Lab 1: Measurement of Skilled Performance

Name:_____ Date:_____

Introduction. The most common tasks used for evaluating performance in motor behavior may be placed into three categories: time, response magnitude, and accuracy of error. These outcome measures provide information about the success or effectiveness of the movement.

Measurement of speed. Time measures or how long it takes the performer to respond to a stimulus and the duration of the movement. Usually, time measures are recorded in reaction time, movement time and/or total response time. Reaction time (RT) is a measure of time in which a person responds as fast as possible once a stimulus is presented. The measure itself is the amount of time, which elapses from the presentation of the stimulus to the initiation of the response. For example, RT is important for starting a spring. The RT for the sprinter would be from the instant the gun was fired to the point the sprinter began the movement to step out of the staring blocks. In contrast, movement time (MT) is the interval from the initiation of the response to the completion of the desired movement. RT and movement may be measure in situations when there is one choice (Simple RT or Simple MT) or when there is more than one choice (Choice RT, Choice MT).

Reaction time is considered by some as the measure of your decision time because it does not include any movement but only the time it take for one to make a decision whether to move or not to move. There are three types of reaction time situations or environments that exist in everyday life or in sport. They are simple, choice, and discrimination reaction time situations or environments. A simple reaction time environment is where the performer is involved in one signal and only one response movement, such as the start of the 100 meter sprint in track. A choice reaction time environment is where the performer is involved in a situation where there is more that one signal and each signal has a designated response movement, such as the hunter comes along a flock of ducks will shoot the mallard male duck but not the female. A discriminate reaction time environment is where the performer is involved in a situation where there is more than one signal but only performs a response movement to a specific signal, such as a walker must respond differently by walking over the log and around rocks on a path.

Measurement of response magnitude. Measures of magnitude provide information about the distance, height, or weight moved in an activity. For example, the distance a ball is thrown, the height of the high jump, the amount of weight bench pressed, or the length of the long jump are measurement of magnitude.

Measurement of error. Accuracy is another way to measure performance in motor behavior. Often one is important to perform a task without error – objective of the task is to achieve accuracy. Since errors are inversely related to accuracy, high skilled performers generate little or no errors in their movement. Three common error scores are

used in measuring accuracy of the movement: constant error (CE), absolute error (AE), and variable error, (VE).

Absolute error is the measure of the magnitude of the error, without respect to the direction. Constant error is the measure of response bias in relation to a target or criterion measure, that is, it measures the performer's tendency for being too fast or slow, high or low, short or long, etc. Variable error measures the consistency of the movement, and total error is a combined error score that includes both CE and VE or biasing and consistency.

Computing Error Scores

1. Absolute Error (AE) or magnitude of error is calculated by the following formula:

   $AE = \Sigma [X-C]/K$

   In the formula, AE represents the sum of the error for each trial divided by the number of trials in the block. The X represents the raw score. Ignore the sign of the value of X when calculating AE. The C represents the criterion score desired. The K represents the number of trials.

   The steps are:

   a. Subtract the criterion (C) from each score (X), i.e., X-C. Remember the AE does not account for direction (short or long); for this reason all scores are positive values.
   b. Next sum ($\sum$) the positive scores or $\sum$ X-C
   c. The last step is dividing the sum of positive scores by the number of trial (k): $\sum$ X-C/k

   A high AE means there was a high magnitude of error (low accuracy) in the performance. A low AE means there was a low magnitude of error (highly accurate) in the performance.

2. Constant Error (CE) or amount of bias is calculated by the following formula:

   $CE = \Sigma(X-C)/K$

   This formula is similar to AE except that the relative sign of each score is considered. You could have a negative or positive CE. The notations for X, C, and K are all the same except when you add make sure you take into consideration the sign of X.

   The steps are:

   a. Subtract the criterion (C) from each score (X)

b. Next sum the error scores. Remember the sign of X-C is used or $\sum$ (X-C)
c. Finally, the average is calculated by dividing the sum of the error scores by the number to trial (k): $\sum$ (X-C)/k

CE tells the direction of error. A high CE means there was a high direction of error or bias in the performance. A low CE measure there was low direction of error or bias in the performance.

3. Variable Error (VE) or the consistency of the performer is calculated by the following formula:

$$VE = \sqrt{[\Sigma(X-C)^2/k] - (CE)^2}$$

In this formula, VE is calculated by taking the square root of the sum of the squared difference between each individual error score and the CE score for that block, divided by the number of trials in the block. A common error is not to square root the entire formula's calculation. You may be aware that this formula is that same as standard deviation. In the future you can use either VE or the standard deviation of the blocks of trials or data.

The steps are:

a. Subtract the criterion from each score and square the value.
b. Next, sum these values, i.e., $\sum (X-C)^2$
c. Find CE, square the term $(CE)^2$ and subtract it from $[\Sigma(X-C)^2/k] - (CE)^2$
d. Finally take the square root, i.e., $\sqrt{}$ or $\sqrt{[\Sigma(X-C)^2/k] - (CE)^2}$

A high VE indicates the performance is inconsistent, while a low VE score implies that the scores were very similar.

Purpose: The purposes of this lab are two fold: 1) to demonstrate how one's decision time (reaction time) can be influenced by the characteristics of different reaction time situations or environments, and 2) to learn to calculate and interpret error scores (AE, CE, and VE) of coincidence anticipation timing ability.

Part I: Reaction Time

*Introduction & Procedure***:** Each student will complete 10 trials at each reaction time environment (simple versus choice). Students should take turns being an experimenter and subject. The experimenter is responsible for recording their subject's reaction time in milliseconds (ms), for each trial. Millseconds are recorded to three places without the decimal. For example, if the response was .125 seconds it is to recorded as 124 ms.

In the simple reaction time environment, the student will be positioned in front of the MoArt reaction timer. For each trial a warning light will appear then after a *random foreperiod* (waiting period) a "red" light will appear. Once the red light appears the

subject will as quickly as possible depress or release a button using their index finger of their non-dominate hand.

In the choice reaction time environment the student will be positioned in front the MoArt timer and place their hand near the display where five button, one for each finger with a corresponding light above each button, is located. For each trial a warning light will appear then after a *random foreperiod* a light above one of the five buttons will be lit. Once the light appears to be lit, the student will attempt to depress the button or key with the corresponding finger as quickly as possible. Keep the subject honest by *randomizing* when the designated stimuli will appear.

Data Collection: Each student's reaction time scores in ms will be recorded on the table below. Realize that ms will be displayed to three places, that is, .217. When you record your reaction time score drop the decimal place and record your score as 217. Once you have recorded the ten trials for each reaction environment, calculate your mean reaction time for the environment (type of reaction time) and record the mean in the space below the 10^{th} trial.

Individual Data

Trials	Simple RT	Choice RT
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Mean		

Part II: Error Scores

Introduction. You will learn how to compute two dimensional accuracy scores by collecting coincidence anticipation timing (CAT) data. This visual ability is of interest to many researchers. CAT affects performance in volleyball, basketball, tennis, field hockey, and skills of catching and hitting. CAT involves anticipating the arrival of a moving object and making a motor response of coincident at the exact moment the moving object arrives at a predetermined target area (Millslagle, 2000, 2002, & 2004).

Studies have proven that a highly skilled player in sports requiring catching, striking, and hitting has a better CAT ability than player' who are inexperienced (Millslagle, 2000). Other studies have determined that a gender difference may exist in CAT ability, that is,

men are better than women. CAT ability seems to mature between the ages of 14-19 and then declines after the age of 30. Of the many variables that have been studied to affect CAT ability, the effect of stimulus speeds seemed to have the greatest affect (Haywood, 1986, Millslagle, 2008a & 2008b).

Bassin Anticipation timer. The Bassin Anticipation timer will record the subject ability to response accurately by depressing a hand held button at the exact moment of the anticipated arrival of the object. The CAT performance is measured in msec. A negative score indicated a early response where as positive score indicates a late response.

Procedure: All subjects in this experiment will perform 20 trials. The experimenter will follow experimental design in Table 1 to determine the effect of stimulus speed (5, 10, 15, 20 mph) on coincidence anticipation. Record the subject's timing and direction of their coincidence on Table 1.

Table 1

		Fast	
Trials	Speed (MPH)	Direction (-/+)	Time (Msec)
1	10		
2	15		
3	20		
4	20		
5	15		
6	5		
7	20		
8	10		
9	5		
10	15		
11	20		
12	5		
13	5		
14	20		
15	15		
16	10		
17	5		
18	10		
19	15		
20	10		

Error score calculation. After you have collected your data for this experiment the next step is to calculate your AE and CE for each speed. Use the above AE, CE, and VE formulas to calculate these error scores. Report your AE, CE, and VE in that below data table.

Error scores\Speed	5mph	10mph	15mph	20mph
AE				
CE				
VE				

**Bring this lab with your individual data and calculations for parts I and II to class on Wednesday!