**Title:** Statistical information about reward timing is insufficient for promoting optimal persistence decisions. Partial replication of Experiment 2: Latent learning of environmental structure

*1. Have any data been collected for this study already?*

No.

*2.  What’s the main question being asked or hypothesis being tested in this study?*

**Note:** This data set will be collected as part of a revision in response to reviews. The new study is a partial replication of the original Experiment 2 with a larger sample size. The originally submitted manuscript can be found here (<https://psyarxiv.com/3yezf/>, version 1 added on April 2, 2022).

**Research Question:** We examine the extent to which passive exposure to environmental statistics influences subsequent decisions about how long to persist for delayed rewards. We expect better-calibrated behavior if preliminary passive experience matches the environmental statistics of the decision context than if it mismatches. This study focuses on decisions in a “limited-persistence” environment, in which reward timing statistics dictate that it is advantageous to wait only a limited amount of time before giving up. Data will be collected online using Amazon Mechanical Turk.

**Hypothesis:** We will test the hypothesis that participants learn the environmental structure in an initial passive exposure block and use it to guide behavior in a subsequent decision block. Our hypothesis would be confirmed if participants who experience congruent timing statistics in the two blocks are willing to wait less time for rewards on average (in the decision block) than participants who experience incongruent statistics in the two blocks.

*3.  Describe the key dependent variable(s) specifying how they will be measured.*

**WTW task.** Voluntary persistence, our primary behavioral measure, will be assessed using the willingness-to-wait (WTW) task (introduced by McGuire & Kable, 2012, *Cognition*, and with modifications introduced by McGuire & Kable, 2015, *Nature Neuroscience*). In the version used here, a progress bar is displayed to show how long the current token has been on the screen (same as in McGuire & Kable, 2015, *Nature Neuroscience*). Participants will perform two 15-minute task blocks. First, they will undergo a passive exposure block, either with “limited-persistence” (LP) reward timing (congruent condition) or “high-persistence” (HP) reward timing (incongruent condition). In this block, participants wait for a token on each trial to deliver a reward and then sell it as fast as possible. Participants must wait for each reward and are unable to end the delay earlier. Then, participants will perform a standard 15-minute block of the WTW task with “limited-persistence” reward timing, in which they are allowed to quit waiting by selling tokens before they mature. Participants will be randomly assigned to either the congruent or the incongruent condition. In the congruent condition, the environmental structure in the passive exposure block (LP) is identical to the structure in the decision block (LP). In the incongruent decision, the environmental structure in the passive exposure block (HP) mismatches the structure in the decision block (LP).

Key dependent variable:

* *Area under the curve:* The main participant-level descriptive statistic will be the “area under the curve” (AUC) derived from a Kaplan-Meier survival curve analysis of waiting times. Separately for each participant, excluding trials that ended within the last 30 seconds of the block, we will construct a survival curve in which “survival” corresponds to continued persistence toward the reward, quit events are analogous to “deaths”, and reward delivery events are treated as censored observations. Persistence will be quantified by the area under the survival curve.

*4.  How many and which conditions will participants be assigned to?*

We will randomly assign participants to one of two between-participant conditions: the congruent and the incongruent condition (n=80 each).

*5.  Specify exactly which analyses you will conduct to examine the main question/hypothesis.*

**Main analysis:** We will test the difference in AUC values between the congruent condition and the incongruent condition using an independent samples t-test, reporting two-tailed p-values and Bayes factors.

Handling missing data:

Participants who do not have usable data for the WTW task (see task-specific exclusion criteria below) will be excluded from analyses.

*6.  Any secondary analyses?*

**Hypothesis:** We will test the hypothesis that learned environmental structure influences response times (RTs) during the passive exposure block.

* **HP condition:** In the passive exposure block with HP timing statistics, RTs to sell a token after it matures are expected to decrease as waiting times increase, since the probability of the token maturing if it has not already matured increases with waiting time.
* **LP condition:** Since short delay intervals occur more frequently in the LP condition, they may be more strongly expected, yielding faster RTs for short delay intervals than for longer intervals.

**Analysis:** To make the two conditions more comparable, our analyses will be restricted to trials on which waiting times were less than or equal to 20 s. To ensure sufficient exposure for learning, we will further restrict our analyses to trials in the second half of the passive block. We will analyze the RT data using two mixed-effects linear regression analysis, one for the group of participants who experienced LP in the passive exposure block and one for the group of participants who experienced HP in the passive exposure block. The dependent variable is the RT on each trial after subtracting the grand median RT for each participant. The independent variable is the wait time that preceded the reward on each trial. We will allow for random slopes (for wait time) and random intercepts to vary by subject.

*7.  How many observations will be collected or what will determine the sample size? No need to justify decision, but be precise about exactly how the number will be determined.*

We plan to collect data from 160 participants (80 per condition). Any participants who do not have a full usable data set for the WTW task (see exclusion criteria below) will be replaced and not counted toward the target sample size.

*8.  Anything else you would like to pre-register? (e.g., data exclusions, variables collected for exploratory purposes, unusual analyses planned?)*

**Exclusion criteria**

**WTW task – passive exposure block:** A participant’s WTW task data will be excluded (and the participant will be replaced) if they meet any of the following two criteria in the passive exposure block.

* Participants will be excluded if they fail to complete the entire passive exposure block.
* Participants will be excluded if they were too slow to sell tokens that had matured. A token expires 1 s after maturing and participants will be excluded if more than 20% of their tokens expire.
* Participants will be excluded if they responded prematurely (by making a “sell” response before the token matured) on more than 20% of trials.

**WTW task – decision block:** A participant’s WTW task data will be excluded (and the participant will be replaced) if they meet any of the following three criteria in the decision block.

* Participants will be excluded if they fail to complete the entire decision block.
* Participants will be excluded if they were too slow to sell tokens that had matured. A token expires 1 s after maturing and participants will be excluded if more than 20% of their tokens expire.