Learning and Memory Strategy Demonstrations

for the Psychology Classroom

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Overview

This 38-page document contains an introduction to the resource, background information on learning and memory strategies, a summary of research on undergraduate student metacognition with regard to these strategies, and a collection of classroom demonstrations that allows students to experience real-time the effectiveness of specific learning and memory strategies. References are included at the end of the document.

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I. Introduction

The purpose of this resource is to provide psychology instructors with an annotated collection of in-class learning and memory strategy demonstrations. The demonstrations illustrate strategies that are empirically validated as effective for long-term memory retention and are readily applicable to both the psychology classroom and, more broadly, to college students' study skills.

Teaching students about effective learning and memory strategies is a first step toward improving metacognitive sophistication (i.e., learning how to learn); an important next step is to find ways to encourage students to actually change their behaviors and implement these strategies in their daily lives, most notably in the context of learning information for college courses. One way psychology instructors can improve student exposure to, confidence in, and motivation to implement the recommended learning strategies is to incorporate in-class demonstrations of each strategy's effectiveness. This technique allows students to witness in real-time the memory advantage of certain strategies (e.g., imagery) over others (e.g., verbal repetition).

The demonstrations included in this resource represent an effort to translate research from cognitive psychology into the arena of higher education. This translational piece has been a focus of recent publications from renowned researchers in the field (e.g., Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Roediger & Pyc, 2012). As such, researchers in psychological science now ask (and ideally answer) questions regarding what their basic research findings imply for real-world educational practice. This resource will help teachers explore one way to translate research findings into the everyday experience of college students.

This project is relevant to teachers of psychology on multiple levels. First, teachers who include a section on human memory in their courses (e.g., Introduction to Psychology, Cognitive Psychology, Learning and Memory) may benefit from a teaching resource that includes evidence for beneficial learning and memory strategies. At a basic level, incorporating this information and these demonstrations into such classes should improve students' knowledge about how memory works. Second, this resource may be particularly valuable to those who teach first-year and/or underprepared students, as these students may especially need training in the metacognitive aspects of learning how to learn. At an applied level, these demonstrations illustrate in real-time the memory benefits of specific strategies, and then class discussion and follow-up assignments could encourage students to implement such strategies in their college courses and also in memory tasks in their everyday lives. For advanced courses in particular, the demonstrations can provide an effective scaffold for discussions of memory theories.

As teachers of psychology, we have a responsibility to share the research findings in our discipline with students to help them acquire the skills for lifelong learning. It is one thing to *tell* students about the best way to learn, but quite another to *show* them that some strategies are more successful than others. This "aha" moment in class when, for example, students realize that all it took was a bit of mental imagery to improve memory far beyond verbal repetition, is rewarding for students and educators alike. This resource provides teachers with the materials to help their students engage in interesting exercises aimed at helping them become more strategic and successful learners.

II. Background Information on Strategies and Metacognition

A large body of literature now exists to document, at least in the laboratory, the memory benefits of learning strategies such as deep (elaborative) processing (e.g., Craik & Lockhart, 1972), the self-reference (i.e., self-referential processing) effect (e.g., Rogers, Kuiper, & Kirker, 1977), spaced study (or distributed practice; e.g., Rohrer & Pashler, 2007), retrieval practice (the testing effect; Roediger & Karpicke, 2006), imagery (dual-coding; Paivio, 1986), chunking (e.g., Butterworth, Shallice, & Watson, 1990), mnemonics (e.g., Bellezza, 1996; for a review, see McCabe, 2011a), and learner-created study materials (the generation effect; e.g., Slamecka & Graf, 1978). See Roediger and Pyc (2012) for a review of several of these strategies.

Although research has established the strategies listed above as beneficial for memory, compelling evidence suggests that many college students have low metacognitive awareness, so these strategies could be helpful for their learning (Kornell & Bjork, 2007; McCabe, 2011b). This lack of awareness may be particularly relevant to those strategies that Bjork (1994) termed *desirable difficulties*, the types of activities that make learning slower and more error-prone in the short term, but have longer-term memory benefits. Research shows that college students sometimes believe that the *opposite* of effective strategies are best for memory (e.g., re-reading versus retrieval practice, or testing; e.g., McCabe, 2011b; Roediger & Karpicke, 2006). In addition, many strategies self-reported by undergraduates are non-elaborative and unsupported by research (e.g., re-reading, highlighting; Hartlep & Forsyth, 2000; Karpicke, Butler, & Roediger, 2009). As learners may not have metacognitive sophistication to judge the most effective learning methods on their own, it is critical that instructors assist them in acquiring these beneficial techniques.

Basic research suggests that learners are more likely to use a strategy that they have experienced as beneficial for their own memory (e.g., Bjork, deWinstanley, & Storm, 2007; Murphy, Schmitt, Caruso, & Sanders, 1987). Thus, demonstrating the most effective strategies in class could help improve strategic choices and minimize the metacognitive disconnect noted above. Specific to mnemonic techniques, Carney, Levin, and Levin (1994) recommended that instructors provide in-class “mnemonstrations,” with the goal that students would then take more ownership of mnemonic creation and use over time. Based on empirical research conducted in his introductory psychology class, Balch (2005) suggested that instructors teach students about elaborative methods such as keyword mnemonics and real-life examples by including these in lecture materials. In a more holistic approach to memory strategy instruction, Shimamura (1984) developed an entire short course focusing on memory skills, emphasizing that instructors must take the time to provide training and practice to bolster successful strategy use.

My own research has shown that explicit in-class instruction about effective learning techniques is associated with improved knowledge of these “desirably difficult” strategies (McCabe, 2011b). Others have demonstrated that instruction on applied learning and memory topics is associated with increased metacognition and subsequent academic performance (e.g., Azevedo & Cromley, 2004; Fleming, 2002; Tuckman, 2003). Assuming that instructors want students to change their strategic study behaviors, one way to make progress toward this goal is to integrate learning and memory strategy demonstrations into the psychology classroom.

III. Classroom Demonstrations for Learning and Memory Strategies

This section is organized by type of learning strategy, based more broadly on principles of memory improvement. Each section includes a brief description of the strategy with key references, at least one classroom demonstration, and when available, empirical support for the demonstration's effectiveness.

The demonstrations described below were chosen using the following inclusion criteria:

1) The demonstration fits within class time.
2) The demonstration includes a comparison between a strategy that improves memory and a strategy that works less well, in a between-subjects or within-subjects manner.
3) The outcomes of the demonstration should clearly illustrate the superiority of the empirically supported strategy.
4) The demonstrated strategy is one that has obvious links to academic behaviors under students' control; that is, students could apply the strategy to their own studying, ideally enhancing self-regulated learning outside the classroom.

A. DEEP PROCESSING

Description of the strategy: Deep processing involves elaborating on to-be-learned information in a semantic (meaning-based) way. Research suggests that semantic (deep) processing of items is superior to phonological (medium) or structural/orthographic (shallow) processing for long term memory (e.g., Craik, 2002; Craik & Lockhart, 1972); Craik & Tulving, 1975).

Deep Processing Demonstration #1

Using an abbreviated version of Craik and Tulving's (1975) levels-of-processing experiment, Bugg, DeLosh, and McDaniel (2008) assessed the impact of an in-class exercise that demonstrated the memory advantage of deep/semantic over shallow/nonsemantic processing using a within-subjects design. Students view 18 words one at a time for 2 seconds each. For each word, they answer a yes/no "orienting question" that represents processing at a shallow/orthographic (e.g., "Is it typed in capital letters?"), medium/phonological (e.g., "Does it rhyme with 'shock'?"), or deep/semantic (e.g., "Does it fit in the sentence 'The ____ was building a nest.'") level. After a brief filled delay, students are given 60 seconds to recall the words. The instructor then asks for a show of hands to tally which level of recall was highest. According to Bugg et al., the demonstration clearly shows that the deep/semantic orienting questions resulted in the best memory for the words. In addition, students in their study rated semantic study strategies as more useful than nonsemantic strategies after the activity, demonstrating a lasting impact from the demonstration.

The activity takes approximately 7 minutes. A presentation using PowerPoint containing the demonstration is available at http://lamar.colostate.edu/~delosh/downloads.htm

Deep Processing Demonstration #2

Chew (2010) reported a demonstration using a 2 (Level of Processing: deep, shallow) x 2 (Intent to Learn: intentional, incidental) between-group factorial design. This works best in classes with at least 40 students. (For classes with fewer students, eliminate the *intent* variable.) The instructor reads a list of words aloud; depending on the instructions given at the top of an answer sheet, for each word students engage in an orienting task that is either shallow (i.e., "Does the word contain an E or G?") or deep ("Is the word pleasant?"). In addition, half of the class is informed it will take a memory test on the words (intentional condition) and half is not informed (incidental).

The demonstration requires four handouts, each with the instructions for the relevant condition: deep/intentional, deep/incidental, shallow/intentional, shallow/incidental. Divide the room into quadrants and distribute one type of encoding instruction to that quadrant. The instructor reads 24 words as the students answer the yes/no question they are assigned:

(1) Evening	(13) Cold
(2) Country	(14) Love
(3) Salt	(15) Bargain
(4) Easy	(16) War
(5) Peace	(17) Hate
(6) Morning	(18) Wet
(7) Pretty	(19) Rich
(8) Expensive	(20) Nurse
(9) Poor	(21) Pepper
(10) Doctor	(22) Hard
(11) City	(23) Ugly
(12) Dry	(24) Hot

After explaining the four conditions, the instructor has the entire class stand and remain standing only if they recalled at least three words. As higher recall numbers are read, more and more students sit down. Chew (2010) reported it should be apparent at 12-15 words recalled that the majority of people still standing engaged in deep processing, and that it does not much matter whether they were warned or not warned about the recall test. He used this as evidence that intention to learn is far less important than what students think about while they are studying. As an extension of the activity, the instructor can ask who noticed that the word list contained pairs of opposites. Typically, the deep processing groups notice it and the shallow processing groups often do not.

This demonstration takes approximately 10 minutes.

Deep Processing Demonstration #3

Pusateri (2003) created a slideshow using PowerPoint to demonstrate the effectiveness of deep processing. Distribute papers with one of two sets of instructions:

[*Shallow processing group*]

Instructions: For this demonstration, you will see a series of words numbered from 1 to 20. When you see each word, circle "Yes" if the word contains the letter E and "No" if it doesn't contain a letter E.

[Followed by the numbers 1 through 20, each with "Yes" and "No" listed adjacent.]

[*Deep processing group*]

Instructions: For this demonstration, you will see a series of words numbered from 1 to 20. When you see each word, circle "Yes" if the word sounds pleasant to you and "No" if it doesn't sound pleasant to you.

[Followed by the numbers 1 through 20, each with "Yes" and "No" listed adjacent.]

Next, all students see the following instructions on the screen: "You will see a list of 20 words. Follow the instructions on your sheet as you see each word. The words will appear relatively quickly, so make a quick decision for each word." Each of the following words appears on the screen for 2 seconds each:

(1) Table	(11) Hate
(2) Night	(12) Father
(3) Red	(13) Day
(4) Love	(14) Green
(5) Salt	(15) Even
(6) Happy	(16) Chair
(7) North	(17) Pepper
(8) Mother	(18) Low
(9) High	(19) Sad
(10) Odd	(20) South

Students are immediately asked to write down as many of the words as they can remember, in any order.

Next, to score their own recall performance, students are shown the words as semantic pairs, as follows:

TABLE - CHAIR
NIGHT - DAY
RED - GREEN
LOVE - HATE
SALT - PEPPER
HAPPY - SAD
NORTH - SOUTH
MOTHER - FATHER
HIGH - LOW
ODD - EVEN

The rationale for showing the items in pairs is so that students can easily compute a "clustering" score (number of semantic pairs listed together out of 10) in addition to a basic recall score (number of items recalled out of 20). The instructor can collate the class data to complete the following matrix:

	RECALL	CLUSTERING
CONTAINS AN "E"?	____	____
PLEASANT OR NOT?	____	____

Results should clearly show an advantage for the pleasantness-rating (*deep*) group over the E-rating (*shallow*) group. In addition, clustering scores should be higher for the deep than for the shallow group. Many students in the shallow condition may not have realized there were clusters in the list at all, as they were focusing only on surface features of the words.

PowerPoint-based materials for this demonstration are available from Tom Pusateri at https://files.kennesaw.edu/xythoswfs/webui/_xy-1257263_1-t_IdbunvA5

(Chapter 6 folder, "Deep Processing" demo)

This demonstration takes approximately 10 minutes.

B. SELF-REFERENCE EFFECT

Description of the strategy: The self-reference effect (or *self-referential processing*) refers to the memory advantage for material personally related to the learner. Information that is attached to the self-schema is more easily encoded and later retrieved (e.g., Klein & Kihlstrom, 1986; Rogers et al., 1977).

Self-Reference Effect Demonstration #1

This demonstration is based on Forsyth and Wibberly's (1993) report of a within-subjects demonstration of the self-reference effect. Each student should number a paper from 1 to 18, and then the instructor reads the following list of 18 adjectives aloud. For each word, students circle the number corresponding to the word if they think it describes themselves. The items are:

(1) Forceful	(10) Courageous
(2) Quiet	(11) Cheerful
(3) Generous	(12) Secretive
(4) Dominant	(13) Principled
(5) Tender	(14) Romantic
(6) Loyal	(15) Responsible
(7) Independent	(16) Dynamic
(8) Compassionate	(17) Forgiving
(9) Adaptable	(18) Careful

After a 1-minute delay filled with a backward counting task, the instructor asks students to recall the adjectives in any order. Students count the number of self-referent words they recalled and the number of non-self-referent words recalled, then convert those to percentages of recall.

In Forsyth and Wibberly (1993), students recalled 42.5% of non-self-referent words, and 56.0% of self-referent words. This is a practical and effective way to demonstrate the self-reference effect (and the related concept of *depth of processing* in the classroom).

This demonstration takes approximately 8 minutes.

Self-Reference Effect Demonstration #2

Rogers et al. (1977) extended Craik and Lockhart's (1972) and Craik and Tulving's (1975) levels-of-processing theory to include a self-referencing condition. This extension can easily be adapted to become a 3-condition between-subjects classroom demonstration.

Before starting the demonstration, 1/3 of the class is given sheets numbered 1 through 16 that instruct them to count and write down the number of vowels in each word (shallow condition); 1/3 of the class is given instructions to rate the pleasantness of the word on a 1 (*very unpleasant*) to 5 (*very pleasant*) scale (deep/semantic condition); and 1/3 is given instructions to rate the extent to which the word describes them on a 1 (*does not describe me at all*) to 5 (*very much describes me*) scale (deep/self-reference condition). Students are not told that they will be taking a recall test. Next, the instructor should visually present this list of 16 words:

(1) Serious	(9) Loyal
(2) Artistic	(10) Rigid
(3) Trusting	(11) Reckless
(4) Gentle	(12) Brave
(5) Timid	(13) Honest
(6) Warm	(14) Rude
(7) Clumsy	(15) Wise
(8) Lazy	(16) Tense

Following the list, students are asked to recall as many words as they can in any order and to score their own recall lists. Class results should show the highest recall in the two deep-processing conditions compared to the shallow condition, and even higher recall in the self-referential compared to the standard semantic-processing condition.

This demonstration takes approximately 8 minutes.

C. SPACING EFFECT

Description of the strategy: The spacing effect refers to the memory advantage of distributing study time with breaks in between, as compared to massing or cramming study time into only one session, holding total study time constant (e.g., Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006; Kornell & Bjork, 2007; Rundus, 1971; Smith & Rothkopf, 1984).

Spacing Effect Demonstration #1

The following demonstration is adapted from Balch (2006), who reported the outcomes of a within-subjects demonstration that compared memory for words that were studied in a massed versus spaced manner. The instructor should tell students they will hear a list of words read aloud for them to remember, at a pace of one every 3 seconds, and to expect that most of the words would appear twice in the list. Thirty-six 2-syllable words are then presented to the class (below), including buffer words in the first four positions that are not included in the recall total (to avoid contamination from the primacy effect).

(1) Vessel	(19) Leather
(2) Household	(20) Leather
(3) Household	(21) Artist
(4) Tower	(22) Witness
(5) Message	(23) Witness
(6) Basket	(24) Pattern
(7) Basket	(25) Bottle
(8) Fashion	(26) Empire
(9) Justice	(27) Empire
(10) Justice	(28) Pattern
(11) Artist	(29) Cousin
(12) Supper	(30) Giant
(13) Fashion	(31) Giant
(14) Ticket	(32) Supper
(15) Ticket	(33) Remark
(16) Remark	(34) Habit
(17) Cousin	(35) Habit
(18) Message	(36) Bottle

After the presentation of the list, students count backward by 3's from a three-digit number (e.g., 245) for 18 seconds, to avoid contamination from the recency effect due to items in short-term memory. Then they are asked to recall as many words as possible in any order, in 2 minutes.

Within the list, ignoring the first four buffer words, eight words are presented in a spaced/distributed fashion, in that other words intervene between the repetition of that word (i.e., for *message, fashion, artist, supper, remark, cousin, pattern, bottle*) and eight words are presented in a massed fashion (i.e., immediate repetition for *basket, justice, ticket, leather, witness, empire, giant, habit*). Students tally the number of “spaced” words out of eight that they recalled, and the number of “massed” words out of eight that they recalled. By a show of hands, students can indicate whether they recalled more “spaced” than “massed” words, more “massed” than “spaced,” or the same number of each type.

Balch’s (2006) results showed that students recalled significantly more distributed/spaced words (47.8%) than massed words (34.5%). In addition, students performed better on quiz questions about the spacing effect (and other research design elements contained in the demonstration) after the demonstration compared to before the demonstration. Finally, students reported feeling convinced of the benefits of distributing study over time and also reported high enjoyment of the activity.

This demonstration takes approximately 10 minutes.

Spacing Effect Demonstration #2

An online demonstration of the spacing effect, similar to Balch's (2006) activity described above, is available at Timothy Bender's web site: http://courses.missouristate.edu/timothybender/mem/mydemos.html#recent

This demonstration takes approximately 10 minutes.

Spacing Effect Demonstration #3

The spacing effect can also be demonstrated over a longer time course (i.e., beyond one class period) by asking students to study a set of terms and definitions at the start of class. Perhaps the terms could be relevant to an upcoming chapter in the course. For half the terms, students study in a massed fashion (e.g., a total of 6 minutes during one class period) For the other half, students study in a distributed fashion (e.g., 3 minutes during one class, then 3 minutes during a second class, with a break in between). A recall test given during a subsequent class period should show an advantage for spaced over massed study.

Depending on the length of the study sessions and the number of items to be recalled on the test, this demonstration should take approximately 15-20 minutes of total class time across two days.

D. TESTING EFFECT

Description of the strategy: The testing effect states that practicing retrieval of information from long-term memory enhances retention more than continued study of the information. This is also known as *retrieval-based learning* (e.g., Karpicke, 2012; McDaniel, Howard, & Einstein, 2009; Roediger & Karpicke, 2006)

Testing Effect Demonstration

Einstein, Mullet, and Harrison (2012) developed a within-subjects activity to allow students to experience and understand the testing effect.

To conduct this demonstration in class, two 1-page passages are required. Einstein et al. (2012) used passages from a preparation book for the Test of English as a Foreign Language. The Sun and Sea Otter passages can be found at http://psych.wustl.edu/memory/stimuli/Stimuli-Roediger&Karpicke2006b.pdf.

During one class period, students should read Passage A (a short prose passage) using a *Study-Study* strategy, then Passage B using a *Study-Test* strategy. For *Study-Study*, students read the passage for 4 minutes, then re-read it for another 4 minutes. For *Study-Test*, students read for 4 minutes, then spend a 4-minute test period writing as much as they can remember about the passage. Then have students rate how well they thought they learned from each condition. One week later, administer a surprise quiz on each passage, each consisting of 12 short-answer items. Students have 7 minutes to take each quiz. The short-answer questions and answers can be found at http://www2.furman.edu/academics/psychology/meet-our-faculty/Documents/Laboratory%202%20MC%20Sun%20Sea%20Otter%20Quiz.pdf

Students score their own quizzes as the instructor reads aloud the correct answers, out of a maximum of 12 for each quiz.

Einstein et al. (2012) showed that a testing effect in the class data (59% correct for *Study-Test*; 52% correct for *Study-Study*). Based on self-report, students did not think that one strategy was more effective than the other. However, at the end of the semester, students reported having changed their study habits, being more likely to use testing as a memory strategy when reading and studying.

E. Imagery

Description of the strategy: The use of visual imagery helps memory for to-be-learned material. Dual-coding theory states that having both verbal and image-based encoding enhances the number of routes for retrieval, and therefore enhances memory success (Paivio, 1986; see also Bower & Winzenz, 1970; Paivio, Smythe, & Yuille, 1968).

Imagery Demonstration #1

Based on Paivio et al. (1968), Pusateri (2003) developed a paired-associates learning demonstration using PowerPoint that quickly and reliably demonstrates the superiority of encoding words that can be readily imagined (concrete) over those than cannot (abstract).

Read the following instructions to students: *In this demonstration, you will see 14 pairs of words, each containing a STIMULUS and a RESPONSE. Try to remember the pairs of words so that later, when you see the STIMULUS word, you'll remember the RESPONSE word. Use whatever techniques you can think of to recall each pair of words. You'll have 5 seconds to see each pair.*

The slideshow then presents the 14 word pairs one at a time for 5 seconds each:

- *hatchet – leaf*
- *cause – meaning*
- *sofa – bicycle*
- *judgment – concern*
- *museum – antelope*
- *truck – apple*
- *mountain – calendar*
- *purpose – value*
- *substance – duty*
- *event – concept*
- *carton – bottle*
- *ocean – newspaper*
- *reason – freedom*
- *decision – program*

Then read the next instruction: *Write the number 1 through 14 on a sheet of paper. On the next several slides, you'll see each of the "STIMULUS" words. Try to recall the "RESPONSE" words. You'll have 7 seconds to recall each RESPONSE.*

1. *truck - ?*
2. *purpose - ?*
3. *carton - ?*
4. *substance - ?*
5. *sofa - ?*

6. *judgment - ?*
7. *mountain - ?*
8. *decision - ?*
9. *hatchet - ?*
10. *cause - ?*
11. *museum - ?*
12. *reason - ?*
13. *ocean - ?*
14. *event - ?*

Next, students check their memory on the next slide, and specifically count how many even-numbered words they recalled correctly (out of 7) and how many odd-numbered words they recalled correctly (out of 7).

1. TRUCK – APPLE
3. CARTON – BOTTLE
5. SOFA – BICYCLE
7. MOUNTAIN – CALENDAR
9. HATCHET – LEAF
11. MUSEUM – ANTELOPE
13. OCEAN – NEWSPAPER

RECALL OF ODD WORD PAIRINGS (CONCRETE): _____ / 7

2. PURPOSE – VALUE
4. SUBSTANCE – DUTY
6. JUDGMENT – CONCERN
8. DECISION - PROGRAM
10. CAUSE – MEANING
12. REASON – FREEDOM
14. EVENT – CONCEPT

RECALL OF EVEN WORD PAIRINGS (ABSTRACT): _____ / 7

Either by a show of hands (e.g., asking students to raise their hands if they recalled more words for the even items than the odd items) or by more formal methods of data analysis (e.g., collecting recall scores and running a paired-samples *t* test on the means), a clear advantage for easily visualizable words should be found.

PowerPoint-based materials for this demonstration are available from Tom Pusateri at: https://files.kennesaw.edu/xythoswfs/webui/_xy-1257263_1-t_IdbunvA5

(Chapter 9 folder, “Dual Coding” demo)

This demonstration takes approximately 10 minutes.

Imagery Demonstration #2

A similar in-class demonstration could be easily modeled on Bower and Winzenz (1970), who showed a significant memory benefit for participants who used an imagery strategy to memorize word pairs compared to those using a verbal repetition strategy. In a between-subjects modification to the Pusateri (2003) demonstration described above, give half the class instructions to encode the word pairs using a word repetition strategy and give the other half instructions to encode the pairs using visual imagery. An example would be presenting the word pair "boat – tree," with the expectation that the repetition group would silently repeat, "boat – tree, boat – tree, boat – tree," and that the imagery group would instead use an interactive mental picture to encode the words (e.g., a boat sitting on top of a tree). Then a series of concrete noun pairs should be presented in a format similar to the Pusateri demonstration above, followed by cued recall of the second word of the pair when provided with the first word, then a discussion of class results that should show better memory for the imagery compared to the repetition group.

A discussion after the experiment could include the critique that although participants heard strategy instructions, nothing prevented those in the repetition condition from also using visual imagery (or vice versa). This is a potential confounding variable in this demonstration, affecting the internal validity of the experiment.

Depending on the length of the stimulus list, the demonstration should take 8-15 minutes.

Imagery Demonstration #3

A demonstration created by Simons and Irwin shows students the value of visual imagery in memory. This demonstration is described in Bolt's (2007) *Instructor's Resources to Accompany* David G. Myers ***Psychology*** (8th ed.). Half of the students (the verbal coding control group) read the instructions: *Please rate the sentences I will read aloud on how easily you can pronounce them. Repeat the sentences silently to yourself. Use the following scale: 1 =* very difficult to pronounce, *to 5 =* very easy to pronounce. The other half (in the experimental, visual imagery group) read the instructions: *Please rate the sentences I will read aloud on how well you can form a vivid mental picture or image of the action in the sentence. Use the following scale: 1 =* impossible to image, *to 5 =* very easy to image. For each of the next 20 sentences, students record their ratings as the instructor reads them aloud:

1. The noisy fan blew the papers off the table.
2. The green frog jumped into the swimming pool.
3. The silly snake slithered down a steep sliding board.
4. The crafty surgeon won the daily double.
5. The skiing trumpeter started a gigantic avalanche.
6. The plump chef liked to jump rope.
7. The captured crook liked to do difficult crossword puzzles.
8. The small child sat under the lilac bush.
9. The medieval minstrel strolled along the babbling brook.
10. The distressed teacher ate a wormy apple.
11. The chocolate choo-choo train chugged down the licorice tracks.
12. The marching soldier lit a cigarette.
13. The long-haired woman had a phobia about scissors.
14. The cheerful choirboy sang off-key.
15. The toothless bathing beauty hardly ever smiled.
16. The sweaty gardener was wearing a scarf and mittens.
17. The spotted dog was sleeping in the sun.
18. The lanky leprechaun wore lavender leotards.
19. The bearded plumber was flushed with success.
20. The novice camper got lost in the woods.

Students are then given a surprise recall test for the sentences. Following the recall period, students self-score as the instructor reveals the correct answer. Allow some flexibility in scoring; an answer that is close can count as correct. Next, tell students about the between-subjects independent variable. Instructors can write the recall scores for each of the two groups on the board ("control," "imagery"), and it should be clear that far better memory resulted from the imagery instructions.

This demonstration takes approximately 10-15 minutes of class time.

Imagery Demonstration #4

Two online demonstrations relevant to imagery strategies are available at Timothy Bender's web site http://courses.missouristate.edu/timothybender/mem/mydemos.html#recent :

(1) "Imagery: Imagery Value vs. Meaningfulness," based on Paivio et al. (1968)

(2) "Paired Associates Strategies," based on Bower and Winzenz (1970)

F. CHUNKING

Description of the strategy: The capacity of short-term (or working) memory can be increased via chunking strategies. Individual pieces of to-be-learned information are organized into meaningful groupings ("chunks"), which can then be retrieved and unpacked at retrieval (Miller, 1956).

Chunking Demonstration #1

Bolt's (2007) *Instructor's Resources to Accompany David G. Myers Psychology* describes an activity that demonstrates the mnemonic value of chunking. Students hear the instructor read a series of digits aloud, with the instructor verbalizing the digits as chunks (e.g., "423-19" would be read as "four twenty-three *(pause)* nineteen." To turn this single-condition demonstration into a within-subjects experiment, the instructor can present half the digit strings without a clear chunking strategy (i.e., read each digit individually and at the same pace) and to present the other half with the chunking strategy described above. That is, students would hear the first string at a given length with no chunking, and the second string with chunking. The second (chunked) string at each length presented below are those presented in Bolt (2007), and the remainder were newly created to be parallel in structure. Strings could easily be added, modified, or subtracted to suit the instructor's needs. Students are told to recall each digit string in the exact order they hear it. The instructor reads each string aloud, counterbalancing as desired whether the chunked or unchunked string occurs first).

1. A. 59824 [5 digits]
   B. 423-19
2. A. 731259 [6 digits]
   B. 267-198
3. A. 5239461 [7 digits]
   B. 390-675-2
4. A. 14962573 [8 digits]
   B. 573-291-43
5. A. 315429635 [9 digits]
   B. 721-354-456
6. A. 8693652174 [10 digits]
   B. 245-619-830-2
7. A. 48374692741 [11 digits]
   B. 141-384-515-89
8. A. 402738491268 [12 digits]
   B. 201-315-426-762

After hearing the instructor read the sequences, then writing down their recalled list for each one, students can score their digit strings. In traditional scoring, only perfectly recalled strings would earn a point. A show of hands could indicate how many students got each string correct for each length and in each chunking condition. This could also lead to a discussion as to whether students were applying a chunking strategy even for the non-externally-chunked strings, and whether this was successful.

A between-subjects modification to this demonstration would be to give half the class instructions to chunk the numbers in each list into sets of two or three as a memory strategy and give the other half no specific instructions regarding strategy. A comparison of recall success should show an advantage for those using chunking over those who did not.

This demonstration takes approximately 10-15 minutes, depending on the number of digit sequences administered.

Classroom Demonstration #2

An online chunking demonstration using letters is available at
http://www.youramazingbrain.org.uk/yourmemory/chunk01.htm

This demonstration takes approximately 5 minutes.

G. MNEMONICS

Description of the strategy: Mnemonics, or mnemonic devices, are encoding strategies used to organize and/or chunk to-be-learned material, in order to make it more meaningful and easier to remember (e.g., Bellezza, 1996; Higbee, 1988). Examples include first-letter mnemonics (e.g., acronyms, acrostics), keyword mnemonics, pegword, method of loci, and songs, rhymes, and stories.

Mnemonics Demonstration #1

Pusateri (2003) created a demonstration of the *pegword* mnemonic technique, which relies on memorization of a simple rhyme involving the numbers 1 through 10 with concrete nouns. Teach students this rhyme ("One is a bun, Two is a shoe," etc.) on Slide 1 (reproduced below). Test students' memory for the rhyme using Slide 2. Once students are comfortable with the rhyme, display the instructions on Slide 3; when students are ready, click the mouse to display the first word to recall. Each word will appear for 7 seconds, followed by the next word. You may want to provide some suggestions for forming a vivid image of the first pegword (*bun*) interacting with the first recall word (*gorilla*). For example a student could imagine a gorilla eating a bun, or could even form the more bizarre image of a person ordering and eating a gorilla sandwich. Encourage students to be as creative as possible with their associations. After the last word is displayed, test students' recall using Slide 4.

<u>Slide 1</u>

To use the pegword technique, learn the following rhyme (each word is a "pegword"):

One is a BUN	Six is STICKS
Two is a SHOE	Seven is HEAVEN
Three is a TREE	Eight is a GATE
Four is a DOOR	Nine is a VINE
Five is a HIVE	Ten is a HEN

<u>Slide 2</u>

Test your memory for pegwords:

What is 3? What is 6? What is 2? What is 8?
What is 1? What is 7? What is 9? What is 4?
What is 5? What is 10? What is 5? What is 3?
What is 10? What is 6? What is 9? What is 1?
What is 7? What is 2? What is 4? What is 8?
What is 9? What is 2? What is 4? What is 8?
What is 3? What is 10? What is 7? What is 6?
What is 1? What is 5?

Slide 3

Now, learn the following list of items by associating the pegword with each item (e.g., use the pegword for 1 with the first item). You'll have 7 seconds per item:

1. gorilla
2. bookend
3. teacher
4. pear
5. tooth
6. rock
7. eraser
8. radio
9. computer
10. rose

Slide 4

Test for the pegword system:

- Tell me the items from 1 through 10.
- Tell me the items in reverse order (10 to 1).
- Tell me the even-numbered items only.
- What are the items for 5? 2? 7? 3? 9?
- What number is associated with: PEAR? RADIO? GORILLA? ROSE? ROCK?

This is a compelling demonstration of the power of mnemonics. With very little exposure to the recall list, students who thought of associations are able to remember all 10 words in the recall list, and they can also recall the position of each of those words in the list.

PowerPoint-based materials for this demonstration are available from Tom Pusateri at https://files.kennesaw.edu/xythoswfs/webui/_xy-1257263_1-t_IdbunvA5

(Chapter 9 folder, "Pegword" demo)

This demonstration takes approximately 15 minutes.

Mnemonics Demonstration #2

The method of loci technique is especially useful for remembering ordered lists of items. The learner starts by creating a *memory palace*, a mental structure that consists of various ordered locations that each have specific sensory experiences (sights, smells, etc.). Then, when learning a list, the learner mentally deposits one item at a time at each location in the memory palace, using mental imagery to imagine each item as integrated with the location. Then at retrieval, the learner revisits the "mental walk" through the palace, "picking up" the items from each location.

McCabe (in press b) created and assessed an in-class demonstration of the *method of loci*. Prior to learning about the mnemonic technique, students take a pretest recall measure of a list of 12 grocery list items. Although grocery lists do not typically have to be recalled in the correct order, this everyday category of recall suits the purposes of this demonstration. Students are clearly told that they must recall the items in order. Later class discussion can focus on other examples of lists that require memory for exact serial order. The instructor reads the list aloud at a slow pace:

1) Eggs
2) Milk
3) Bread
4) Sugar
5) Apples
6) Jelly
7) Bacon
8) Vinegar
9) Hot dogs
10) Crackers
11) Cinnamon
12) Grapes

After hearing the list, students try to recall the items in the correct serial order. Students self-score their recall sheets, write a code name of their choice on the sheets, and submit them to the instructor.

Next, students learn about the method of loci and then, out of class, create and sketch their own memory palaces based on 12 ordered locations on their college campus. They bring their sketches to the next class, practice visualizing the "mental walk," and then approximately 2 weeks after the pretest, they again try to remember a list of 12 ordered grocery items, but this time using their memory palace and the method of loci as a mnemonic strategy. The instructor reads the new list aloud at a slow pace:

1) Tacos
2) Carrots
3) Soda
4) Pretzels
5) Juice
6) Ice cream
7) Chips

8) Popsicles
9) Bagels
10) Pizza
11) Broccoli
12) Cheese

Students again self-score their recall sheets, write their code names, and submit them to the instructor.

An analysis of recall scores from pretest to posttest showed a significant improvement in number of items recalled in the correct serial order (McCabe, in press b). Indeed, the percentage of students who recalled the list perfectly, or nearly so (11 out of 12), doubled from pretest to posttest. Students also rated their everyday use of the method of loci significantly higher from pretest to posttest. Students are generally impressed by this relatively easy (and fun) method of improving their memory.

This demonstration takes approximately 10 minutes on each of two class days.

Mnemonics Demonstration #3

The keyword mnemonic method has been successfully demonstrated to aid memory in the short- and long-term, and on a variety of basic and higher-order thinking assessments (e.g., Carney & Levin, 2008). The keyword mnemonic applies to learning new terms and definitions. Researchers and educators have developed keyword mnemonics for a variety of psychology terms (see references below for extensive examples). The learner starts by creating a keyword for the term, something that sounds similar to the term but is more easily visualized using mental imagery. Then the learner connects the keyword to the definition of the term by way of an interactive mental image. For example, to learn the function of the *sympathetic nervous system*, one could use the keyword *symphony*, then imagine *a symphony (sympathetic) playing in the room next door; the music excites you and you can't sit still* (Carney & Levin, 1998).

Instructors can use a table such as the one below (examples from Richmond, Carney, & Levin, 2011) :

Term	***Keyword***	***Meaning***	***Your Mental Picture***
Broca's area	broken	Directs muscles involved in talking	Imagine *breaking* a talking doll. If it gets *broken* (Broca), it won't talk (speech) anymore.
Corpus callosum	Corpse	Connects the two cerebral hemispheres	Imagine a tiny *corpse* (corpus) *lying across* (connecting) the two cerebral hemispheres.
Hippocampus	Hippo, Campus	Memories	Imagine a *hippo* visiting its old college *campus* (hippocampus). Revisiting its campus brings back many wonderful memories.
Occipital lobes	Octopus	Vision	Imagine an *octopus* (occipital) staring at you with its big, round *eyes* (vision).

To demonstrate the benefit of using keyword mnemonics in a within-subjects fashion, instructors could have students learn the first half of a set of terms without mnemonics, followed by a quiz. Then have them learn the second set using keyword mnemonics, followed by a quiz. Scores on the terms learned by mnemonics should be higher.

Using a between-subjects design, instructors could have half the class learn the terms by studying the basic terms and definitions, while the other half learns the same terms using keyword mnemonics. Compare quiz scores between groups.

Instructors are directed to the following resources for additional keyword mnemonics relevant to psychology: Britt (2008); Carney & Levin (1998); Richmond et al. (2011); for a compilation of psychology-relevant mnemonics, see McCabe (2011a).

H. GENERATION EFFECT

Description of the strategy: The generation effect refers to the memory advantage for learner-created materials over materials created by someone else (e.g., instructor, researcher) (Slamecka & Graf, 1978).

Generation Effect Demonstration #1

Bloom and Lamkin (2006) reported a generation effect over two delayed time periods for an acrostic-based cranial nerves assignment. The *acrostic* is a first-letter mnemonic method, which most commonly involves using the first letters of a list of to-be-learned items to create a meaningful and/or odd sentence. Students either created their own acrostic mnemonic to remember the 12 cranial nerves (i.e., *olfactory, optic, oculomotor, trochlear, trigeminal, abducens, facial, vestibulocochlear, glossopharyngeal, vagus, spinal accessory, hypoglossal*) or used an instructor-provided acrostic. An example of the instructor-provided mnemonic is, *On Old Olympus' Towering Top A Famous Vocal German Viewed Some Hops*, and an example of a student-generated mnemonic is, *Old Otto Otavius Tried Trigonometry After Facing Very Grim Virgin's Sad Husbands* (p. 128). At both 2-week and 10-week-delay points, students who self-generated acrostics performed better on a recall test and did not show a decline in learning from 2 to 10 weeks (whereas the control condition did). These results suggest that active learner involvement in creating acrostics is beneficial for memory.

Instructors can demonstrate the memory advantage for self-generated mnemonics by comparing memory results following an activity during which half the class creates their own acrostics and half the class studies with an acrostic provided by the instructor.

Generation Effect Demonstration #2

A keyword mnemonic generation activity can help students learn neurophysiological terms in *Introductory Psychology*. In small groups or individually, students study some terms and definitions using an instructor-provided mnemonic (used with permission from Carney & Levin, 1998), and study other terms and definitions by creating their own keyword mnemonics (see above for a description of this mnemonic technique). Students get 1.5 minutes to study each term. An unannounced quiz can be administered immediately after and/or at a delayed time point such as at the start of the next class period. Contact Jennifer.McCabe@goucher.edu to request materials.

McCabe (in press a) described the implementation and assessment of a similar "Speed-Learning the Brain" activity that also included a real-life-example-generation condition. On definitional test items administered immediately and at a 3-day delay, recall in the keyword-generation condition was significantly higher than in the example-generation or the control (instructor-provided materials) condition.

The demonstration described in McCabe takes approximately 40 minutes.

Generation Effect Demonstration #3

A within-subjects demonstration based on the original Slamecka and Graf (1978) research can be adapted from methods and materials in Hirshman and Bjork (1988). Stimuli are 14 word pairs (*stimulus-response*) consisting of a primary word and a semantic associate. One pair is presented per slide. For the *read* group, both words are presented. For the *generate* group, the stimulus word is presented along with a fragment of the response word created by removing the vowels.

Phase 1: *Study each word pair for 5 seconds each. When there are letters missing from the second word in a pair, mentally fill in the missing vowels to create a word. When no letters are missing, simply read the words.*

1. sickness – illness
2. rough – h_rd
3. eating – hungry
4. always – s_m_t_m_s
5. hammer – tool
6. high – l_dd_r
7. house – roof
8. king – r_l_r
9. speak – loudly
10. scissors – p_p_r
11. bed – pillow
12. dark – r_ _ m
13. quickly – run
14. chair – l_u_ly

[5-minute filled delay: The instructor can present course material in the filled delay, or give students an individual or small-group activity.]

After the delay, the cued recall test consists of the presentation of stimulus words (in a random order) with the requirement to write the response word.

Phase 2: *Number your paper 1 through 14. For each word presented, fill in the second word based on the word pairs you learned in Phase 1. You have 7 seconds for each item to write down the correct response.*

1. speak – __________ (*loudly*)
2. rough – __________ (*hard*)
3. quickly – __________ (*run*)
4. house – __________ (*roof*)
5. chair – __________ (*soft*)
6. hammer – __________ (*tool*)
7. sickness – __________ (*illness*)
8. dark – __________ (*room*)
9. king – __________ (*ruler*)
10. eating – __________ (*hungry*)
11. bed – __________ (*pillow*)

12. always – __________ (*sometimes*)
13. high – __________ (*ladder*)
14. scissors – __________ (*paper*)

Show students the correct answers (in parentheses above) and ask them to self-score their sheets, giving one point per correct answer. Now ask them to compute their score out of 7 for the odd-numbered items (*read* condition) and their score out of 7 for the even-numbered items (*generate* condition). Results should show a memory advantage for generated items.

This demonstration takes approximately 15 minutes.

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