Background Information for Mental Rotation Experiment

This experiment involved one aspect of spatial cognition called **mental rotation**—that is, the process of manipulating visual images "in our heads." One of the first researchers to study mental rotation was Roger Shepard. His classic experiment on mental rotation of **three-dimensional** objects (co-authored with Jacqueline Metzler) was published in the journal *Science* in 1971. Shepard and Metzler demonstrated that mental rotation is similar in some ways to physically rotating an object in space: the greater the amount of rotation, the longer the process takes. This is shown in the table below, which summarizes their main results. As you can see, the time it took participants to respond correctly to the rotated figures increased as the amount of difference between the two figures increased, at least up to 180 degrees. (With differences larger than 180 degrees, it's more efficient to rotate one of the figures in the opposite direction, so that a difference of 340 degrees should be the same as a difference of 20 degrees.)

Angular difference between figures in degrees	**0**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**
Approximate Mean RT in milliseconds	1200	1600	1950	2400	2700	3050	3650	3900	4300	4550

Our experiment involved a simplified form of mental rotation, using a familiar **two-dimensiona**l object—the uppercase letter "R". We studied how long it takes people to judge whether the letter was *rotated* (the actual letter tipped to a new orientation) or *flipped* (a mirror image of the actual letter, tipped to a new orientation). Our experiment was designed to replicate the basic finding of the Shepard and Metzler experiment, namely that the time it takes to respond to rotated figures increases as the amount of rotation increases.

After 12 Practice Trials, you completed 60 Test Trials. On each trial you saw a black letter "R" in a red circle. The letter appeared in one of 6 different orientations -- the typical orientation (vertical or 0 degrees) or rotated to one of 5 other positions (60, 120, 180, 240, or 300 degrees from the vertical). On half the trials, you saw a *normal* letter -- that is, a letter "R" that had been rotated but not flipped. On the other half of the trials, you saw a *backward* letter -- that is, a letter "R" that had been flipped so that it is a mirror image of a normal "R", and thus could never be rotated into a position that matches a normal "R". So there were **6 levels of angular rotation** (0, 60, 120, 180, 240, or 300 degrees) by **2 stimulus types** (normal, backward) for a total of 12 cells in the "within-subjects" design; each cell was measured five times, so the data value for each cell in your results is the mean of five trials.

You had to decide whether each letter was "normal" or "backward". If the letter was "normal", you pressed the N key. If the letter was "backward", you pressed the B key. You were asked to press the key as quickly as you could without making mistakes. The basic response measure was **reaction time** or **RT**—the number of milliseconds (thousandths of a second) from the moment the stimulus appeared to the moment that you pressed a key. We also measured your **accuracy** in terms of the **number of correct responses.**

Shepard, R. N., & Metzler, J. (1971). Mental rotation of three-dimensional objects. *Science, 171,* 701-703.