstrate that ritual participation influences children's in-group signaling and out-group monitoring. Our results enrich our understanding of the empirically-documented and early-developing tendency to prefer in-group members to out-group members [37,39] by demonstrating how participating in collective rituals impacts behaviors directed at in- and out-group members over time. We provide behavioral evidence to support that rituals serve psychological functions for group cognition in children by using an ecologically valid design with groups of children engaging in coordinated activities.

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Table 1. Linear regression analyses for predictors of the average proportion of time participants spent engaging in behaviors of interest.

Predictors	Engagement with in-group tasks			In-group displays			Out-group monitoring		
	$\beta(SE)$	p	95% CI	$\beta(SE)$	p	95% CI	$\beta(SE)$	p	95% CI
Constant	.90 (.04)	<.001	[.82-.98]	-.01 (.02)	.710	[-.05-.03]	.07 (.02)	<.001	[.03-.10]
Condition (Ritual)	-.01 (.01)	.328	[-.03-.01]	.01 (.01)	.043	[.00-.03]	.02 (.01)	.002	[.01-.03]
Time (vs. Time 1)									
Time 3	-.01 (.01)	.620	[-.03-.01]	-.01 (.01)	.241	[-.02-.00]	-.01 (.01)	.032	[-.02-.00]
Time 6	-.01 (.01)	.178	[-.04-.01]	.00 (.01)	.692	[-.02-.01]	-.01 (.01)	.025	[-.02-.00]
Age (months)	.00 (.00)	.537	[.00-.00]	.00 (.00)	.957	[0.00-.00]	.00 (.00)	.080	[.00-.00]
Color Group (Yellow)	.02 (.01)	.021	[.00-.04]	-.01 (.01)	.148	[-.02-.00]	-.01 (.01)	.339	[-.01-.00]
Sex (Female)	-.03 (.01)	.007	[-.05- -.01]	-.01 (.01)	.102	[-.02-.00]	.01 (.01)	.271	[.00-.01]
Wristbands worn (proportion of days)	.03 (.03)	.359	[-.03-.10]	.03 (.02)	.069	[.00-.07]	-.03 (.02)	.042	[-.06-.00]

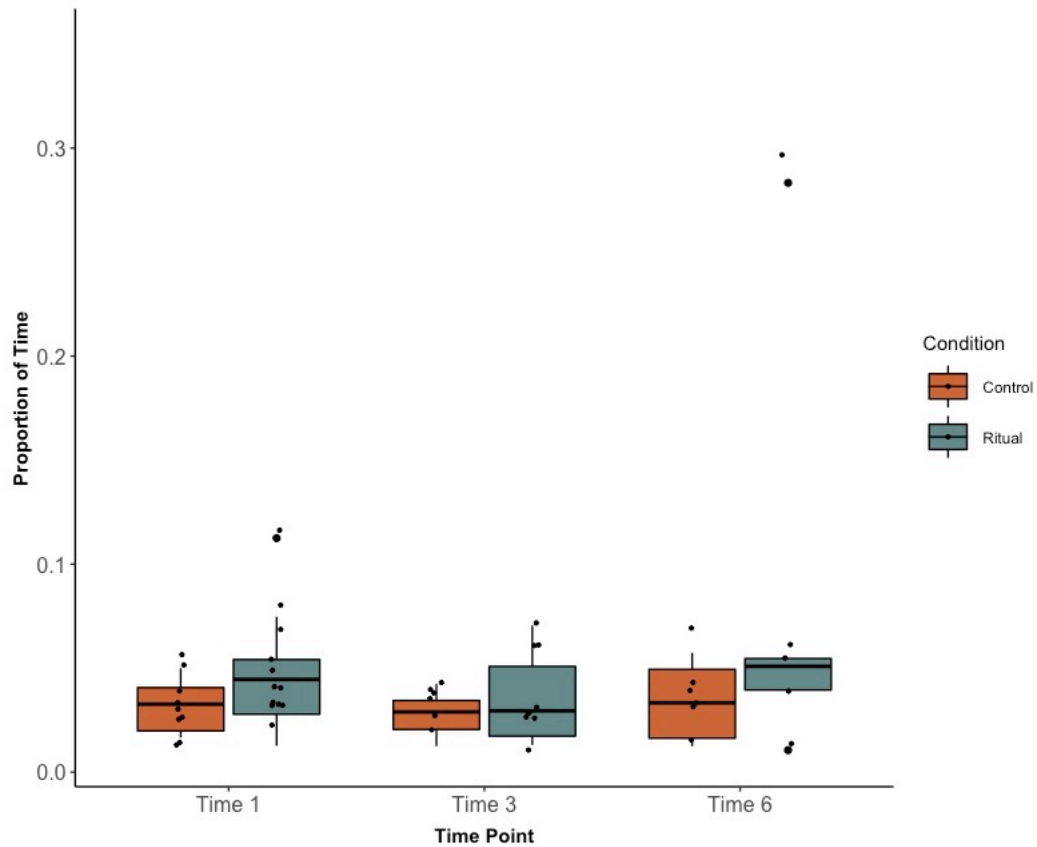


Figure 1. The box-and-whisker plots show the proportion of time spent displaying materials to in-group members by condition and time point. The boxes indicate the first and fourth quartiles (50% of all values in the group). The solid horizontal lines inside the boxes represent the medians. The solid vertical lines capture the location of extreme values, with the exception of outliers (shown as circles) that exceeded the inter-quartile distance by more than 1.5.

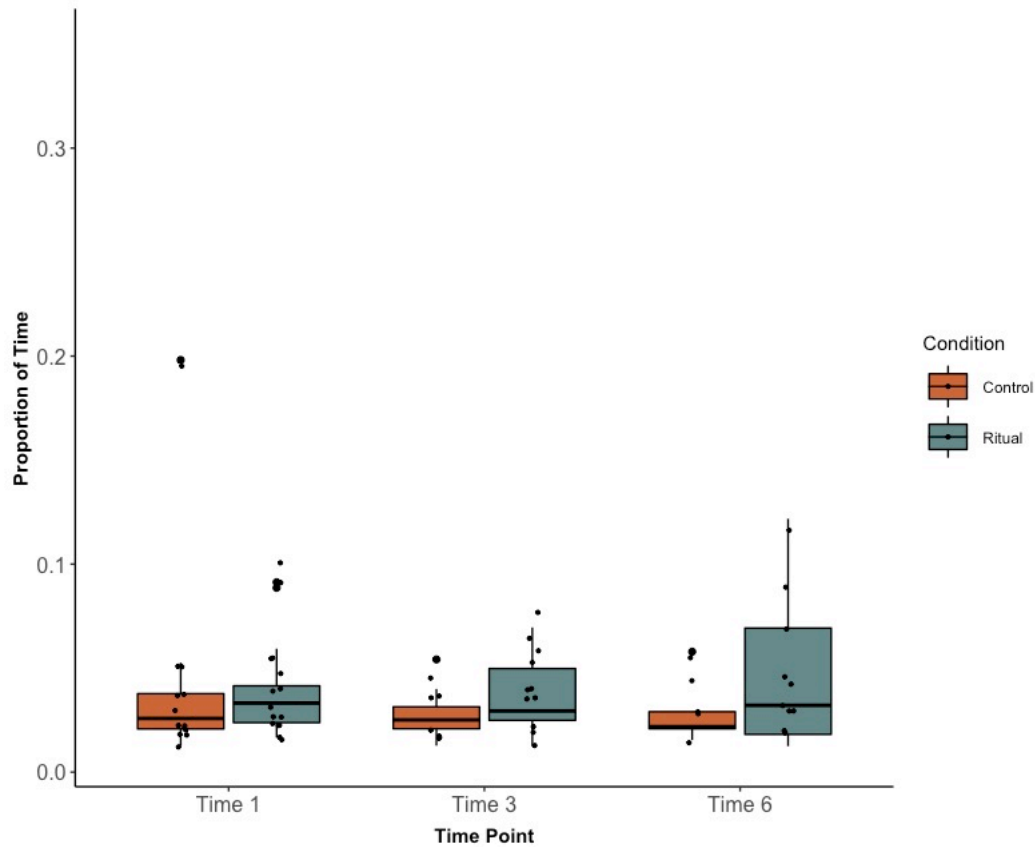


Figure 2. The box-and-whisker plots show the proportion of time spent monitoring out-group members by condition and time point. The boxes indicate the first and fourth quartiles (50% of all values in the group). The solid horizontal lines inside the boxes represent the medians. The solid vertical lines capture the location of extreme values, with the exception of outliers (shown as circles) that exceeded the inter-quartile distance by more than 1.5.

Supporting Information for “Watch me, watch you: Ritual participation increases in-group displays and out-group monitoring in children

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Additional Methodological Information

Table S1. Breakdown of sex, age, ethnicity, and socioeconomic status by condition/location.

		Ritual	Control
<i>n</i>		28	32
Sex	Female	36%	44%
	Male	64%	56%
Age	<i>M_{age}</i>	7y, 11m	6y, 10m
	<i>Range</i>	4y, 11m - 11y, 5m	4y, 2m – 10y, 4m
Ethnicity (based on school district records)	Hispanic	70%	59%
	White	17%	29%
	African-American	10%	10%
	Other	3%	1%
Socioeconomic Status	Economically disadvantaged (based on school district records)	77%	54%

Table S2. *Ritual condition group leader actions by color group.*

Order of Action	Green Group		Yellow Group	
	Bead	Gesture	Bead	Gesture
1 st		Touch Star to Forehead		3 Hand Claps
2 nd	String Star		String Square	
3 rd		3 Hand Claps		Touch Heart to Forehead
4 th	String Circle		String Heart	
5 th		Touch Square to Forehead		3 Hand Claps
6 th	String Square		String Star	
7 th		3 Hand Claps		Touch Circle to Forehead
8 th	String Heart		String Circle	

Table S3. Mean proportion of time participants engaged in behaviors of interest by condition and time point.

	Engagement with in-group tasks		In-group displays		Out-group monitoring	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Time 1						
Control	.94	.05	.01	.02	.02	.04
Ritual	.95	.05	.03	.03	.03	.03
Time 3						
Control	.93	.06	.01	.01	.01	.01
Ritual	.95	.04	.02	.02	.02	.02
Time 6						
Control	.94	.07	.01	.02	.01	.01
Ritual	.92	.06	.02	.06	.02	.03

Table S4. Linear regression analyses for predictors of the average proportion of time participants spent engaging in behaviors of interest for each time point.

Predictors	Engagement with in-group tasks			In-group displays			Out-group monitoring		
	β (SE)	<i>p</i>	95% CI	β (SE)	<i>p</i>	95% CI	β (SE)	<i>p</i>	95% CI
Time 1									
Constant	.84 (.05)	<.001	[.75-.94]	-.02 (.03)	.496	[-.07-.03]	-.09 (.04)	.021	[-.02-.16]
Condition (Ritual)	-.01 (.01)	.685	[-.03-.02]	.02 (.01)	.024	[.00-.03]	.01 (.01)	.257	[-.01-.03]
Age (months)	.00 (.00)	.09	[.00-.00]	.00 (.00)	.629	[.00-.00]	.00 (.00)	.646	[.00-.00]
Color Group (Yellow)	.03 (.01)	.009	[.01-.06]	.00 (.01)	.965	[-.01-.01]	-.01 (.01)	.371	[-.03-.01]
Sex (Female)	-.02 (.01)	.119	[-.05-.00]	-.01 (.01)	.054	[-.03-.00]	.00 (.01)	.906	[-.02-.02]
Wristbands worn (proportion of days)	.04 (.04)	.346	[-.04-.12]	.03 (.02)	.215	[-.02-.07]	-.06 (.03)	.087	[-.12-.01]
Time 3									
Constant	.91 (.07)	<.001	[.78-1.04]	.00 (.02)	.817	[-.04-.03]	.04 (.02)	.048	[.00-.08]
Condition (Ritual)	.01 (.02)	.690	[-.03-.04]	.01 (.01)	.014	[.00-.02]	.01 (.01)	.013	[.00-.02]
Age (months)	.00 (.00)	.872	[.00-.00]	.00 (.00)	.428	[.00-.00]	.00 (.00)	.125	[.00-.00]
Color Group (Yellow)	.01 (.02)	.527	[-.02-.04]	-.01 (.00)	.017	[-.02-.00]	.00 (.01)	.962	[-.01-.01]
Sex (Female)	-.01 (.02)	.705	[-.04-.03]	.00 (.00)	.361	[-.01-.01]	.01 (.01)	.255	[.00-.02]
Wristbands worn (proportion of days)	.01 (.06)	.809	[-.10-.13]	.03 (.02)	.058	[.00-.06]	-.02 (.02)	.388	[-.05-.02]
Time 6									
Constant	.87 (.08)	<.001	[.72-1.03]	-.03 (.06)	.583	[-.14-.08]	.04 (.03)	.155	[-.02-.11]
Condition (Ritual)	-.03 (.02)	.098	[-.08-.01]	.02 (.01)	.240	[-.01-.05]	.03 (.01)	.001	[.01-.04]
Age (months)	.00 (.00)	.911	[.00-.00]	.00 (.00)	.768	[.00-.00]	.00 (.00)	.027	[.00-.00]
Color Group (Yellow)	.02 (.02)	.212	[-.01-.06]	-.02 (.01)	.114	[-.05-.00]	-.01 (.01)	.253	[-.02-.01]
Sex (Female)	-.06 (.02)	.004	[-.10-.02]	-.01 (.01)	.642	[-.03-.02]	.01 (.01)	.075	[.00-.03]
Wristbands worn (proportion of days)	.09 (.08)	.252	[-.06-.24]	.07 (.05)	.195	[-.04-.18]	.00 (.03)	.991	[-.06-.06]

Exploratory Analyses

Table S5. Mean proportion of participants engaged in in-group displays and out-group monitoring by condition and time point.

	In-group displays		Out-group monitoring	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Time 1				
Control	.43	.50	.61	.50
Ritual	.72	.46	.86	.36
Time 3				
Control	.34	.48	.45	.51
Ritual	.61	.50	.70	.47
Time 6				
Control	.32	.48	.43	.50
Ritual	.35	.49	.70	.47

Table S6. Exploratory regression analyses for predictors of the average proportion of participants engaged in in-group displays and out-group monitoring.

Predictors	In-group displays			Out-group monitoring		
	$\beta(SE)$	p	95% CI	$\beta(SE)$	p	95% CI
Constant	.06 (.35)	.864	[-.59-.72]	1.15 (.35)	.001	[.49-1.81]
Condition (Ritual)	.15 (.09)	.101	[-.02-.32]	.32 (.09)	.001	[-.14-.50]
Time (vs. Time 1)						
Time 3	-.09 (.10)	.389	[-.28-.11]	-.17 (.09)	.067	[-.34-.01]
Time 6	-.20 (.10)	.050	[-.39-.01]	-.19 (.09)	.038	[-.37-.01]
Age (months)	.00 (.00)	.424	[.00-.01]	.00 (.00)	.356	[-.01-.00]
Color Group (Yellow)	.01 (.08)	.905	[-.15-.17]	.01 (.09)	.950	[-.16-.17]
Sex (Female)	-.09 (.09)	.295	[-.26-.07]	.14 (.09)	.129	[-.03-.32]
Wristbands worn (proportion of days)	.29 (.30)	.326	[-.28-.86]	-.45 (.29)	.131	[-1.00-.12]