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Rituals Improve Children's Ability to Delay Gratification

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To be accepted into social groups, individuals must internalize and reproduce appropriate group conventions, such as rituals. The copying of such rigid and socially stipulated behavioral sequences places heavy demands on executive function. Given previous research showing that challenging executive functioning improves it, it was hypothesized that engagement in ritualistic behaviors improves children's executive functioning, in turn improving their ability to delay gratification. A 3-month circle time games intervention with 210 schoolchildren (M_{age} = 7.78 years, SD = 1.47) in two contrasting cultural environments (Slovakia and Vanuatu) was conducted. The intervention improved children's executive function and in turn their ability to delay gratification. Moreover, these effects were amplified when the intervention task was imbued with ritual, rather than instrumental, cues.

Psychologists have invested considerable effort in the study of how instrumental skills (e.g., tool use) are socially learned (Carpenter, Call, & Tomasello, 2005; Gleissner, Meltzoff, & Bekkering, 2000; Williamson & Markman, 2006; Woodward, 2009), but much less is known about how cultural conventions are acquired and transmitted (Harris, 2012; Whitehouse, 2011, 2012). Recent research suggests that even preschool children are alert to a distinction between instrumental and ritual actions and are liable to copy the latter more precisely, with lower propensity to innovate or embellish modeled behavior (Herrmann, Legare, Harris, & Whitehouse, 2013; Legare, Wen, Herrmann, & Whitehouse, 2015; Watson-Jones, Legare, Whitehouse, & Clegg, 2014).

These findings imply two distinct interpretive framings of modeled behavior (Herrmann et al., 2013). The first of these—the "instrumental stance"—involves the tacit assumption that the modeled actions are performed in the service of a specific concrete goal in accordance with normal expectations about physical causation. The second—the "ritual stance"—involves the tacit assumption that the actions are conventional, being arranged thus for no other reason than that it is the "done" or "proper" way of behaving. Although activation of the instrumental stance may engender innovations, modifications, or embellishments insofar as the actor can detect and manipulate the causal mechanisms by which the actions accomplish the goal, activation of the ritual stance promotes imitation with high precision and rigidity: Modeled actions are reproduced with greater fidelity.

The present study investigates the cognitive effects of activating the ritual stance. In particular, we examine the effects of ritual stance activation on executive functioning, and one of its developmentally significant outcomes: the capacity to delay gratification (Inzlicht & Schmeichel, 2012; Shamosh et al., 2008; Weatherly & Ferraro, 2011). We hypothesize that ritual stance activation affects executive functioning because it promotes imitative fidelity, which in turn requires maintenance of attention on the model, memory for detailed action sequences, and inhibition of instrumental goals. That is, imitative fidelity makes significant demands on the major constituents of executive functioning: attention, memory, and inhibitory control (e.g., Friedman et al., 2007; Hull, Martin, Beier, Lane, & Hamilton, 2008; Miyake, Friedman, Emerson,

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Witzki, & Howerter, 2000). As activities that challenge executive functioning also improve it (Diamond & Lee, 2011), recurrent activation of the ritual stance should cultivate executive functioning, and consequently the ability to delay gratification. Indeed, there is already some correlational evidence for a link between ritualized behavior and the relevant aspects of executive functioning. For example, Pietrefesa and Evans (2007) found that among children over 6 years old, those who engaged in more ritualized behaviors also demonstrated greater inhibitory control. In the present study, we experimentally activate the ritual and instrumental stances, and measure children's executive functioning and ability to delay gratification.

Our manipulation of the ritual and instrumental stances involves a series of "circle time games," previously used in developmental research on executive functioning (see Tominey & McClelland, 2011 for detailed description; see also Schmitt, McClelland, Tominey, & Acock, 2015). The intervention games were designed by Tominey and McClelland to improve children's executive function by practicing *attention* (performing specific behaviors in response to various cues, then doing the opposite), *inhibitory control* (starting and stopping in response to different oral and visual cues), and *working memory* (remembering rules and instructions, and switching between different sets of rules). Tominey and McClelland (2011; see also Tominey & McClelland, 2013) report that intervention participation was related to a significant improvement in executive function skills. We adapted the protocol of Tominey and McClelland, supplementing the games with verbal priming to activate the ritual and instrumental stances, respectively (Herrmann et al., 2013). We expected to replicate and extend the finding that such games improve children's executive functioning (Schmitt et al., 2015; Tominey & McClelland, 2011), as measured via the HTKS (Head–Toes–Knees–Shoulders) task, a direct measure of the relevant aspects of behavioral regulation (viz., inhibitory control, attention, and working memory; Cameron Ponitz, McClelland, Matthews, & Morrison, 2009). We also expected positive effects of the circle time games on children's ability to delay gratification, as measured via an adaptation of the marshmallow test (Mischel, Ebbesen, & Zeiss, 1972). Our main hypothesis was that the ritualized version of the circle time games would have greater positive effects than the instrumentalist version. Furthermore, we propose a mediation model, such that the effect of ritualized intervention games on children's ability to delay gratification is mediated by improvements in executive function. Finally, to account for possible variation in sensitivity to ritual cues caused by different cultural environments, we collected data in two cultural contexts: Slovakia and Vanuatu.

Method

Design

The study consisted of three phases. In the *pretest* phase, measures of executive function and the ability to delay gratification were administered. The *intervention* phase then lasted 3 months. In the *posttest* phase, the pretest measures were readministered. All the task and test instructions were translated into Slovak (Slovakia) and Bislama (Vanuatu) by a single translator and then back-translated into English by two other translators.

As the pretest in this study might itself have influenced participants' performance at the posttest stage, we used the Solomon four-group design (SFGD; Solomon, 1949; Solomon & Lessac, 1968) that, with various combinations of pretested groups and groups with intervention, allowed us to ensure that the results were not attributable to the influence of the pretest (McCambridge, Butor-Bhavsar, Witton, & Elbourne, 2011). Following the SFGD, participants were randomly assigned to four groups, as described in Table 1.

Groups 1 and 2 in the SFGD are interpreted as per a pretest/posttest design. Comparing the results of Groups 1 and 2 with the results of Groups 3 and 4 allows one to determine if the pretest itself influenced the results. The comparison between Groups

Table 1
Solomon Four-Group Design

Group description	Pretest	Intervention	Posttest
Group 1: Pretested participants from the experimental (ritual and instrumental) groups	✓	✓	✓
Group 2: Pretested participants from the control group	✓		✓
Group 3: Non-pretested participants from the experimental (ritual and instrumental) groups		✓	✓
Group 4: Non-pretested participants from the control group			✓

1 and 3 allows one to determine the effect (if any) of the pretest upon the intervention. Finally, comparing the results of Groups 2 and 4 shows the possible effect of the pretest, independently of the intervention. Although the SFGD requires twice as many groups as the classic pretest/posttest design, it does not require twice the number of participants. Braver and Braver (1988) showed that when the original number of participants is simply split in half, no statistical power is lost—on the contrary, there generally is a slight gain in power when analyzed meta-analytically. The results of the SFGD analysis are included in the Supporting Information.

Participants

Data were gathered in two countries: Slovakia and Vanuatu. Slovakia is a Central European nation state with a neoliberal economic system. Its public education system values and promotes analytic reasoning, and focuses on individual attributes and qualities (Kaščák & Pupala, 2014). There is a relatively low emphasis on cultural customs and rituals in Slovakia. In contrast, Vanuatu, an archipelago in the Southwest Pacific, is a traditional and heavily ritualistic Melanesian culture. It is a small-scale society, further subdivided into smaller societies with their own languages and authorities, many of whose peoples place a high store on local and traditional ways of life. The culture values and promotes the creation and expression of strong societal bonds, emphasizing prosocial feelings and adherence to communities' normative conventions, which are also emphasized in local schools. The two contrasting cultures were selected to examine the cross-cultural generalizability of the effects of ritual cues on executive functioning. One possibility is that Vanuatuan subjects, who place high importance on ritual performance, are more likely to be affected by the activation of the ritual stance, even in novel contexts. On the other hand, the cognitive effects of ritual participation may be less dependent on cultural familiarity. At the outset, we had no specific predictions about which of these scenarios is more likely.

In total, 110 participants were recruited in Slovakia, and 105 participants in Vanuatu. Attrition rate was low, with only five children dropping out, three (two Slovakia; one Vanuatu) of whom did so due to prolonged illness during the pretest phase before any data were collected. One child dropped out after the first intervention session (Slovakia), and one child was dropped after the intervention phase as she only attended 23% of the sessions. After attrition, the final sample consisted of 107 children from European middle class families in Slovakia (48 girls, 59 boys; M_{age} = 7.82 years, SD = 1.85; data collected between January and May 2013) and 103 Melanesian children living in communities consisting of self-sustaining cooperative groups in Vanuatu (56 girls, 47 boys; M_{age} = 7.73 years, SD = 0.95; data collected between February and June 2014), totaling 210 participants (104 girls, 106 boys; M_{age} = 7.78 years, SD = 1.47); as required by the SFGD, of the 210 study participants only 124 were pretested, and all of the participants completed the posttest. The two cultural groups did not differ in age, $t(208) = 0.44$, $p = .59$, or sex, $\chi^2(1, N = 201) = 1.89$, $p = .17$. The difference in pretest executive function was marginal, $t(122) = 3.49$, $p = .053$; Slovakian children (M = 27.62, SD = 8.39) performed slightly better than Vanuatuan children (M = 22.18, SD = 0.69).

Measures

Executive Function

We employed the HTKS task (Cameron Ponitz et al., 2009) to measure executive functioning, as it is widely used to measure children's ability to attend to instructions, use working memory to remember and execute commands, and inhibit automatic responses (Cameron Ponitz et al., 2009; Lan, Legare, Cameron Ponitz, Li, & Morrison, 2011; von Suchodoletz et al., 2013; Wanless et al., 2011). The HTKS is a version of the Head-to-Toes task (McClelland et al., 2007; Cameron Ponitz et al., 2008), specifically adapted for children over 5 years old by adding additional sections to broaden the range of scores on the task. The HTKS task was administered individually in a quiet room with minimal distractions. Children were initially asked to respond naturally to two pairs of commands: (a) "Touch your head!" and "Touch your toes!"; (b) "Touch your knees!" and "Touch your shoulders!" We then invited them to play a game that involved responding in a stipulated fashion contrary to these commands, that is, to touch their toes when they were commanded to touch their head, and vice versa; and to touch their shoulders when commanded to touch their knees, and vice versa. The HTKS task included 20 incongruent items in total, with possible item scores of 0, 1, or 2 for each item (total scores thus ranged from 0 to 40). Children received 2 points for a correct response without a prior movement toward the incorrect response; 1

point for a "self-correcting response," defined as any motion toward the incorrect response, followed by the child stopping and responding correctly; and 0 points for an incorrect response. Higher scores in the task indicate higher levels of executive functioning ability.

Delay of Gratification

Following Mischel and colleagues (e.g., Mischel & Ebbsen, 1970; Mischel & Moore, 1973), each child was presented with a piece of candy and was given two options: (a) they could eat the candy while they waited for the experimenter to return or (b) they could refrain from eating, touching, or smelling the candy until the experimenter returned, at which point they would receive three pieces of candy. Following previous research, we used a predetermined criterion time of 15 min but did not inform children of what the delay would be. All the session were videorecorded and as soon as a child touched, smelled, or tasted the candy, or otherwise indicated that he or she no longer wanted to wait, the session ended and the time elapsed to that point (in minutes) was recorded.

Interrater Reliability

All sessions of the study were videorecorded to enable independent blind coders to provide HTKS and delay of gratification scores. HTKS scores were coded by the experimenter and one additional blind coder per site. The delay of gratification task was coded by the experimenter as well as two blind coders. Interrater reliabilities (averaged across the pretest and posttest) between each pair of coders for the HTKS task (Cohen's $\kappa = .99$; $n = 103$) and each group ($n = 3$) of coders for the delay of gratification task (Cohen's $\kappa = .96$; $n = 107$) were excellent.

Intervention and Experimental Manipulation

The intervention period lasted 3 months. Children were randomly assigned to one of three groups: *ritual*, *instrumental*, or *control*. Those assigned to the *ritual* and *instrumental* conditions were taken out of the classroom twice weekly for the "circle time" games in groups of eight to ten. These games, which require inhibitory control, attention, and working memory, were designed by Tominey and McClelland (2011) to improve behavioral self-regulation. In their study, six games were presented over sixteen 30-min sessions (1–2 games per session); as the sessions progressed additional instructions were added, increasing the complexity of the games. We adapted this protocol, such that there were six games in each 30- to 45-min long session, with the games becoming increasingly complicated and new rules being added as each session progressed. All sessions were supervised by the same researcher to ensure fidelity of implementation with the help of a local substitute teacher, who was hypothesis and condition blind. Sessions always took place on the same day of the week and at the same time of day, and games were played in invariant order. This adaptation made the intervention appropriately challenging and engaging for the participating age group. All the children in both countries were able to follow the instructions, enjoyed the game sessions, and participated fully.

The games were supplemented with verbal priming to prompt the adoption of the *ritual* or *instrumental* stances, respectively. Following previous research, in the *ritual* condition, no rationale or explanation was provided for the actions, and no goal was specified. Moreover, instructions were accompanied by assertions, such as "it has always been done this way" or "those are the rules and they must be followed," to encourage interpretation of the actions as conventional rather than instrumental (cf. Herrmann et al., 2013). It was hypothesized that conventional framing of actions would encourage the participants to adopt a ritual stance by cuing opportunities for convention learning. Learning of conventions (e.g., forms of greeting, dining etiquette, religious rituals, bodily attire) calls for rigid learning strategies because procedural norms are that way because it is the "done" or "proper" way and not because of a knowable causal structure, which once recognized can generate goal-directed action. As well as gaining competence in various technical instrumental skills, children also need to acquire the normative conventions of their surrounding communities in order to achieve group acceptance, respect, or influence. In contrast, in the *instrumental* condition instructions were accompanied by explanations, such as "if we do it this way, we will learn how to dance," "if we do it this way, we will learn about different animals," to encourage interpretation of the actions as having a goal-directed rationale, allowing for less rigid learning and individual innovations. Besides these verbal differences, the circle time games in the ritual and instrumental conditions were identical to ensure that no extraneous differences in the games themselves could account for the results. Children assigned to the control group did not play any circles games. The intervention took place during

school hours. Only the children participating in the intervention were taken out of the classroom to participate in the games. The children assigned to the control group remained in the classroom participating in the school's educational curriculum in the normal way.

Results

Descriptive Statistics

Descriptive statistics for the measures are presented in Table 2.

Multilevel Analyses

To test for potential cross-cultural differences, we conducted multilevel analyses with cultural setting introduced as a random effect and delay of gratification as the dependent variable. The analyses demonstrated that introducing the type of intervention (*ritual* vs. *instrumental*) significantly improved the fit of the model ($p < .0001$). However, introducing cultural setting (Slovakia vs. Vanuatu) as a random effect did not improve the model ($p = .96$). Indeed, only 0.7% of the variance in posttest delayed gratification scores was explained by cultural setting (ICC = .007). We thus concluded that the intervention had a similar effect on the children from both settings and the data from both were subsequently merged and analyzed as a whole.

Pretest Comparisons

Experimental conditions differed neither in age, $t(207) = 1.7631$, $p = .17$, or sex, $\chi^2(2, N = 210) = 5.25$, $p = .07$, nor in pretest executive function, $F(2, 123) = 1.35$, $p = .26$, and delay of gratification scores, $F(2, 123) = 1.97$, $p = .14$. All the children attended at least 97% of the intervention.

Table 2
Descriptive Statistics for the Measures Across Cultural Settings

	Executive function (HTKS) scores	Delay of gratification scores
Pretest		
N	124	124
Range	0–39	0–15
M	23.36	8.92
SD	12.25	5.48
Posttest		
N	210	210
Range	0–40	0–15
M	25.69	10.10
SD	11.01	5.08

Note. HTKS = Head–Toes–Knees–Shoulders task.

Relation Between Executive Function and Delayed Gratification

As the data violated several assumptions of analysis of variance (ANOVA) and regression, to test whether children's executive function predicted their ability to delay gratification, we performed a robust (percentile bootstrap: see Supporting Information for a description of assumption tests and their results) regression analysis with the Theil–Sen estimator (a method of slope estimation insensitive to outliers and heteroscedasticity; Wilcox, 1998). As predicted, higher scores on the HTKS task predicted longer waiting periods on the delay of gratification task, $\beta = .26$, $p < .001$, $R^2 = .26$).

Effects of Circle Time Games Intervention on Executive Function

To investigate whether the circle time games intervention improved children's executive function, especially when coupled with ritual priming, we performed Welch ANOVAs, and analyzed linear contrasts between groups. First, as suggested by Braver and Braver (1988), we performed a meta-analysis for SFGD, which demonstrated that the intervention had a significant effect on executive function improvement even in the absence of the pretest (detailed results presented in Supporting Information). Next, we performed a robust 3 (condition: *ritual* vs. *instrumental* vs. *control*; between-subjects) × 2 (HTKS task administration: pretest vs. posttest; within-subjects) mixed design ANOVA. This revealed a main effect of HTKS task administration, indicating that scores on the executive function measure improved after the intervention. This was qualified by an interaction between the HTKS task administration factor and condition, indicating differences in the improvement of executive function between children from the *control*, *instrumental*, and *ritual* groups, $F(1, 121) = 12.16$, $p < .001$, $\eta^2 = .39$. A follow-up one-way robust ANOVA on the posttest HTKS scores revealed large differences in posttest executive function between the *control* and intervention (*ritual* and *instrumental*) groups, $F(1, 54.05) = 30.22$, $p < .001$, $\eta^2 = .4$. Children assigned to the *instrumental* group scored higher on the executive function task than children assigned to the *control* group ($p < .001$, $\eta^2 = .21$). The largest improvement in executive function was recorded

among children in the *ritual* group, who scored higher than their peers from both the *control* ($p < .001$, $\eta^2 = .56$) and *instrumental* groups ($p < .002$, $\eta^2 = .24$). The impact of the different types of intervention explained 37% of the variance in posttest executive function.

Effects of Circle Time Games Intervention on Delayed Gratification

Next, we investigated whether the circle time games improved children's ability to delay gratification, especially when coupled with ritual priming. Again, we first performed the meta-analysis, which demonstrated that the intervention was effective in improving the ability to delay gratification even in the absence of the pretest (see Supporting Information). Next, we performed a robust 3 (condition) × 2 (delayed gratification task administration: pretest vs. posttest; within-subjects) mixed design ANOVA. This revealed a main effect of delayed gratification task administration, indicating that scores on the delay of gratification measure improved after the intervention. This was qualified by an interaction between the delayed gratification task administration factor and condition, indicating differences in the improvement of the ability to delay gratification between children from the *control*, *instrumental*, and *ritual* groups, $F(1, 121) = 8.78$, $p < .001$, $\eta^2 = .34$. A follow-up one-way robust ANOVA on the posttest delayed gratification scores revealed large differences in the ability to delay gratification at posttest between the *control* and intervention (*ritual* and *instrumental*) groups, $F(2, 72.5) = 31.1$, $p < .001$, $\eta^2 = .53$. These differences explained 28% of the variance in posttest delay of gratification scores. At posttest, children from the *instrumental* group evinced better ability to delay gratification than their peers from the *control* group ($p < .001$, $\eta^2 = .17$). Again, however, the largest improvement was recorded among children from the *ritual* group, whose ability to delay gratification was better than that of children assigned both to the *instrumental* ($p < .002$, $\eta^2 = .16$) and *control* groups ($p < .001$, $\eta^2 = .49$).

Mediation Analysis

To test the prediction that the effect of the intervention games on children's ability to delay gratification is significantly mediated by executive function, we conducted a mediation analysis with Huber-type M-estimator, in conjunction with a percentile bootstrap method, as described in Zu and Yuan (2010). This analysis showed that the effect of intervention condition on the ability to delay gratification was mediated by executive function ($\beta = 2.28$, $p < .001$). We also performed a path analysis to determine the contribution of the indirect effect of intervention condition (relative to the direct effect of intervention) to the total effect. The indirect effect was defined by the path "intervention→executive function→delay of gratification" and the direct effect by the path "intervention→delay of gratification." The model with executive function as a mediator was found to have a good fit, $\chi^2(1) = 1.83$, $p = .18$, comparative fit index = 0.99, with the standardized total effect being .3, of which .21 was contributed by the standardized indirect effect of intervention condition on posttest delayed gratification scores. This result confirmed that the effect of intervention condition on children's ability to delay gratification was mediated by executive function.

Robust statistical analyses indicated that rule-based intervention games incorporating a ritual priming manipulation led to a greater improvement in the ability to delay gratification than games incorporating an instrumental priming manipulation. To test the prediction that the effect of ritualistic intervention games on children's ability to delay gratification would be significantly mediated by executive function, we conducted a robust mediation analysis, using the Zu and Yuan method. This analysis showed that the effect of ritualistic intervention games on children's ability to delay gratification was significantly mediated by executive function ($\beta = 1.62$, $p < .001$). Finally, an additional path analysis was conducted to determine the contribution of the indirect effect of ritual priming (relative to the direct effect of ritual priming) to the total effect. This analysis indicated that the model had a good fit, $\chi^2(1) = .17$, $p = .68$, comparative fit index = 1.00, with a standardized total effect of .48, of which the standardized indirect effect of ritual on posttest delay of gratification was .28. This result confirmed that the effect of the *ritual* condition on children's ability to delay gratification was mediated by their executive function.

The study results are portrayed in Figure 1.

Discussion and Conclusions

Many aspects of "ritual" behavior have been identified in the social sciences. Some recent theoretical and empirical research has considered rituals as action sequences that are interpreted in

conventional rather than instrumental terms (Herrmann et al., 2013; Legare et al., 2015; Watson-Jones et al., 2014). Accordingly, in our studies —across two sites, among two culturally and linguistically distinct groups—we manipulated children's ritual participation by framing an identical series of action sequences in either conventional or instrumental terms. This manipulation enabled us to look at the downstream developmental effects of ritual participation per se in a carefully controlled manner.

This study examined the effect of ritual participation on children's executive functioning and their ability to delay gratification. Replicating the results of previous research (Schmitt et al., 2015; Tominey & McClelland, 2011), we found that circle time games generally improved children's executive functioning; furthermore, they improved children's ability to delay gratification.

The ways in which intervention components (designed to enhance executive function) influenced the improvement of the ability to delay gratification are hypothesized to be as follows:

1. *Working memory* serves to maintain active representations of goal-relevant information in delayed gratification situations (including abstract representations of future self, the consequences of present behavior, the value of delayed rewards, etc.).
2. *Attention* supports focus on goal-relevant stimuli, instead of focusing on cues that signal indulgence and immediate gratification. When attention shifts from cues signaling long-term advantages toward cues signaling gratification, the individual fails to exert self-control and surrenders to the tempting, gratifying stimuli of immediate rewards.
3. *Inhibitory control* may suppress automatic prepotent response and impulsive behaviors related to more available or pleasing immediate rewards in pursuit of longer term goals.

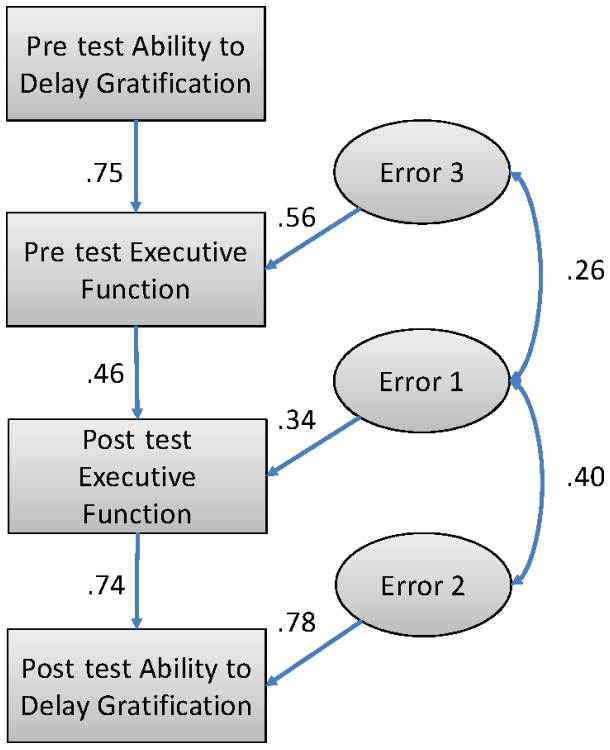

Figure 1. Mediation analysis portraying the study results.

In situations in which a goal is not perceptually present (finishing studies, receiving a larger reward later, having a successful relationship, etc.) in the time when an action is supposed to be made (studying for exams, not eating one sweet now in order to receive two sweets later, resisting the urge to fight with a partner, etc.), individuals must be attentive to the cues that are relevant to the desired goal and must inhibit impulsive, counterproductive, or intrusive thoughts and behaviors.

As hypothesized, we also found that compared to instructions emphasizing the instrumental function of the activities, framing the same behaviors as prescribed conventions led to overall greater improvement in children's executive function and their ability to delay gratification. This may be the result of using generic normative language ("this is how one must do it"; "this is the way it has been done," etc.). Research on children's understanding of normative conventions shows that children typically view rules not as expressions of personal preference but as requirements that everybody should conform to (Göckeritz, Schmidt, & Tomasello, 2014; Rakoczy & Schmidt, 2013; Schmidt & Tomasello, 2012). Generic normative statements, such as those used in the ritual condition (as opposed to more idiosyncratic ones used in the instrumental condition), may point to the presence of rules that must be followed and replicated in a precise manner. The use of such language may indicate that these rules apply to the group as a whole irrespective of individual preferences. Our analyses also supported our hypothesized causal model: The effect of the ritual stance on children's capacity to delay gratification was mediated by its effect on executive functioning.

These findings, which were equally strong in both Western and Melanesian populations, suggest

that ritual participation is effective at improving executive functioning, even across widely differing cultural environments. This conclusion is necessarily qualified as only one task was used to assess children's executive functioning (i.e., HTKS; see also Diamond, 2014; Diamond & Lee, 2011 for other tasks), albeit one that has previously been shown to be a valid and reliable measure of children's executive function and that has previously been used in cross-cultural research (Cameron Ponitz et al., 2008, 2009; Wanless et al., 2011). Future research should attempt to administer other measures, including those that separately measure different components of executive function, suitably adapted given the difficulties in implementing tasks in rural Vanuatu, where materials and other resources (e.g., electricity) are scarce.

Although Ni-Vanuatu culture is more ritualistic than that of Slovakia, the effects of the intervention were similar for participants from both regions. It is possible, however, that participants from Vanuatu were more sensitive to the normative language used to cue the ritual stance but that this was masked by the effects of socioeconomic differences between Western and Melanesian populations. Previous research has shown that the ability to delay gratification is correlated with socioeconomic variables including levels of education and literacy (Kirby et al., 2002; Shoda, Mischel, & Peake, 1990), lower rates of conflict and violence in the family (McBride, Paikoff, & Holmbeck, 2003), higher income and physical resources (Green, Myerson, Lichtman, Rosen, & Fry, 1996; Kirby et al., 2002), and lower prevalence of local catastrophes (Li, Li, & Liu, 2011). Future research might investigate these issues further. Nevertheless, it still remains the case that ritual participation positively influenced the ability to delay gratification among participants from both countries, consistent with our hypothesis that the ritual stance, triggered by normative language, helps to train one's ability to resist immediate temptations and inhibit prepotent responses.

Given that the Vanuatu population was selected as representative of ritual-based culture, one might have expected to see differences in pretest executive function across cultures, with Vanuatuan children performing better at pretest. We did not, however, observe such differences (if anything, Slovakian children performed better). It may be that the demands (and thus the effects) of ritual-based culture do not begin to manifest until later in development, once children engage in extensive ritualized behaviors in both the school environment and community life (cf. Pietrefesa & Evans, 2007).

Another possible limitation of the present study is the compromise made between experimental control and experimental blindness: All the sessions were supervised by the same researcher, who was not blind to conditions, with assisting teachers who provided the instructions and who were condition and hypotheses blind. Although our outcome measures were recorded in part by blind coders and raters, we cannot wholly rule out effects of experimenter bias. Furthermore, the ritual/instrumental framing manipulation (Herrmann et al., 2013; Legare et al., 2015) also has its limitations. Following previous research, we interpret the different conditions as activating different cognitive stances toward the task, but extraneous differences between the conditions (e.g., instruction vagueness/specificity) may have had an effect. Finally, although our contention is that activation of the ritual stance affects executive functioning because it leads to greater fidelity of imitation (we suggest the imitator pays close attention to all aspects of the modeled behavior, copying each and every parseable feature rather than just the causally efficacious elements), we did not collect any measures of imitative fidelity in the present study. We suggest that future studies incorporate such measures.

The research reported here suggests that, all else being equal, adopting a ritual stance makes more cognitive demands on at least some aspects of executive function than does adopting an instrumental stance; in particular, ritual actions appear to engage aspects of executive function related to one's ability to delay gratification. Far from being a simple matter of "mindless" copying, ritual participation arguably requires the kind of rigorous computation of arbitrary detail and avoidance of normatively proscribed deviation from the script (Herrmann et al., 2013) that engages and exercises our executive functioning abilities.

The tendency of much previous research on social learning to overlook this point may be symptomatic of a widespread devaluation of ritual and tradition in Western childrearing (Kanu, 2007; Matthews, Watego, Cooper, & Baturo, 2005; Provenzo, 2009) and educational practice. The irony may be that in devising strategies for parenting and schooling geared to a world of rapid technological change while neglecting the importance of traditional cultural practices, we may be contributing to a deterioration of young people's attentive and inhibitive resources, thus promoting impulses toward instant

gratification. Given that a poorer ability to delay gratification has been shown to predict addictions, earlier sexual debut and unwanted pregnancy, problems with emotion regulation, and lower levels of academic performance (e.g., Casey et al., 2011; Gross, 1998; Hanoch, Rolison, & Gummerum, 2013; Kirby, Petry, & Bickel, 1999; Shoda et al., 1990), our results may have important implications for the design and implementation of future educational strategies.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Data S1. Solomon four-group design analyses and testing assumptions of ANOVA and regression