43 Information Processing Capacity: A Visual Demonstration of the Magical Number Seven

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This activity provides a visual demonstration of the well-known limitation on information processing capacity represented by the G. A. Miller's phrase "the magical number seven, plus or minus two." Students are presented with an arrays of dots, arranged either randomly or in patterns. A graph of students' judgments of the number of dots in each array demonstrates the limits of information processing capacity and the facilitative effect of chunking. The demonstration also provides opportunities to explore aspects of experimental design and descriptive statistics.

Concept

The phrase "magical number seven, plus or minus two" refers to the limited capacity of short-term memory (Miller, 1956). This activity, unlike the auditory demonstrations typically included in introductory texts, uses visual stimuli to demonstrate this capacity and the value of chunking. It easily can be extended to cover experimental design and descriptive statistics.

Materials Needed

In addition to chalk and a chalkboard, you will need 17 stimulus items, each constructed from a sheet of 8½-by-11 in. white paper and black or blue colored adhesive dots approximately ¾ in. in diameter. These dots are available in office supply stores. A total of 136 dots are needed.

Prepare the 17 stimulus items as indicated in appendix A. Each must consist of one sheet of paper with the number of dots indicated distributed either randomly or in a pattern. On the back of each sheet note lightly, for your own reference, the stimulus item number as well as the number and distribution of the dots. This will enable you to check that the sheets are in the proper sequence before beginning the demonstration.

The construction of stimulus items as described here has proved adequate for classes of up to 90 students. For larger classes, you may want to construct the stimulus items by placing adhesive dots directly on overhead transparency sheets. These, however, are more difficult to handle. If you use this method, check in advance to make sure all the dots on each transparency actually project on the screen.

You may also want to prepare a summary sheet that indicates the random stimulus item numbers in order of increasing number of dots (stimulus items 6, 3, 12, 1, 16, 14, 9, 11, 5, 4, 17, 2, 8, and 13) and the patterned item numbers in the same order (stimulus items 15, 7, and 10). This will facilitate the construction of the results graph.

INSTRUCTIONS

Preparation

On a table in front of you, arrange the stimulus items face down from Item 1 (on top) through Item 17 (on the bottom). Ask the class to turn to a blank page in their notebooks and number from line 1 through line 17.

Say to the class: "I am going to show you some sheets of paper with dots on them. For each sheet, I will give you three beats to get ready, one beat to watch, and one beat to write down the number of dots you see on that sheet. Write your answer for each sheet on a different line, going from Line 1 through Line 17. I will not be calling out line numbers, so just keep going until we finish. For each sheet, I will say, 'dah, dah, dah, look, write.'" Demonstrate with hand motions how you will hold up a stimulus item on "look."

Stimulus Presentation

Show each sheet by counting, at approximately 1 sec per beat, "dah, dah, dah, look, write." As you say "look," hold up a stimulus item. As you say "write," put the sheet face down. Repeat for each stimulus item.

RECORDING RESULTS

Draw a graph on the chalkboard. Label the vertical axis "Number of Persons Correct" and mark it in units of 10. Label the horizontal axis "Number of Dots" and number it from 1 to 14 (the maximum number of dots).

Referring to your summary sheet listing all the stimulus items, go through each item in the order of increasing dots and ask for a show of hands as to the number of students who wrote down the correct number. For example, say, "Sheet 6 had one dot. How many of you were correct?" Follow this with, "Sheet 12, two dots," and so on. It is helpful to know in advance how many are actually present so you can subtract the number of people wrong when almost everyone is correct. With a large class, divide the class into sections and have someone count each section.

Using this procedure, record the number of persons correctly responding to random arrangements of 1 through 14 dots. For each stimulus item, count the number of correct persons and plot a solid dot at the appropriate place on the graph. Connect the solid dots with solid lines to complete the graph. Then record the number of persons correctly responding to the three items with dots arranged in patterns. Indicate the number correct with small hollow circles and connect these with broken lines. Complete your graph with a key indicating that solid circles connected by a solid line correspond to random arrangements, whereas hollow circles connected with a broken line indicate pattern arrangements.

DISCUSSION

Typically, for random arrangements of dots, virtually the entire class is correct for 1 through 5 dots. Thereafter, the number of persons correct begins to decline, and does so precipitously for 10 through 14 dots. Your graph will not be perfect, but the trend should be clearly apparent.

Once you have constructed the graph for random arrangements, ask the class to interpret the graph. Identify the point where lots of people begin to make mistakes and relate this to the "magical number seven," which represents our information-processing capacity.

When dots are arranged in patterns, the number correct is always higher. Ask the class to compare the number correct for 9, 10, and 12 dots arranged in patterns with the number correct for 9, 10, and 12 dots distributed randomly. Ask for suggestions as to why the results are as they are. Introduce the concept of chunking to explain the dramatic increase in capacity when information is organized into patterns.

After discussing the main findings of the demonstration, you can extend the activity by having students analyze it in terms of experimental design. Have them identify the independent variables (there are two: the total number of dots and the type of arrangement, random or pattern) and the dependent variable (number of persons correct) for the demonstration. Ask for someone to state a relationship between the independent and dependent variables that was illustrated by this activity. (As the number of dots increased, the number of persons correct decreased. However, the number of persons correct was higher when the dots were in a pattern.)

Continuing your discussion of variables, ask the class to identify possible uncontrolled variables that might have affected the outcome. These might include such things as distance from the stimulus items, viewing angle, movement of stimulus items as you held them up, inadvertent variations in viewing time, and so forth. Ask for suggestions as to how to adequately control for these variables, and describe laboratory instruments, such as the tachistoscope, that have been designed to enable increased control over such variables.

Finally, it is good to point out how a very large number of individual responses (roughly 17 times the number of people who participated) can be summarized by means of a single graph. This illustrates the value of graphs and other forms of statistics for making data manageable and understandable.

Writing Component

Several writing exercises can be assigned to assess students' understanding of information-processing capacity as illustrated by this activity. For example, ask the students to write a paragraph summarizing the purpose of the demonstration and describing the independent variable, the dependent variable, and the relationship between them.

As a follow-up to the classroom discussion of uncontrolled variables, you can also have students choose one of these variables and design an experiment in which it becomes an independent variable while other variables are controlled. Have students explain in writing how results could be summarized in a graph.

Finally, have students write descriptions of situations in which chunking of visual information into patterns is important. These might include occupations (e.g., air traffic controller or musician), sports (e.g., football or basketball), board games (e.g., chess), and activities of daily life (e.g., finding one's car in a large parking lot or finding items during a trip to a supermarket). In each instance, have students indicate why they believe chunking is of value. Some examples of studies reporting visual chunking are noted in the Reference and Suggested Reading sections.

Reference

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review, 63,* 81–97.

Suggested Reading

Allard, F., & Burnett, N. (1985). Skill in sport. *Canadian Journal of Psychology, 39*, 294–312.

Chase, W. G., & Simon, H. A. (1973). Perception in chess. *Cognitive Psychology, 4*, 55–81.

Cohen, G. (1989). *Memory in the real world.* Hillsdale, NJ: Erlbaum.

Squire, L. R. (1992). *Encyclopedia of learning and memory.* New York: Macmillan.

Appendix A

Stimulus Items

Item Number	Number of Dots	Distribution
1	4	Random
2	12	Random
3	2	Random
4	10	Random
5	9	Random
6	1	Random
7	10	Pattern (2 rows of 5)
8	13	Random
9	7	Random
10	12	Pattern (4 rows of 3)
11	8	Random
12	3	Random
13	14	Random
14	6	Random
15	9	Pattern (3 rows of 3)
16	5	Random
17	11	Random