

Anxiety and ritualization: Can attention discriminate compulsion from routine?

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ABSTRACT

Despite the wide occurrence of ritual behavior in humans and animals, much of its causal underpinnings, as well as evolutionary functions, remain unknown. A prominent line of research focuses on ritualization as a response to anxiogenic stimuli. By manipulating anxiety levels, and subsequently assessing their motor behavior dynamics, our recent study investigated this causal link in a controlled way. As an extension to our original argument, we here discuss 2 theoretical explanations of rituals—ritualized behavior and automated behavior—and their link to anxiety. We propose that investigating participant's locus of attention can discriminate between these 2 models.

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Humans and other animals engage in ritual behaviors, yet their evolutionary functions are unknown. Marked by limitation of behavioral variability, greater repetitiveness, and stereotypy,^{1,2} ritual expressions manifest on multiple levels of behavior.³ Ritualization occurs in gestures, but also in complex behaviors, and is typically characterized by the presence of redundant or unnecessary steps in behavioral patterns that are not functionally related to a pragmatic goal.^{4,5}

It has been suggested that rituals can function as a type of coping strategy, an automatic response to novelty, unpredictability and uncontrollability; in other words, to environmental features that cause anxiety and psycho-somatic stress.^{6,7} In addition, human rituals can be understood as culturally evolved behavioral responses to ecological or social threats.^{9,10} However, in its excessive form, ritual behavior is symptomatic of certain human pathologies, such as obsessive-compulsive disorder and autism spectrum disorder.⁸

Despite the fact that rituals are found in a wide range of domains, explanations for their pervasiveness have been inconclusive. Recently, 2 partially contradictory explanations of ritual behavior as a response to anxiogenic situations have been suggested. First, Boyer & Liénard¹¹ presented a model of ritualized behavior (RB) that describes ritualization as a scripted sequence of redundant, goal-demoted behaviors. The precise execution of such a

sequence demands diligent focus on the task and results in higher cognitive effort, precluding the practitioner from conscious preoccupation with the stressor. However, there is evidence that ritual behaviors are often performed in an automated way (automated behavior, AB)^{2,12} that requires little cognitive effort. By simplifying action via repetition, stereotypy, and routinization, individuals can allocate more cognitive resources to threatening external stimuli,¹³ thus increasing their chances of survival. Since both RB and AB manifest as behavioral stereotypy and repetition, they might be indistinguishable from each other by mere observation. In what follows, we propose a way to distinguish between these competing models in order to gain a better understanding of the cognitive mechanisms that underlie behavioral ritualization.

In a recent study,¹⁴ we documented a link between anxiety and spontaneous gestural motor ritualization. Study subjects underwent a treatment based on the public speech paradigm¹⁵ resulting in 2 levels of stress (high anxiety – HA; low anxiety – LA). Subsequently, each individual was asked to perform a motor task consisting of cleaning the object with their hands during which levels of spontaneous gestural ritualization were measured. We hypothesized that differences in stress levels would manifest in gestural dynamics measured by GT3X Acti-Graph motion sensors. Specifically, we predicted that HA subjects would display a higher level of motor

ritualization. The results showed that subjects exhibited a shift toward higher redundancy, repetitiveness and rigidity of hand movements in the HA compared to the LA condition. We considered this increased ritualization as the manifestation of a psycho-physiological state of anxiety, and interpreted our findings in the light of an entropy model of uncertainty.¹⁶ According to this model, anxiety acts as a destabilizing factor increasing overall systemic entropy, and associated spontaneous ritualization acts as a coping strategy that decreases overall perceived entropy and prediction error.^{17,18}

However, it is not clear whether such ritualization stems from RB or AB, because both manifest as high levels of repetitiveness and rigidity. In other words, did HA participants' behavior become more ritualized because they focused on the cleaning, or on the threat? By investigating participants' hand-movement trajectories more thoroughly, we can get a better insight into their locus of attention. In the case of AB, a focus on external anxiogenic stimuli has been shown to have adverse effects on attention and processing efficiency^{19,20} that may manifest as limited motor control. Such a limitation of the degree of motor control should affect overall task execution²¹⁻²³ and possibly lead to less detailed and/or less complex behavioral patterns. On the other hand, RB should manifest as elaborate patterns that require conscious attention and longer execution, thereby distracting participants from the stressor.

A degree of structural organization of hand-movement trajectories in 3-dimensional space should discriminate between those with the locus of attention directed at the task (RB) and those with the locus of attention directed at the stressor (AB). Given that RB and AB may in principle involve typologically and quantitatively similar movements, we would need to investigate at least 3 movement characteristics to be able to distinguish between the two. First, it is important to examine the hierarchy of movements, that is, the degree of structuration of behaviors in a given space. RB should exhibit a higher degree of movement nesting (a ratio between longer and shorter moves) with a preference toward shorter (nested) movements within the space demarcated by longer movements. If participants focus on executed motor task, their motor patterns will display inner structure and hierarchy as revealed by movement nesting. Second, RB should exhibit a higher recurrence of movement patterns across space, thus it is important to compare the similarity of trajectories in sub-regions of the cleaning space. If participants focus on cleaning, their nested movement patterns will be similar across the surface of an object. Finally, the proportion of surface cleaned by participants is critical for distinguishing between the RB and AB models. If subjects visit the whole space in a structured manner, this would

suggest a consciously followed overall task plan executed over the surface of the entire object.

To test such hypotheses, we will need to map movement trajectories that go beyond the one-dimensional measures of acceleration used in our previous study.¹⁴ For instance, videotaping participants' movements or more complex measures like 3D motion trackers could provide a richer picture of movement trajectories, thus allowing a more fine-grained distinction between RB and AB. Further research should also examine whether a higher degree of movement organization in RB leads to a higher degree of predictive success compared to AB, and in what ways this interacts with resource depletion related to the focus of attention.

To conclude, examining the above hypotheses will help us gain a better understanding of human ritualization and its distinction from routinization. Such a distinction might prove important for investigating the ways in which rituals are associated with anxiety across various contexts.

Abbreviations

AB	automated behavior
HA	high anxiety
LA	low anxiety
RB	ritualized behavior

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No potential conflicts of interest were disclosed.

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