The Ritual Stance and the Precaution System: The role of goal-demotion and opacity in ritual and everyday actions

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Abstract

Rituals tend to be both causally opaque and goal-demoted, yet these two qualities are rarely dissociated in the literature. Here we manipulate both factors and demonstrate their unique influence on ritual cognition. In a 2 x 3 (Action-Type x Goal-Information) between subjects design 484 US adults viewed Causally Opaque (Ritual) or Causally Transparent (Ordinary) actions performed on identical objects. They were provided with no goal information, positive goal information ('Blessing') or negative goal information ('Cursing'). Neither causal opacity nor goal information influenced perceptions of physical change/causation. In contrast, causal opacity increased attributions of 'specialness', whereas goal-information did not. Finally, goal-information interacted with action-type on measures of preference, such that ordinary actions are influenced by both 'blessings' and 'curses', but ritual actions are only influenced by 'curses'. These findings are interpreted in light of the Ritual Stance, and the cognitive bases of the effects are described with reference to Boyer and Liénard's Precaution theory of ritualized behavior. The combined value of these two theories is discussed, and extended to a causal model of developmental ritual 'calibration'.

Keywords: Ritual Cognition, Ritual, Goal Demotion, Causal Opacity, Religion, Action Perception, Action Precaution System

1.1 Introduction

Ritual-like behavior appears to have been a part of the *Homo* behavioral repertoire for hundreds of thousands of years, with evidence of Neandertal burial dating back ~300kya (Rendu et al., 2014). The ubiquity of such actions in modern *Homo sapiens*, and their general absence in our closest living relatives, suggests an adaptive role. Rituals solve evolutionary and cultural problems, including bonding and cooperation (Konvalinka et al., 2011; Legare & Nielsen, 2015; Reddish, Bulbulia, & Fischer, 2014; Wiltermuth & Heath, 2009), commitment to group values (Ensminger, 1997; Henrich, 2009; Irons, 2001; Ruffle & Sosis, 2007; Sosis & Ruffle, 2003), and transmission of normative and cultural information (Atran & Henrich, 2010; Chudek & Henrich, 2011; Rossano, 2012; Schjoedt et al., 2013; Sosis & Bressler, 2003). While the effects of ritual are well documented, less is understood regarding the cognitive mechanisms that bring these effects about. Ritualized actions can be recognized for their repetition, redundancy, stereotypy, and formality (Boyer & Liénard, 2006; Bulbulia & Sosis, 2011; Eilam, Zor, Szechtman, & Hermesh, 2006; Legare & Souza, 2012; Rappaport, 1999; Rossano, 2012). Such actions also feature causal opacity and goal-demotion: qualities which can apply to the *whole sequence* of actions ('ritual'; Nielbo & Sørensen, 2015; Sørensen & Nielbo, 2013). While many ordinary behaviors embody these qualities (as with the repetition of cleaning, or the formalities of social life) rituals feature these qualities in conjunction and often without instrumental justification. In the absence of a rich exegetical history associated with particular actions (as is often the case with religious rituals) both causal opacity and goal-demotion, which are common qualities of many rituals, allow observers to identify an action sequence as a ritual rather than as an ordinary alternative (Nielbo & Sørensen, 2015; Sørensen & Nielbo, 2013), thus cuing different behavioral and cognitive responses.

However, not all rituals are created equal. Rituals may not be causally opaque, nor goal demoted (nor do they always occur simultaneously). Religious rituals, for example, typically have a great deal of history and exegetical justification (which means they are not goal-demoted), and may involve instrumental outcomes, such as making something clean (which means they are causally transparent). Hereafter, we refer to the phenomenon under consideration as ritualized behavior (as defined in the first paragraph) and refer to

sequences of ritualized behaviors, not as 'rituals', but as ritualized actions. This terminology has been used in order to avoid confusion or conflation with other kinds of ritual, particularly religious rituals.

Causally opaque actions (like crossing one's fingers for good luck) deny observers intuitive access to the mechanism by which the action causes an effect. According to a number of authors such actions obfuscate instrumental interpretations due to a "decoupling of an action sequence's causal dependency structure" (Kapitány & Nielsen, 2015; Keupp, Behne, & Rakoczy, 2013; Legare & Wen, 2014; Legare, Whitehouse, Wen, & Herrmann, 2012; McGuigan, Makinson, & Whiten, 2011; Nielsen, Kapitány, & Elkins, 2015; Schjoedt et al., 2013; Watson-Jones, Legare, Whitehouse, & Clegg, 2014). Conversely, causally transparent (ordinary) actions can be easily and intuitively understood (as is the case with hammering a nail into wood). While causal opacity describes whether or not an action sequence has an observable potential mechanism, goal-demotion refers to an observer's ability to infer and understand an actor's reason (e.g., goals or motivations) for a given action sequence (Boyer & Liénard, 2006; Keren, Fux, Eilam, Mort, & Lawson, 2013; Liénard & Boyer, 2006; Nielbo & Sorensen, 2011; Schjoedt et al., 2013). Put simply, causal opacity begets the question '*by what mechanism is an effect being caused'* while goal-demotion begets '*Why does the actor act?*'. Rituals tend to be both opaque and goal-demoted, and as a result, are rarely dissociated in the literature.

When we perceive an action as opaque and goal-demoted we recognize it as deliberate (not incidental or accidental) and adopt *the ritual stance;* via conventional and affiliative motives we make normative and social inferences which inform our subsequent behavior (Herrmann, Legare, Harris, & Whitehouse, 2013; Legare & Souza, 2012; Nielsen et al., 2015). This has been demonstrated in children (DiYanni, Corriveau, Kurkul, Nasrini, & Nini, 2015; Herrmann et al., 2013; Legare, Wen, Herrmann, & Whitehouse, 2015; Nielsen et al., 2015) and adults (Ensminger, 1997; Henrich, 2009; Irons, 2001; Ruffle & Sosis, 2007; Sosis & Ruffle, 2003). Furthermore, artificial neural networks have been shown to learn how to discriminate between ritualized and non-ritualized action sequences (Nielbo & Sørensen, 2015; Sørensen & Nielbo, 2013). But what are the proximate and ultimate explanations for discriminating between ritualised

actions and non-ritualized actions? What cognitive mechanisms or systems are responsible?

According to Boyer & Liénard (2006) and Liénard & Boyer (2006) ritualized behavior constitutes the elements of ritual. They argue that ritualized actions are 'partly parasitic' on cognitive systems adapted to serve other purposes and that cultural rituals are a by-product. These systems, identified respectively as the Hazard-Precaution and the Action Parsing system, are design to detect inferred threat and potential harm to protect the organism, but misfire in the case of ritualized action[1]. The 'proper functional range' of activation is a range of stimuli calibrated by evolution adaptive to the organism, while the 'actual domain' includes an extended range of stimuli, not shaped by evolution, which share a sufficient number of features with 'proper' stimuli. For example, children may adaptively avoid dangerous foods by virtue of taste cues - like bitterness - but may incorrectly reject palatable food - like broccoli - as a result (Wardle & Cooke, 2008). The Hazard-Precaution and Action Parsing systems are calibrated to respond to inferred threat via cues in the behavior of others who are directly responding to legitimate threats. For example, the proper range of activation for hazard-precaution may include responding to others' behavior as they respond to pathogen or social threat. To illustrate: observing a response to pathogen threat may include observing deliberate *repetitive* cleaning and caution (in the form of *stereotypy*); observing a response to social threat may include imitation/*synchrony*, submission/supplication, or conformity (Watson-Jones, Whitehouse, & Legare, in press).

Ritualized actions share many features and cues with 'proper' threat response, and tend to disrupt the level at which the actions are analysed and interpreted, arresting the system, a phenomenon known as 'cognitive capture' (Boyer & Liénard, 2006; Liénard & Boyer, 2006; Nielbo, Schjoedt, & Sorensen, 2013; Zacks, 2004a, 2004b; Zacks, Speer, Swallow, Braver, & Reynolds, 2007). There are three hierarchical levels of action parsing: '*Scripts*' '*Behavior*', and '*Gesture*'. The default level is Behavior. For example,

[1] A great deal has been written on Action Parsing independent of these authors. See Nielbo, Schjoedt, & Sorensen, 2013; Nielbo & Sørensen, 2015; Sørensen & Nielbo, 2013; Zacks, 2004a, 2004b; Zacks, Speer, Swallow, Braver, & Reynolds, 2007.

you might observe someone in a kitchen and describe their behavior as {cleaning a glass}, because you can intuit the actor's intentions and the mechanisms of action. This contrasts with Gesture. Here, the same actions are parsed discretely as [raising a glass], [grasping a cloth] and [rubbing the glass with a cloth]. Scripts generate a broader description, like '*preparing lunch'* or '*cleaning the kitchen'*. When the action-elements involved in {cleaning a glass} are used in such a way as to prevent an instrumental outcome we shift down to [gesture]. For example, we cannot say someone is {cleaning} if a cloth, despite being moved in a cleaning motion, is never bought into contact with the glass. Thus, we automatically parse the actions discretely as [raising a glass] [grasping a cloth] and [waving the cloth in the air].

Our systems are arrested when cognitive predictions are disrupted by error-checking processes. When actions are goal demoted and causally opaque we are forced to parse at a *gestural,* rather than a *behavioral,* level (Schjoedt et al., 2013; Watson-Jones et al., in press; Zacks, Tversky, & Iyer, 2001). However, we are motivated to return to the default level of interpretation, and so we attempt to attribute and infer meaning (Herrmann et al., 2013; Legare & Souza, 2012; Rossano, 2012; Nielbo & Sørensen, 2015; Schjoedt et al., 2013; Sørensen & Nielbo, 2013). Causal opacity has been discussed in the literature in depth (Kapitány & Nielsen, 2015; Legare et al., 2012; Nielsen et al., 2015; Schjoedt et al., 2013; Watson-Jones et al., 2014). In a recent study Kapitány and Nielsen (2015) showed that objects subjected to opaque actions were reported as more special and desirable compared to objects subjected to transparent actions. Providing benign social context increased this effect, while aversive context had no influence. They concluded that ritualized actions are interpreted normatively. Unlike causal opacity, goal-demotion has been less explored (but see: Keren et al., 2013; Mitkidis, Lienard, Nielbo, & Sorensen, 2014; Nielbo & Sørensen, 2015; Sørensen & Nielbo, 2013).

In the current study we directly manipulate and dissociate causal opacity and goal-demotion. Participants were shown a series of videos featuring an actor performing actions on sets of identical glasses containing an amber liquid. Actions were presented as either ritualistic (causally opaque) or ordinary (causally transparent) and were accompanied with a description of the actor's intentions ('goals') as either a blessing or a curse, or were left without a description. We chose to employ two opposite-valence goals

in order to better assess the magnitude of any potential effect (as we anticipate they will elicit different responses). All actions were described as belonging to a specific benign ritual tradition. After viewing the videos participants responded to questions addressing whether each glass was the 'same' and/or 'special', and which they'd most like to drink from.

Our predictions derive from the ritual stance (that ritualistic actions are interpreted normatively). We hypothesised that objects subjected to ritualized actions *(opaque actions)* would be rated as more special and desirable (i.e., they would be chosen as the glass to drink from) than objects subjected to *ordinary (transparent) actions*. Additionally, compared to *no goal* information, *blessings* (positive goal information) would increase desirability, and *curses* (negative goal information) would decrease it. We made no predictions regarding the 'same' question, as this question primarily serves as an attention-check (Kapitány & Nielsen, 2015, found judgements of 'sameness' to be unaffected by the types of actions presented).

2.1 Methods

2.2 Participants

Participants were recruited via mTurk and were offered $1.20(US) for their time. Based on the methods and analyses of Kapitany and Nielsen (2015), and an informal p-curve analyses conducted on those findings (unpublished), we made an a priori decision to attempt to collect 100 participants per cell. Data was collected in a single wave, and no ad hoc decisions were made to alter the desired N. A total of 694 people accepted the initial HIT, but 170 immediately dropped out. A further 22 completed less than 51% of the key questions and were omitted from the final dataset. Finally, we deleted 19 participants from condition 5 (Ordinary / Blessing), as experimenter error compromised their data (they were accidentally given a question from condition 3 – Ritual / Blessing). The final sample comprised 484 participants (Mean age = 34.34 years, SD = 11.18). Of these, 41.5% completed a tertiary degree, 10.4% held a Post-graduate degree, 29.0% reported some tertiary education, and 18% had only completed high school, 1% reporting 'some high school' and 1 participant did not provide a response. The majority of participants (48.3%) earned less than $25,000(US) annually, 13.3% earned between

$25,001 and $35,000, and 18.5% earned more than $45,001 annually. Participants comprised 57.6% males and 42.2% female (with one value missing; note that we also provided a third option, 'other', for gender. It was not used). Possible gender effects were examined in analyses (upon peer-review) but did not indicate any cause for concern, as a result, all analyses disregard gender information.

2.3 Procedure

Participants were briefed and randomly assigned to one of six conditions that varied by Action-Type (either Ritual or Ordinary actions) or Goal-type (Blessing, Curse, or Goal-Absent). They first completed a basic demographic survey, then, over three blocks of stimuli, watched six videos (two per block) in which a male adult acted on glasses containing an amber liquid. After viewing each video participants responded to the same questions: '*Are the drinks the same?', 'Is either/any drink special? If so, which one?',* and *'Which drink would you select to drink?'*. After viewing all videos, participants explained how they understood the terms 'special' and 'same'. Finally, participants completed a 'Religiosity Scale' (8-items; Rohrbaugh & Jessor, 1975), and a novel scale assessing their 'History of religious and ritual exposure' (16-items; Kapitány & Nielsen, 2015).

2.4 Materials

Following Kapitány and Nielsen (2015), half of the videos used in this experiment featured novel ritualized action sequences (causally opaque, goal-demoted actions). The other half were matched sequences of ordinary actions (causally transparent, goal-apparent actions). There were three examples of each type of video in each category. All videos involved pouring a liquid from a small glass into a large glass, where superficial features of the procedure were varied according to condition[2]. All videos are available upon request.

Both *ritual* and *ordinary* videos followed identical formats (see Figure 1). In which an experimenter presented a number of large glasses, performed a condition-

[2] Examples of videos are available at www.rohankapitany.com

specific action on them, and poured an amber liquid from a smaller glass into the larger glass. The ritual condition included additional redundancy and concluded with the experimenter bowing to the glass (it was simply inspected in the ordinary condition). As per Kapitány and Nielsen (2015), videos belonged to one of three discrete blocks of stimuli. Block 1 involved one action performed on one of two glasses, Block 2 involved one action on one of three glasses, and Block 3 involved two actions on two of three glasses. In Block 3 one glass is singled out through inaction, while in Block 1 and 2, one glass was singled out by virtue of actions performed. Block 3 was included to ensure that participants' responses were attributable to qualities of the action, rather than the fact that one glass was singled out. The locations of the acted-upon object(s) in each block were fully counter-balanced (positions: Left, Right, or Centre). All videos were accompanied with the following statement: '*This video contains elements of established ritual seen around the world. The actions in this video can be seen in [ceremony name] of [Location]'*. The ceremonies used were: '*Bwiti Ceremony (Gabon, Africa*)', '*Kava Ceremony (Fiji, Pacific Islands)*, and '*Ayahuasca Ceremony (Ecuador, South America*)'. Depending on goal condition, participants were either told that 1) *These actions are a blessing. They are performed to give someone good luck and excellent health*, 2) *These actions a curse. They are performed to give someone bad luck and poor health*, or 3) were provided no goal information.

[Figure 1 and Figure 1 caption here]

2.5 Coding and Analysis

After each video the same questions were asked. When asked the forced-choice questions 'are the drinks the same' and 'is either/any drink special?', an affirmative response was coded as 1, with a negative response coded 0. Thus, a participant could score a maximum of 2 per block, where 2 affirms the quality on both trials, 1 indicates alternating responses, and a score of 0 represents no support for the quality. When asked to choose which drink they would select to drink, a score of 1 was awarded only if they selected a drink which had been acted-upon. Thus, 2 represents exclusive preference for

the acted-upon object(s), 1 indicates alternating responses, and 0 indicates they consistently avoided the acted-upon drinks.

Such ordered categorical data is best treated with an Ordinal Logistic Regression (OLR), but where the assumption of proportional odds was violated a Multinomial Logistic Regression (MLR) was used. Unless otherwise stated, all OLR analyses satisfied this assumption. For more information on OLR and MLR please see Menard (2010), Field (2013) and Kleinbaum & Klein (2010).

2.6 Are the drinks the same?

Using an OLR, neither Block 1 ($\chi^2(3) = 2.753$, $p = .431$) nor Block 2 ($\chi^2(3) = 1.305$, $p = .728$) had a better fit than the general model. A non-significant value indicates that a model *with* predictors is not better than a general model *without* predictors. The data in Block 3 returned a significant Test of Parallel lines ($p < .001$)[3], but the final model fit was not significant, $\chi^2(3) = 1.279$, $p = .734$. Based on these null results we have no evidence to conclude that action-type or goal information influenced participants' perceptions of sameness amongst objects. Figure 2 shows the mean percentage of responses in each category with goal information collapsed into action-type.

[Figure 2 and Figure 2 caption here]

2.7 Is either drink special?

In Block 1 we found a significantly better final model fit, $\chi^2(3) = 18.953$, $p < .001$, indicating that a model with predictors was better than a model without predictors. Pearson's Goodness-of-fit, $\chi^2(7) = 3.234$, $p = .863$, did not fall below the threshold for rejection ($p < .05$). As Table 1 shows, when actions are opaque, participants are 2.07

[3] This suggests that the assumption of proportional odds was violated. When an MLR was run (and the reference category was set 'Drinks Always the Same') the only significant result ($p = .037$) was that Opacity made participants about half as likely (OR = .542) to have alternating responses across presentations (but made no difference to reporting that objects different across *both* presentation). However, this analysis violated Pearson's Goodness of Fit statistic, $\chi^2(6) = 17.190$, $p = .009$. Inclusion of an interaction term (as discussed in 'Exploratory Analysis') returned no significant results. Thus, for the sake of consistency, and because no analysis appears superior to any other, the results of the OLR are reported here.

times more likely to report the presence of specialness at each [increasing] level of the DV. No effect of Goal was observed. Pseudo-R^2 values range from .021 (McFadden) to .045 (Nagelkerke).

In Block 2 we found a significantly better final model fit, $\chi^2(3)= 23.811$, $p < .001$. Pearson's Goodness-of-fit, $\chi^2(7)= 9.235$, $p = .236$, did not fall below the threshold for rejection ($p < .05$). As Table 1 shows, when actions are opaque, participants are 2.28 times more likely to report the presence of specialness at each [increasing] level of the DV. No effect of Goal was observed. Pseudo-R^2 values range from .026 (McFadden) to .057 (Nagelkerke).

In Block 3 we found a significantly better final model fit, $\chi^2(3)= 28.919$, $p < .001$. Pearson's Goodness-of-fit, $\chi^2(7)= 9.027$, $p = .251$, did not fall below the threshold for rejection ($p < .05$). As Table 1 shows, when actions are opaque, participants are 2.58 times more likely to report the presence of specialness at each [increasing] level of the DV. No effect of Goal was observed. Pseudo-R^2 values range from .030 (McFadden) to .067 (Nagelkerke). Figure 3 shows the mean proportion of responses in each category with goal-information collapsed into action-type.

Thus, across all three blocks, when the modelled actions were opaque participants were more than twice as likely to report the presence of a special object within the set compared to causally transparent actions.

[Table 1 and Table 1 caption here]

[Figure 3 and Figure 3 caption here]

2.8 Which drink would you select to drink?

Blocks 1 and 3 on the 'Drink' variable returned a significant result on the Test of Parallel Lines ($p < .05$), indicating that the *logit* (the odds ratio) varies between levels of the DV for a given IV. Block 2 had a Pearson's Goodness of fit violation. Thus, we used an MLR analysis.

In Block 1 we found a significantly better final model fit, $\chi^2(6)= 156.715$, $p < .001$. Pearson's Goodness-of-fit, $\chi^2(4)= 5.087$, $p = .279$, did not fall below the threshold

for rejection ($p < .05$). As Table 2 shows, at level 1 of the DV, opacity does not significantly predict outcomes. However, at level 2 of the DV, opacity makes participants 2.96 times more likely the select the acted upon drink exclusively (i.e., to select it twice over two trials). Compared to no goal, a curse makes participants .44 times as likely to select the acted upon object once (at Level 1), and .08 times as likely to select the acted upon object exclusively (at Level 2). A blessing makes participants 1.95 times more likely to select the acted upon object once (at Level 1), and 1.98 times as likely to select the acted upon object exclusively (at Level 2). Pseudo-R^2 values range from .152 (McFadden) to .314 (Nagelkerke).

In Block 2 we found a significantly better final model fit, $\chi^2(6)= 114.913$, $p < .001$. Pearson's Goodness-of-fit, $\chi^2(4)= 9.094$, $p = .059$, did not fall below the threshold for rejection ($p < .05$). As Table 2 shows, opacity does not significantly predict outcomes at Level 1. However, it does make participants 2.78 times more likely to select the acted upon object exclusively at Level 2. Compared to no goal, a curse makes participants .50 times as likely to select the acted upon object once (at Level 1), and .18 times as likely to select the acted upon object exclusively (at Level 2). A blessing makes participants 2.39 times as likely to select the acted upon object once (at Level 1), and 2.25 times as likely to select the acted upon object exclusively (at Level 2). Pseudo-R^2 values range from .112 (McFadden) to .240 (Nagelkerke).

In Block 3 we found a significantly better final model fit, $\chi^2(6)= 49.685$, $p < .001$. Pearson's Goodness-of-fit, $\chi^2(4)= 14.129$, $p = .007$, did fall below the threshold ($p < .05$), which suggests there are non-linearities in the data, and the model fit could be improved by their inclusion (Field, 2013), a point discussed in the next section 'Exploratory Analysis'. As Table 2 shows, opacity does not significantly predict outcomes at Level 1. However, it does make participants 1.78 times more likely to select the acted upon drink exclusively at Level 2.

Compared to no goal, a curse makes participants .49 times as likely to select the acted upon object once (Level 1), and .24 times as likely to select the acted upon object exclusively (Level 2). A blessing does not significantly predict responses at Level 1 or Level 2. Pseudo-R^2 values range from .048 (McFadden) to .110 (Nagelkerke).

In sum, across blocks, opacity increased likelihood of selecting an acted-upon object exclusively. Curses reliably decrease the likelihood of selection across both levels of the DV, and blessings generally increased the likelihood of selection.

[Table 2 and Table 2 caption here]

2.9 Exploratory Analysis

An informed, post-hoc, decision was made to evaluate whether or not there was a significant interaction between Action-Type and Goal, as suggested by the Pearson's goodness-of-fit statistic on the desirability measure. All analyses were re-run including an interaction term. Using an OLR, the pattern of results remained identical for 'same' and 'special' and no interaction was observed (as one would expect, given the pattern of results in the *a priori* analyses). Using an MLR, a significant interaction between Action-Type and Goal was observed in drink preferences (as implied by the Pearson goodness-of-fit statistic), and the pattern of results remained largely intact (i.e., opacity had a significant and positive impact at level 2 across all three blocks). However, the influence of Goal Information varied. Due to the difficulty in describing interactions of nominal categorical IVs on ordinal categorical DVs with respect to a reference category we ran two separate analyses. First, we manually split our data by Action-Type, then ran an OLR to determine the influence of Goal on drink preference for those who observed ordinary actions, and a separate OLR on drink preference for those who observed ritualized actions. The results of these analyses (including tests of assumptions) can be seen in Table 3. For ordinary actions, in Block 1 and 2 we found that Goal information influenced drink preference in the expected directions at similar magnitudes as before. In Block 3, no effect of goal information was observed, indeed, the model fit was not significant. For opaque actions, curses made participants significantly less likely to select acted-upon objects at each level across all three blocks. Interestingly, blessings had no effect on participants' responses in any block. While both positive and negative goal information appears to influence participant perceptions for transparent actions, only negative goal information influences perceptions of opaque actions.

All analysis (see table 3) satisfied the assumption of proportional odds, and model fitness (except for the effect of goal information on transparent actions in Block 3, (χ2(2) =2.404, p =.301).

[Table 3 and Table 3 caption here]

[Figure 4 and Figure 4 caption here]

3.1 Understanding participant responses on 'specialness' and 'sameness'.

After the videos, but prior to the survey items, participants were asked "*After you watched the videos we asked you whether you thought objects were 'special' ['the same']...*" and were respectively presented with each of the following sentences: "*If you indicated that objects were special, in what way did you mean? How were you using the label 'special'?*" and "*In what way did you understand the objects as being 'same' (or different)?*". Table 4 shows the coded qualitative responses with regard to their understanding of 'Same' and Table 5 shows the coded qualitative responses for 'Special'.

The lead author developed a coding system based on the existing responses, and informed by previous work by Kapitány & Nielsen (2015) Menard (2010) and predictions of the Action-Parsing system (Boyer & Liénard, 2006; Liénard & Boyer, 2006; Zacks, 2004a). These responses were then coded in their entirety by two blind coders. Special Responses had a mean percentage agreement 84.9% and a Krippendorff's Alpha of .767 (indicating 'Substantial' agreement; for context: values greater than .81 are regarded as 'Almost Perfect Agreement'. See Hayes & Krippendorff, 2007). Same responses had a mean percentage agreement of 89.64% and a Krippendorff's Alph of .800.

When asked to define the term 'same', across all conditions, between 65.5% and 76.6% of all responses made reference to 'physical or visually accessible qualities of the object' (See Table 4 for full breakdown). When asked to define the term 'special' across all conditions, between 36.9% and 62.8% of all responses (forming the primary response category) made reference to the actor's actions or focus. We anticipated that this would happen proportionally more in ritual conditions, by virtue of the action's casual opacity. When analyzed with an MLR, we found a significantly better fit, $\chi^2(18) = 42.452$, p =

.001. When the reference category was set to 'Denial of Specialness' we found Opaque Actions made participants 2.136 times more likely to define special with reference to 'the actions or focus of the actor' (Wald Value(1) = 7.898, p = .005, β = 0.759, 95%CI = 1.258– 3.626). Opaque Actions also made participants 3.340 times more likely to reference a non-physical quality of the object (Wald Value(1) = 8.953, p = .003, β = 1.206, 95%CI = 1.516 – 7.359). Opaque actions also made participants 4.062 times more likely to refer to location of an object, (Wald Value(1) = 6.708, p = .010, β = 1.402, 95%CI = 1.406 – 11.734). There was no effect of goal information. Pseudo-R^2 values for 'Special' ranged from .035 (McFadden) to .098 (Nagelkerke).

[Table 4 and Table 4 caption here]

[Table 5 and Table 5 caption here]

4.1 Participant Demographics

Participants completed a 'Religiosity Scale' (Rohrbaugh & Jessor, 1975), and a scale assessing their 'History of religious and ritual exposure' (Kapitány & Nielsen, 2015). Religiosity was measured on 3-subscales and aggregated into a single 5-point measure (M = 2.24; SD = 1.29; α = .95) while history of religious and ritual exposure comprised 3 sub-scales (5-items on Superstitious Rituals, 8-items on Cultural Rituals, and 3-items on Religious Rituals). These scales were converted to a 6-points for aggregation (M = 2.92; SD = .71; α = .81). Religiosity and Ritual exposure were moderately correlated at r = .562, p < .01. No systematic pattern correlation between these scales and the dependent variables was observed.

5.1 Discussion

In this work we aimed to dissociate the roles of goal-demotion and causal opacity in adults' processing of ritualized actions. First, neither action-type nor goal-information influenced participants' perceptions of whether or not the objects were the 'same', with the vast majority interpreting sameness in terms of physical qualities of the object. Opaque actions reliably caused attributions of specialness, while goal-information had no

effect. Indeed, the majority of participants organically defined specialness with reference to the actions or focus of the actor. Further, opaque actions made participants much more likely to exclusively prefer acted-upon objects. Such actions did not influence preference on only one trial, suggesting (for some people) ritualized actions provide a categorical imperative to select ritualized objects always. Critically, curses made objects less desirable: any action labelled a curse considerably increased avoidance. This is consistent with other work, in which people tend to be cautious of things that are 'magically dangerous' (Subbotsky & Quinteros, 2002) or essentially corrupted (Nemeroff & Rozin, 1994; Rohrbaugh & Jessor, 1975; Rozin, Millman, & Nemeroff, 1986; Savani, Kumar, Naidu, & Dweck, 2011). However, calling an action a blessing increased preference for acted-upon objects in Block 1 and 2, but not in Block 3. Follow-up analysis revealed an interaction (explaining this anomaly). We found that goal-information systematically varied preference across action-type. Objects subjected to ordinary actions became less desirable when called a curse, but more desirable if called a blessing. Objects subjected to ritualistic actions became less desirable when called a curse, but were not influenced when called a blessing. As far as ritualized actions are interpreted positively by default (Kapitány & Nielsen, 2015) adding additional positive goal information appears to have little effect. *Actions*, so the saying goes, *speak louder than words*[4]. This suggests an interesting dissociation between causal opacity and goal-demotion. Opacity informs our understanding of an object's status, while Goal-Information *and* opacity inform our approach/avoid behavior toward such objects. Moreover, while negative Goal-Information causes aversion, positive Goal-Information does not always cause approach behavior above-and-beyond variance attributable to opacity.

Other researchers have produced equally interesting work on this dissociation, modelling potential differences in action parsing attributable to these qualities (Nielbo &

[4] It should be noted that the measure of effect size presented here, the Pseudo-R^2 value, 'should be treated with caution' (Field, 2013). While it can be regarded as somewhat analogous to R^2 in linear regression, many have argued the measure has issues. Thus, while the effect of specialness is small, it is reliably elicited by the described methods, as it is consistent with experiments 1 and 2 of Kapitany and Nielsen (2015). A p-curve analysis conducted prior to this experiment suggested the effect has evidentiary value. A p-curve analysis of these prior experiments and the present experiment affirms this result. This data can be extracted from the stated publications, or is available from the corresponding author upon request.

Sørensen, 2015; Sørensen & Nielbo, 2013). They report that 'cultural priors' tend to increase the degree to which cultural experts (those experienced and expert in a given ritual tradition, for example, *a priest*) see a ritualized act as ordinary and instrumental compared to one who is not a cultural expert. Thus, it is possible that actions are not necessarily treated equally in the minds of all individuals. Our ritual condition included a number of causally opaque and goal demoted actions, but also included bowing – a highly familiar, abstract action that carries pre-existing culture-dependent associations of respect and reverence. Any individual familiar, or 'expert', in the role a bow serves may rely heavily (and perhaps exclusively) on this action at the expense of the novel actions in determining an objects' significance. However, we do not think this is the case here. When participants were asked how they defined special, only six participants (of 484) made explicit reference to the bow. Of those 6, all made reference to the bow as one of multiple actions (e.g., '*He … did something to the particular glass… i.e. hum at it or bow to it*' and '*I took it to mean if it ['specialness'] was gestured to via the flapping or sound or bowing'*), and the two responses which appeared to make the strongest case for bowing without referencing other actions explicitly still included other generalities associated with the novel actions (i.e., '*Objects were treated with respect, and bowed head as a offering'* and '*more elaborate ritual, the bowing and offering'*). Given that participants in the ritual conditions saw six bows (across six videos) and up to three different kinds of ritualized actions, and only six made reference to the bow, four of whom made explicit reference to other ritualized actions, we do not believe the bow was privileged above-and-beyond the other actions."

Differences in how the term 'special' was understood across conditions revealed different levels of action-parsing. Causally opaque actions caused parsing at the lowest level (gesture) and generated an appeal to the actor's inner state. This is consistent with empirical work (Nielbo & Sorensen, 2011; Zacks, 2004a; Zacks et al., 2007; Zacks et al., 2001) and theoretical predictions (Boyer & Liénard, 2006; Liénard & Boyer, 2006). It is nevertheless worth noting that ritual videos were typically slightly longer than the control videos, and the ritual videos contained two extra event-boundaries not generated by causal opacity: the redundant raising prior to pouring action, and the use of two hands (rather than one hand) in the bow/inspection action at the end of the sequence. However,

the extent to which these two additional boundaries contributed to the overall effect is likely to be relatively minor. Ritual actions, by their causally opaque nature, generate more additional boundaries than ordinary actions, and so, the difference in perceived event boundaries between the two conditions is already considerably weighted in favor of the ritual condition. Further, this falls fully under the umbrella of cognitive capture – these two additional boundaries further captured participants, which in turn, likely increased the motivation to restore behavioral understanding. Finally, we are not making the claim that a specific number of subunits of action make a ritual special or efficacious (though this is an interesting question), we are simply making the argument that a greater number of subunits (generated by opacity and goal demotion) motivates participants to restore a behavioral explanation for the actions, which begets appeals to the actor's goals. We found evidence in support of this position. However, we are cautious, and maintain this is only modest evidence for the role of cognitive capture.

Ritualized actions activate cognitive systems outside the proper range causing participants to process actions at a lower-level, in turn, motivating a search for the actions' meaning to restore default {behavioral} parsing and understanding (Herrmann et al., 2013; Legare & Souza, 2012; Nielbo & Sorensen, 2011; Rossano, 2012; Schjoedt et al., 2013; Zacks, 2004a; Zacks et al., 2007; Zacks et al., 2001). Lacking a clear way to integrate this experience, we interpret these deliberate causally opaque actions as socially normative (Herrmann et al., 2013; Legare & Souza, 2012; Nielsen et al., 2015). Boyer and Liénard have argued that cultural rituals are a special case of ritualized behavior: Mis-activations of the hazard-system are calibrated throughout childhood, and adult responses are constrained to a limited repertoire of learned behaviors. We suggest the dominant calibrated response is to interpret the actions as normative. Further, we believe the phenomenon of overimitation may be the mechanism of calibration. Overimitation occurs when children copy obviously causally-irrelevant actions within a larger sequence of adult-modeled behavior: When children observe these redundant, repetitive, goal-demoted, causally-opaque acts they interpret them normatively and conventionally (Kenward, 2012). Additionally, they copy with high-fidelity (Horner & Whiten, 2005; Lyons, Damrosch, Lin, Marcris, & Keil, 2011) and do so reliably across cultures (Nielsen, Mushin, Tomaselli, & Whiten, 2014; Nielsen & Tomaselli, 2010). It is possible

our observations reflect this calibration – ritualized actions activate the Precaution System which has been calibrated throughout development to respond in a normative manner (notably, adults are more likely to overimitate than children; McGuigan et al., 2011). We believe over-imitation/calibration explains why providing positive goal information (a blessing) doesn't influence behavior toward goal-demoted acts.

We propose, as predicted by the Hazard-Precaution system, that over the course of development we begin to understand many actions as socially normative, particularly casually-opaque and goal-demoted actions (via over-imitation). Further, as predicted by the Action-Parsing system, ritualized actions are parsed differently from ordinary actions due to the absence of a plausible causal mechanism and the obscurity of the actor's goals; ritualized actions are necessarily interpreted at the level of {gesture} rather than [behavior], resulting in 'cognitive capture'. Such capture occurs when the Precaution-System activates outside the 'proper range' of stimuli, motivating us to restore a [behavioral] understanding. Thus, lacking a clear schema for why an action is being performed, and due to calibration in childhood, we interpret these actions as socially normative, as described by the Ritual Stance. More work needs to be done delineating how this process operates, work well outside the scope of the present study. Though it is notable that each of the distinct approaches has been previously validated and empirically supported.

While rituals only emerged as a part of our behavioral repertoire in recent evolutionary history, their ubiquity suggests they serve an adaptive role. Rituals, as intentional motor acts, are unique: they disrupt our capacity to infer a causal mechanism, they deny us insight into an actor's inner-state, and they activate cognitive systems adapted to other purposes. Understanding each of these elements is complicated, but here we contribute to the growing body of evidence that illustrates the importance each element plays. Moreover, we have taken modest steps toward dissociating the influence of goal-demotion from causal opacity, and have attempted to unify into a causal chain several fields of psychological enquiry. While there are several competing and complementary grand theories of ritual cognition (notably Whitehouse's Modes of Religiosity and Henrich's CREDs), we believe Boyer and Liénard Hazard-Precaution theory, in conjunction with Legare's Ritual Stance, coupled with a understanding of the

development of overimitation, provide a more comprehensive frame-work than do the alternatives. Indeed, together they make important predictions about the underlying developmental, cognitive and evolutionary mechanisms of ritual cognition, and dissociate the specific roles individual qualities play in ritual. Moreover, they inform both why we *participate* in rituals, and how we respond when we *observe* them. Targeted research is needed to test this proposal. Such work will reveal the foundations, mechanisms, and consequences of ritual actions, and provide insight into a core feature of the human behavioral repertoire.

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Table 1. *Results of OLR analysis for Blocks 1, 2, and 3 of the 'Special' variable*

	Predictor	Wald's χ^2	*p*	95% CI	Odds Ratio
Block 1 Two Glasses One Action	Opacity (1) vs Transparency (2)	16.147	< .001	0.373 - 1.085	2.073
	Curse (1) vs No Goal (3)	1.329	0.249	-0.174 - 0.671	-
	Bless (2) vs No Goal (3)	1.613	0.204	-0.153 - 0.718	-
	Predictor	Wald's χ^2	*p*	95% CI	Odds Ratio
Block 2 Three Glasses One Action	Opacity (1) vs Transparency (2)	20.373	< .001	0.466 - 1.182	2.280
	Curse (1) vs No Goal (3)	0.245	0.620	-0.315 - 0.528	-
	Bless (2) vs No Goal (3)	2.021	0.155	-0.121 - 0.761	-
	Predictor	Wald's χ^2	*p*	95% CI	Odds Ratio
Block 3 Three Glasses Two Actions	Opacity (1) vs Transparency (2)	28.183	< .001	0.598 - 1.298	2.581
	Curse (1) vs No Goal (3)	0.031	0.860	-0.378 - .454	-
	Bless (2) vs No Goal (3)	0.072	0.789	-0.485 - .368	-

Table 2. Full results of MLR analysis for Blocks 1, 2, and 3 of the 'Drink Preference' variable

Block 1	Predictor	Wald's χ^2	*p*	95% CI	Odds Ratio
Picking Acted Upon Objects ONCE	Opacity (1) vs Transparency (2)	0.088	0.767	0.562 - 1.530	-
	Curse (1) vs No Goal (3)	8.046	0.005	0.246 - 0.774	0.436
	Bless (2) vs No Goal (3)	3.85	0.050	1.001 - 3.819	1.954
Picking Acted Upon Objects TWICE	Opacity (1) vs Transparency (2)	19.402	< .001	1.827 - 4.803	2.962
	Curse (1) vs No Goal (3)	59.285	< .001	0'.041 - 0.151	0.079
	Bless (2) vs No Goal (3)	5.405	0.020	1.114 - 3.537	1.984

Block 2	Predictor	Wald's χ^2	*p*	95% CI	Odds Ratio
Picking Acted Upon Objects ONCE	Opacity (1) vs Transparency (2)	0.007	0.933	.591 - 1.620	-
	Curse (1) vs No Goal (3)	5.557	0.018	.276 - .888	0.495
	Bless (2) vs No Goal (3)	6.727	0.009	1.237 - 4.614	2.389
Picking Acted Upon Objects TWICE	Opacity (1) vs Transparency (2)	19.192	< .001	1.759 - 4.392	2.779
	Curse (1) vs No Goal (3)	36.766	< .001	.103 - .312	0.179
	Bless (2) vs No Goal (3)	7.869	0.005	2.250 - 1.277	2.250

Block 3	Predictor	Wald's χ^2	*p*	95% CI	Odds Ratio
Picking Acted Upon Objects ONCE	Opacity (1) vs Transparency (2)	3.520	0.061	0.426 - 1.019	-
	Curse (1) vs No Goal (3)	7.049	0.008	0.297 - 0.833	0.497
	Bless (2) vs No Goal (3)	0.016	0.900	0.600 - 1.788	-
Picking Acted Upon Objects TWICE	Opacity (1) vs Transparency (2)	5.800	0.016	1.113 - 2.843	1.779
	Curse (1) vs No Goal (3)	23.303	< .001	0.131 - 0.424	0.236
	Bless (2) vs No Goal (3)	0.106	0.745	0.534 - 1.566	-

Table 3. Statistics for exploratory analysis for Blocks 1, 2, and 3 with data split by action-type.

Block 1	Predictor	Wald's χ^2	*p*	95% CI	Odds Ratio
Opaque/ Ritual	Curse (1) vs No Goal (3)	53.592	< .001	-3.204 - -1.851	0.080
	Bless (2) vs No Goal (3)	0.02	0.888	-0.576 - 0.665	-
Transparent/ Ordinary	Curse (1) vs No Goal (3)	16.841	< .001	-1.873 - -0.662	0.282
	Bless (2) vs No Goal (3)	7.294	0.007	0.236 - 1.482	2.361

Block 2	Predictor	Wald's χ^2	*p*	95% CI	Odds Ratio
Opaque/ Ritual	Curse (1) vs No Goal (3)	42.279	< .001	-2.805 - -1.506	0.116
	Bless (2) vs No Goal (3)	0.299	0.585	-0.440 - 0.780	-
Transparent/ Ordinary	Curse (1) vs No Goal (3)	4.788	0.029	-1.235 - -0.068	0.521
	Bless (2) vs No Goal (3)	8.57	0.003	-0.308 - 1.556	2.540

Block 3	Predictor	Wald's χ^2	*p*	95% CI	Odds Ratio
Opaque/ Ritual	Curse (1) vs No Goal (3)	35.026	< .001	-2.559 - -1.286	0.146
	Bless (2) vs No Goal (3)	1.56	0.212	-0.903 - 0.200	-
Transparent/ Ordinary	Curse (1) vs No Goal (3)	0.815	0.367	-0.824 - 0.304	-
	Bless (2) vs No Goal (3)	0.502	0.478	-0.393 - 0.838	-

Table 4. *Coded qualitative responses for 'Same'*

Coded Response	Ritual / Curse n (%)	Ritual / No Goal n (%)	Ritual / Blessing n (%)	Control / Curse n (%)	Control / No Goal n (%)	Control / Blessing n (%)
Denial of Sameness	1 (.013)	0	0	0	0	0
Reference to Actions/Processes or Attention/Focus of the Actor	13 (.171)	19 (.221)	16 (.178)	22 (.253)	13 (.155)	9 (.150)
Reference to physical or visually accessible qualities of the object	56 (.737)	58 (.674)	61 (.678)	57 (.655)	63 (.750)	46 (.767)
Reference to non-physical qualities of object	3 (.039)	6 (.070)	3 (.033)	3 (.034)	5 (.060)	2 (.033)
Unintelligible response	3 (.039)	2 (.023)	10 (.111)	3 (.034)	2 (.024)	1 (.017)
Missing	0	1 (.012)	0	2 (.023)	1 (.012)	2 (.033)
Total N (Total %)	*76 (1)*	*86 (1)*	*90 (1)*	*87 (1)*	*84 (1)*	*60 (1)*

Table 5. *Coded qualitative responses for 'Special'*

	Coded Response	Ritual / Curse n (%)	Ritual / No Purpose n (%)	Ritual / Blessing n (%)	Control / Curse n (%)	Control / No Purpose n (%)	Control / Blessing n (%)
0	Denial of Specialness	10 (.132)	9 (.105)	10 (.111)	20 (.230)	19 (.226)	9 (.150)
1	Reference to Actions/Processes or Attention/Focus of the Actor	37 (.487)	54 (.628)	48 (.533)	37 (.425)	31 (.369)	36 (.600)
2	Reference to physical or visually accessible qualities of the object	6 (.079)	3 (.035)	2 (.022)	8 (.092)	12 (.143)	5 (.083)
3	Reference to non-physical qualities of object	9 (.118)	9 (.105)	12 (.133)	4 (.046)	8 (.095)	2 (.033)
4	Unintelligible response	1 (.013)	1 (.012)	3 (.033)	5 (.057)	6 (.071)	0
5	Referred to the acted-upon and/or non-acted-upon object	7 (.092)	2 (.023)	6 (.067)	3 (.033)	1 (.012)	2 (.033)
6	Reference to semantic information or re-iteration of statement	2 (.026)	0	1 (.011)	1 (.011)	0	0
	Missing	4 (.053)	9 (.105)	8 (.089(	8 (.092)	7 (.083)	6 (.100)
	Total N (Total %)	*76 (1)*	*86 (1)*	*90 (1)*	*87 (1)*	*84 (1)*	*60 (1)*

Figure Captions.

Figure 1. Images show the 'Cloth' ritual acted upon the center glass. Steps 1 and 2 are identical for both the ritual and control conditions: the demonstrator moves the large glasses in front of the small glasses. In Step 3 the cloth is waved vigorously at the glass (ritual), while in the control condition the cloth is used to clean the glass. In step 4 the small glass is raised before being poured into the large glass, while in the control condition the small glass is poured directly. In step 5 the glass is raised with both hands and bowed to (ritual), while in the control condition it is raised with one hand and inspected. Finally, the demonstrator returns to a neutral position. (From Kapitány & Nielsen, 2015).

Fig. 2. Mean percentage values on 'Same' variables across all three blocks with Goal Information collapsed into action-type

Fig. 3. Mean percentage values on 'Special' responses in each category with goal-information collapsed into action-type

Fig. 4. Percentage responses for each category split by action-type.