Investigation #11: Distracted Learning

While you study, do you watch TV, listen to music, check your MySpace page, surf the Internet, chat on e-mail, talk or text on your cell phone? Do your parents insist that you can't possibly concentrate on studying while you're distracted by one of these activities? Maybe the conversation goes something like this:

Parent: "Take off your headphones and do your homework!"

Student: "I am doing my homework, and I work better with my music on."

Parent: "Turn it off! You can't study with that distraction!"

Student: "Yes I can. It helps me relax."

Parent: "Turn off that racket and concentrate on your school work!"

Student: "I study better with it on!"

Who is right? Some say that any distraction might interfere with your focus on the work you're doing, which may in turn affect the quality of the finished product. But others argue that listening to music actually helps them concentrate because the music "drowns out" other potential distractions. What do you think? Can previous research help us sort this out?[1]

In 1993, Frances Raucher and his colleagues designed an experiment to test whether listening to Mozart would help students improve their performance on a spatial reasoning task. They recruited 36 college students to participate in the experiment. The subjects were randomly assigned to three groups, with 12 students per group. Subjects in Group 1 listened to a 10-minute selection from a Mozart piece. Group 2 listened to a relaxation tape for 10 minutes. Subjects in Group 3 sat in silence for 10 minutes. Each subject took a pretest on spatial reasoning two days before the experiment and a post-test on spatial reasoning immediately after the 10-minute treatment. The results of the experiment seemed surprising: Students who listened to Mozart showed significantly higher gains in their scores on spatial-reasoning tasks than students in the other two groups.

After hearing the results of Rauscher's experiment, some eager parents started playing Mozart tapes for their children in hopes of increasing their spatial reasoning skills. One state even passed legislation requiring preschools to play 30 minutes of classical music a day. Other researchers tried to confirm this so-called "Mozart effect" in experiments of their own, but with little success.

So the question remains: Does listening to music help or hinder students' learning? The answer may depend on what type of "learning" we mean. In this investigation, your class will design and carry out an experiment to test whether listening to music

1 *www.madsci.org/posts/archives/mar98/889467626.Ns.r.html* served as inspiration for part of this investigation.

helps or hinders students as they perform a memorization task. Then, you will analyze data from the experiment and draw some preliminary conclusions from your research.

1. For simplicity, the members of your class will serve as the subjects in your experiment. How might this affect your ability to generalize the results of your study?

2. One possible design for the experiment would be to randomly assign about half of the students in your class to perform the memorization task while listening to Mozart, and the other half to perform the task in a silent room nearby. Then, you could compare the scores of students who listened to Mozart while memorizing with the scores of students who didn't. What flaw(s) do you see in using this design to conduct the experiment?

3. Some people are better at memorizing things than others. Here's another possible design for your experiment that takes this fact into account. Begin by having each student perform a memory task. Based on students' performance on this task, split the class into two roughly equal-sized groups containing the "good memorizers" and the "not-so-good memorizers." Randomly assign about half of the good memorizers to perform a second memory task while listening to Mozart, and the other half to perform the task in a silent room nearby. Use the same random assignment strategy for the not-so-good memorizers. To analyze the data from the experiment, you would compare the change in scores from the first memory task to the second for the good memorizers who listened to Mozart and those who didn't, and separately for the not-so-good memorizers who did and didn't listen to Mozart while memorizing.

(a) In what ways does this design improve on the design from question 2?

(b) How might you further improve the design of this experiment using the idea that some people are better memorizers than others? Explain.

4. Perhaps the best way to take individual differences in memorization skills into account in this experiment is to have each person perform two memory tasks—one while listening to Mozart and one in silence. Then, you can analyze data on the difference in performance for all students in your class and determine whether listening to Mozart seems to help or hurt memorization.

To carry out the experiment in this way, you will need two different but similar memory tasks. Let's call them task A and task B.

(a) Explain why you should not have all students perform task A while listening to Mozart and task B while in a silent room.

(b) Explain why you should not have all students perform their first memory task while sitting in a silent room and their second memory task while listening to Mozart, or vice versa.

(c) Discuss with your classmates how you could use random assignment to most effectively address the issues raised in parts (a) and (b). Once you have settled on a plan, propose it to your teacher.

(d) Describe carefully how you will perform the random assignment required by your approved plan from part (c).

5. Now that we have settled on a design for the experiment, let's confirm some of the details.

(a) Who are the subjects in this experiment?

(b) What factor(s)/explanatory variable(s) is this experiment investigating?

(c) What treatments are being administered? Explain why task A and task B are not treatments.

(d) Let's take a look at the tasks. Each subject will be presented with a list of 20 randomly generated two-digit numbers, such as the list shown below. The student will then have one minute to memorize as many of the numbers in the list as possible. At the end of the minute, each student will have two minutes to write down as many of the numbers as he or she can remember.

26	86	64	65	75	11	49	47	85	19
23	57	97	00	62	43	66	94	79	50

A wily student might just write down a bunch of two-digit numbers during the two minute period, hoping to match as many as possible. How might you score performance on this task to reward students for actual memorization and not for guessing?

(e) Based on your answer to (d), describe the response variable(s) this experiment will measure.

Now it's time to do the experiment! Your teacher will assist with logistics so that all students can participate.

6. Carry out the random assignment required for your experiment from question 4(d). Indicate clearly what each student will be doing first and second. You may find it helpful to make a chart like the one below that summarizes how the experiment will be carried out.

Subject	**First Task**	**First Treatment**	**Second Task**	**Second Treatment**
1	A	Music	B	Silence
2	A	Silence	B	Music
3	B	Music	A	Silence
4	B	Silence	A	Music

Subject	Which Task First? (A or B)	Music First? (Yes or No)	Score With Music	Score Without Music	Difference

7. Have students perform the two memorization tasks as specified in question 6. Record data from the experiment in the table on the previous page.

8. Construct comparative dotplots or boxplots of the scores with music and the scores without music. Describe any similarities and differences you see in a few sentences.

9. Calculate the difference in scores for each student when listening to Mozart versus sitting in a silent room. As a class, decide on which order you will subtract the values. Record these values in the right-most column of the table on the previous page.

10. Construct an appropriate graph of the difference in memorization scores. Describe what the graph tells you in a couple of sentences.

11. In what way is the graph you constructed for question 10 more informative than the comparative graph from question 8?

12. Calculate a measure of center (mean or median) and a measure of spread that you think summarize the differences well. Explain why you chose the measures you did.

13. Was this experiment single-blind, double-blind, or neither? Justify your answer.

14. Based on the results of your experiment, does it appear that listening to Mozart helps or hinders students' performance on memorization tasks? Give appropriate graphical and numerical evidence to support your answer.

15. Can we generalize the results of this experiment to any kind of task that requires memorization? Justify your answer.

16. Why did we have all students listen to the same piece of Mozart music, rather than letting each student choose music he or she liked? Explain.