



# INDUCING ANXIETY IN A LABORATORY SETTING RESULTS IN RITUALIZED BEHAVIOR

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## INTRODUCTION

Rituals exist in every human society, and despite incredible cross-cultural diversity, there are several fundamental features common to the majority of them. At the cultural level, rituals are associated with times of stress, and uncertainty. At the individual level, there exist universal “ritualized behaviors,” often assumed to assuage anxiety. Boyer and Liénard theorize that ritualized behaviors are the result of cognitive structures that urge diligent focus on ongoing actions whose activation results in anxiety reduction. The generally recognized characteristics of ritualized behavior are: **non-functionality, rigidity, repetitiveness, and compulsiveness.**

If Boyer and Liénard are correct then individuals who are more anxious ought to engage in behaviors that are more ritualized. We tested the hypothesis that anxious people engage in more repetitive, rigid and redundant behavioral movement.

## PREDICTIONS

**Participants with induced anxiety will:**

1. engage in more repetitive behaviors.
2. engage in more rigid behaviors.
3. engage in more redundant behaviors.

## OPERATIONALIZATION

**REPETITIVENESS.** To assess the repetitiveness of movements, we employed recurrence quantification analysis (RQA) which quantifies the amount of recurrent points in signal trajectories. When signals return to the same phase-space neighborhood, a recurrence point is recorded. Hence the percent of recurrent points (%RR) can be understood as an indicator of repetitiveness.

**RIGIDITY. A)** if recurrent points follow similar trajectories they are said to be deterministic (e.g., high reliability of trajectory). Thus, the percent of recurrent points exhibiting determinism (%DET) is indicative of rigidity in movement trajectories. **B)** repertoire of movements is reduced, resulting in shorter movements with decreased variability

**REDUNDANCY.** Indicated by extra time spent on cleaning of an object.

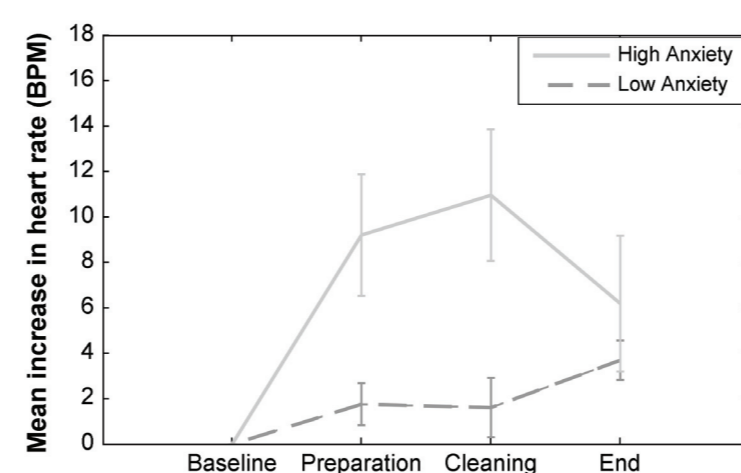
## METHODS

Sixty-two participants (32 females) were randomly assigned to either a high or low anxiety condition. The study utilized a modified version of the public speech paradigm to induce anxiety/stress among participants in the high anxiety condition. >>

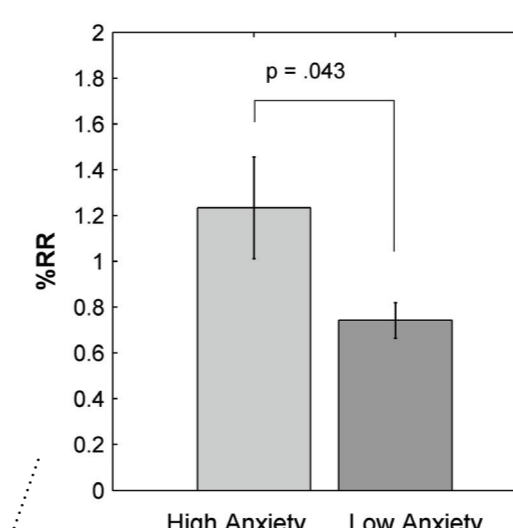
**HIGH ANXIETY CONDITION (HA):** participants were asked to prepare a five-minute-long speech about an art object (a round shiny metal object on a ceramic stand) to be performed later in front of an expert.

**LOW ANXIETY CONDITION (LA):** participants were instructed to dwell on the same object.

Before participants were to present the speech (HA) or end the task and leave (LA), they were asked to clean the object with a cloth. Sixty-two participants (32 females) were randomly assigned to either a high or low anxiety condition. The study utilized a modified version of the public speech paradigm to induce anxiety/stress among participants in the high anxiety condition.



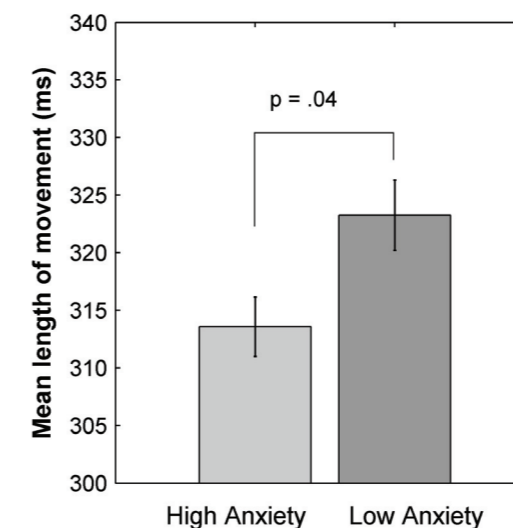
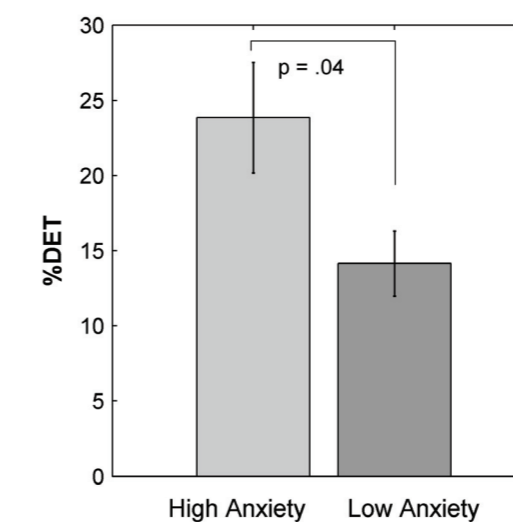
**FIG. 1:** A difference between conditions in mean heart rate increase during various periods of the experiment. High anxiety condition exhibits significant quadratic trend corresponding to induced anxiety.



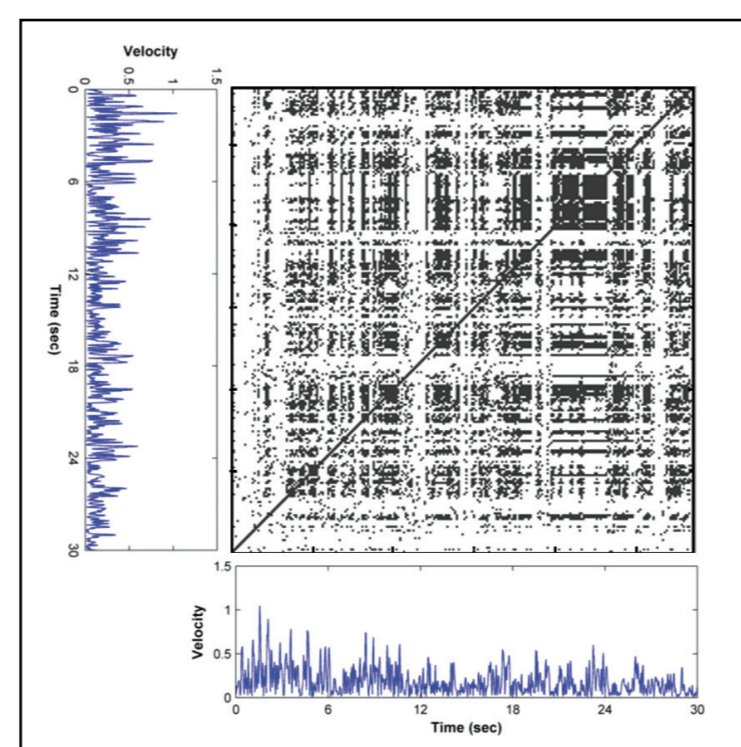
**FIG. 2A:** The recurrence rate of hand-movement pointing to a higher repetitiveness in the High anxiety condition.

**FIG. 2B:** The percent of recurrent points following similar trajectories indicating more rigid movements in the High anxiety condition.

**FIG. 2C:** A difference in mean movement duration between condition recorded in milliseconds. The hand movements of participants in the High anxiety condition exhibits significantly shorter duration.



**FIG. 3:** Recurrence plot showing the hand-movements of a participant in the High anxiety condition during cleaning of the art object. The small square-like structures represent individual movements recurring over time embedded in higher-level complex movements (larger squares).



## MEASUREMENTS

**MANIPULATION CHECK:** heart rate and galvanic skin response

**RIGIDITY & REPETITIVENESS:** derived from hand-movements recorded by ActiGraph Motion Sensors positioned on participants' wrists

**REDUNDANCY:** time cleaning the object

## RESULTS

**MANIPULATION CHECK.** Analyses of self-perceived anxiety during the cleaning task revealed a significant difference between conditions [ $t(60) = 3.090, p = .003$ ], confirming that anxiety was higher in the HA condition ( $M = 2.936, SE = .196$ ) relative to LA ( $M = 2.129, SE = .957$ ). Next, we analyzed changes in mean heart rate across periods of interest consisting of baseline, preparation/thinking task, cleaning task and end of experiment. Mixed-plot two-way ANOVA revealed a significant difference between conditions in a quadratic trend [ $F(1,45) = 19.950, p < .001$ ], pointing to a high increase of HR during the preparation task for the HA condition and its subsequent decrease after the cleaning task (see Fig. 1).

**RITUALIZED BEHAVIOR.** To assess the level of rigidity and repetitiveness in participants' movements, we computed recurrence rate (%RR), determinism (%DET), and mean length of movements. The results show a significantly higher %RR [ $t(37.217) = 2.095, p = .043$ ] and significantly higher %DET [ $t(48.648) = 2.276, p = .040$ ] in the HA condition relative to the LA condition. Moreover, the mean duration of movement was significantly shorter in the HA condition [ $t(60) = 2.425, p = 0.040$ ] with a trend for less variable movements in the HA [ $t(60) = 1.827, p = .073$ ] (see Fig. 2a-2c; t-tests were corrected for multiple comparisons using false discovery rate correction). There was no significant difference in the duration of cleaning between conditions (MHA = 69.710 sec; MLA = 66.161 sec [ $t(60) = .337, p = .737$ ]).

## IN SHORT

We investigated the effect of induced anxiety on ritualized behavior. The results provide support for the hypothesis that anxious people display more repetitive and rigid movements. These findings can help to explain the occurrence of rituals and their purported connection to anxiety.

## FUTURE DIRECTIONS

- (1) Continue to refine methodology towards greater measurement precision (i.e. additional measures, alternative ways of analysis)
- (2) Build upon a framework of current methodology to move from the individual level of ritualized behavior to a group level, thus moving towards greater ecological validity.
- (3) Use the framework to test hypotheses derived from major theories on ritual and anxiety