

## MOVEMENT PREPARATION LAB

**Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

### *Activity I: Predictability of the correct response choice & Influence of Pre-cueing*

Introduction: Pre-cueing technique is where the researcher provides the participant with differing amounts of advanced information about which movement must be made in a choice situation. Prior to the signal to move, the subject receives advance information (the pre-cue) specifying the correct upcoming response. The critical factor influencing the preparation time (reaction time) in this situation is the probability of the advance information being correct

The purpose of this experiment is to determine what happens to the subject's response time when the advance information is given to the learner which is wrong or correct.

Procedure: Members of the lab will be divided into groups consisting of 3-4 students. Using the choice reaction timer, a two choice situation has been developed where the subject will depress one of two buttons associated with a lighted button. The experimenter will give the participant advanced information (pre-cue information) about which color will appear.

Each subject will perform under three pre-cue conditions: 1) where the pre-cue was correct only 20 percent of the trials, 2) where the pre-cue was correct 50 percent of the time, and 3) where the pre-cue was correct 80 percent of the time. Each subject in your group will perform 30 trials, ten trials under each pre-cue condition. Trials 1-10 will be the 50-50 condition, trials 11-20 will be 80-20 correct-wrong condition, and trials 21-30 will be 20-80 correct-wrong condition.

In the 50-50 pre-cue condition, 5 pre-cues of the 10 trials need to be correct. In the 80-20 chance condition, 8 pre-cues out of the 10 trials will be correct. In the 20-80 chance condition, 2 pre-cues out of the 10 trials will be correct. Make sure you randomize the number of correct and incorrect pre-cues. Record all the subject's reaction times on the data form provided in ms.

Results: Record your reaction time scores on Subject Data Form of Table 1. Record the reaction time in ms (i.e., 234). Calculate the mean reaction times for only the correct pre-cue trials for each condition.

**Table 1 Subject Data**

Subject Data Form: (Remember to randomize the correct trials and calculate means for only the correct trials.)

Trials	50 (W)-50 (C) Condition	Trials	80 (W)-20 (C) Condition	Trials	20 (W) – 80 (C) Condition
01		01		01	
02		02		02	

03		03		03	
04		04		04	
05		05		05	
06		06		06	
07		07		07	
08		08		08	
09		09		09	
10		10		10	
Mean for C		Mean for C		Mean for C	

*Activity II: Hick's Law*

Hick's Law, named after British psychologist, William Edmund Hick or the Hick–Hyman Law, describes the time it takes for a person to make a decision as a result of the possible choices he or she has. The Hick-Hyman Law assesses cognitive information capacity in choice reaction experiments or situations. The amount of time taken to process a certain amount of bits in the Hick-Hyman Law is known as the rate of gain of information. Given n equally probable choices, the average reaction time T required to choose among them is approximately

$$T = b \cdot \text{Log}_2 (N + 1)$$

where b is a constant that can be determined empirically by fitting a line to measured data. Operation of logarithm here expresses depth of "choice tree" hierarchy. Basically log2 means that you perform binary search. According to Card, Moran, and Newell (1983), the +1 is "because there is uncertainty about whether to respond or not, as well as about which response to make." The law can be generalized in the case of choices with unequal probabilities  $p_i$  of occurring, to  $T = bh$  where H is the information –theory entropy of the decision, define as

$$H = \sum p_i \text{Log}_2 (1/p_i + 1)$$

where  $p_i$  refers to the probability of the ith alternative yielding the information-theoretic entropy.

Hick's Law is similar in form to Fitt's Law. Intuitively, one can reason that Hick's Law has a logarithmic form because people subdivide the total collection of choices into categories, eliminating about half of the remaining choices at each step, rather than considering each and every choice one-by-one, requiring linear time.

In 1868, the relationship between having multiple stimuli and the choice reaction time was reported by Franciscus Donders. Later, in 1885, J. Merkel discovered the response time is longer when a stimulus belongs to a large set rather than a smaller set of stimuli. At this point, psychologists began to see similarities between this phenomenon and the Information Theory. Hick first began experimenting with this theory in 1951. His first experiment involved 10 lamps with corresponding Morse Code keys. The lamps would light at random every five seconds. The choice reaction time was recorded with the

number of choices ranging from 2-10 lamps. E. Roth (1964) could demonstrate a significant correlation between IQ and information processing speed, which is the reciprocal of the slope of the function

$$\text{Reaction Time} = \text{Movement Time} + \log_2(n) / \text{Processing Speed}$$

where  $\text{ProcessingSpeed} \cdot \log_2(n)$  is the time taken to come to a decision and  $n$  is the number of choices.[1]

Hick performed a second experiment using the same task, while keeping the number of alternatives steady at 10. The participant performed the task the first two times with the instruction to perform the task as accurately as possible. For the last task, the participant was asked to perform the task as quickly as possible.

While Hick was stating that the relationship between reaction time and the number of choices was logarithmic, Hyman wanted to better understand the relationship between the reaction time and the mean number of choices. In Hyman's experiment he had eight different lights arranged in a 6x6 matrix. Each of these different lights was given a name, so the participant was timed in the amount of time it took to say the name of the light after it was lit. In further experimentation using this model, the number of each different type of light changed. Hyman was responsible for determining a linear relation between reaction time and the information transmitted.

In this experiment we will attempt to prove or disprove Hyman contentions that one choice reaction time will increase as the number of stimuli response choices increase. Also, Hick's indicates one's change in choice reaction will occur in a logarithmic predictable fashion. For every change, one choice reaction time will increase in predictable amount (e.g. for every additional stimuli response situation one's RT will increase 25-50 msec).

Equipment: 4 MoArt timers with choice reaction time function.

Procedure: Each MoArt timer will be programmed in a manner where the number of choices will increase. The subject will respond to 2, 4, 6, and 8 choices-responds. MoArt timer 1 will involve a 2 choice-response situation. MoArt timer 2 will involve a 4 choice-response situation. MoArt Timer 3 will involve a 6 choice-response situation. MoArt timer 4 will involve an 8 choice-response situation. In all the choice response situations the subject will be involved of what 2,4,6, and 8 fingers will be used to depress the button when the stimuli appears. The subject is to depress the button where the stimuli light is lit above the key. In the 2 choice-response situation, the right forefinger and middle finger will be positioned and one of the bulbs above these two buttons will be lit. The subject is to use the appropriate finger in depressing the button associated with the bulb that was lit as fast as possible. In the 4 choice-response situation, all 4 finger of the right hand will be used. The subject is to use the appropriate fingers of the right hand when one of the bulbs is lit. In the 6 choice-response situation, all the finger of right hand and forefinger and middle finger of left hand will be used. As before the subject will use the appropriate finger when one the six bulbs are lit. In the 8 choice-response situation, all fingers of both hands will be used. The task is to depress the button that is associated with one of the fingers when the bulb is lit.

Data Collection. Each subject is to randomly perform across the 3 different situation (2, 4, 6, & 8 choice responses) 5 times. The researcher needs to randomize these situations and record their reactions for each time they perform. There will a total of 12 trials performed. Record the subject's reaction time in the table below.

Trials	2 S-R	4 S-R	6 S-4	8 S-R
1				
2				
3				
Mean (RT)				