

PSY1012

Learning & Memory Homework

The following homework project is most closely related to the Learning and Memory chapters—in particular the Learning chapter. These instructions and an Excel file have been sent to you. Your homework will entail generating data from a mathematical model on learning called the Rescorla-Wagner model. Finally, you will graph your data and write a summary on what it all means.

Background Problem

This homework assignment is related to basic processes in associative learning. In the Learning and Memory chapters, you will come to understand that all learning takes place through associations. That is, for learning to occur there will always be a minimum of three stimuli being associated—two cues within a context. Typically, stimuli are associated through both space and time. They can, however, be associated through only one of those two variables. For instance, two stimuli can occur at different locations but at the same time—and they will become associated. Also, two stimuli can occur in the same location but at different times—and they will become associated. Regardless of which stimulus dimension that they are associated through, each of the three stimuli (context stimulus and two cues) can be associated with any of the other two stimuli. In this assignment, we will focus on the simplest of all scenarios, when the context remains constant and two unchanging stimuli are systematically associated together.

There are numerous mathematical models which describe the process of how stimuli become associated. The one model we will work with has been around for nearly five decades. It is the Rescorla-Wagner (1972) model. The Rescorla-Wagner model describes the development of learning over time as a process dependent upon the degree of salience—noticeability—of stimuli and the probability they will be associated together relative to other stimuli. In this assignment, we will keep the salience and probabilities constant so that you can model the development of learning related to two stimuli (light + food) that are consistently associated together over 500 trials for a hypothetical subject.

When the salience of stimuli and the probabilities of their associations are kept constant, the Rescorla-Wagner model suggests that the rate of learning is a function of how much associative value accrues (is learned) to a stimulus relative to the amount already accrued (already learned). What the model does is calculates a hypothetical amount of learning and then uses that number in the calculation for the next trial. Each time a trial occurs, the amount learned is added to the amount already learned and then that total amount goes back into the equation to determine how much will be learned on the following trial. The total amount learned is called its associative value because it is the amount learned as a result of repeated associations.

At the beginning of any learning experiment, the total amount of associative value is assumed to be zero. Once a cue is associated with another cue, the associative value increases based upon the values of the salience of the CS (α), the salience of the US (β) and the difference between the total amounts that can be learned (λ) and the amount already learned (V_{tot}). The Rescorla-Wagner model is shown below. For those of you taking college algebra, you may recognize this equation as a geometric sequence.

$$\Delta V_N = \alpha\beta(\lambda - V_{tot})$$

The model calculates the increased amount of learning (ΔV_N) that occurs on each association of the CS and US. The amount learned on each trial is added to everything already learned in the previous trials as shown in the following supplemental equation.

$$V_{tot} = \Delta V_N + V_{tot(N-1)}$$

The values of (V_{tot}) and (ΔV_N) are the same in both equations but $V_{tot(N-1)}$ simply refers to the total amount of learning from all previous trials ($\Delta V_1 + \Delta V_2 + \Delta V_3, \dots + \Delta V_N$). The reiteration of this equation 500 times will give an estimate of the rate and pattern of learning over those associations. Your task in this homework is to use the Rescorla-Wagner model to generate a stream of 500 data points that reflect the development of associative learning in our hypothetical (light + food) scenario. A brief restatement of the above description is on our YouTube channel <https://www.youtube.com/watch?v=TnKZezvZAdI>

Completing the Homework

Task 1: 50%

Program the Rescorla-Wagner model into the Excel file sent to you. The trial, α , β and λ values are already entered into the file (a leading value of zero is purposely there in the V_{tot} column to help you begin the first trial). Your PRIMARY job will be to calculate the growth of learning in the ΔV and V_{tot} columns. Essentially, you are translating the equation $\Delta V_N = \alpha\beta(\lambda - V_{tot})$ into a mini-computer program written in Excel's language. To be clear, once you get the equation correct for the first two rows, you can just drag the equation down to fill in the total 500 rows. Your knowledge of how to create an equation that works comes from your skills at completing the previous homework assignments.

Task 2: 25%

Make separate graphs of ΔV and V_{tot} plotted across trials (trials is on the x-axis). Please use a simple line graph WITHOUT data symbols so that the graph will produce a smooth curved function. Allow Excel to choose your x-axis and y-axis tick marks. Please label the x-axis (Trials) and y-axis either Delta V or V Total (because you cannot get Greek symbols or subscripts on axes in Excel).

Task 3: 25%

In less than approximately 100-words in your Excel file, describe the relationship of learning on each trial to the manner in which learning occurs [ΔV and V_{tot}]. Your answer should be relative only to the values you generated in the above program.