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DATA PAPER

Psychology Data on the Effects of Study Schedules on Category-Member Classification

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Subjects (*N* = 100) studied a series of 6 natural exemplars (birds) from each of 12 different categories (families). Birds were presented in one of 4 ways: (1) blocked by category; (2) intermixed; (3) first blocked, then intermixed; or (4) first intermixed, then blocked. Following study, subjects judged the likelihood that they would be able to classify new birds belonging to families that had been studied earlier. Finally, subjects were asked to classify 6 new birds from each of 12 studied families. The data were collected in the laboratory and are stored using ***figshare*** in an Excel file alongside an annotation file. The data can inform future investigations of the way that individuals learn natural concepts and categories.

Keywords: category learning; classification; induction; natural concepts; blocking; intermixing; hybrid study schedules

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(1) Overview

Context

Collection Date(s)

The data were collected in 2012.

Background

The ability to classify previously unseen category items into learned categories, sometimes referred to as *inductive reasoning* or inductive learning, is a fundamental ability with important implications for learning and education. What is the best way to study material in preparation for a classification test? In other words, what is the best study schedule?

Historically, researchers have compared the effects of *blocked study* – studying members of the same category at once – with effects of *intermixed study* – interleaving to-be-studied items from different categories. Research has shown that intermixed study is often better than blocked study when it comes to learning new concepts (e.g., [1, 2]; for a recent look, see [3]). The concept of intermixed study also relates to the well-known phenomenon of the *spacing effect*, the finding that spacing out study opportunities often leads to greater learning than not spacing them does (see [4], but also see [5]). Often, when study trials are intermixed, more time passes between exposures to similar concepts than when trials are blocked (i.e., trials are also spaced).

The data presented here were collected to explore effects of blocked and intermixed study on subsequent classification performance of natural categories – here, different bird species belonging to different bird families. The study was a conceptual successor of another study, which investigated effects of test trials on classification performance [6]. In addition to investigating blocked and intermixed study, we also tested two *hybrid study schedules*, which combine both blocked and intermixed study elements.

In this study, we also asked subjects to predict their future classification performance using a recent measure of metacognition called the *category-learning judgment* [7]. This judgment asks subjects to predict future classification performance for new or old items belonging to studied categories. Some researchers believe that these judgments have an important relation to how students choose to schedule their own learning ([8]; for a review of self-regulated learning, see [9]).

(2) Methods

Sample

One hundred college students participated at Washington University in St. Louis, MO, a research institution in the Midwestern United States (mean age = 19.2, min age = 18 years, max = 27, *SD* = 1.6; 34 men, 66 women). Subjects were recruited through an online subject-participation system (Experimetrix) and were awarded cash or course credit for their participation. Subjects were assigned randomly to one of four conditions: blocked, intermixed, blocked-intermixed, and intermixed-blocked. Twenty-five subjects participated in each condition. One subject in the blocked condition did not complete the experiment and was replaced with another.

Materials

We used bird illustrations taken from [7], which originated from the website www.whatbird.com. Each bird (e.g., Baltimore oriole) belonged to a specific family (e.g., oriole). In this study, we used 12 birds, each taken from 12 different families. See [7, 10] for an illustration of the materials. Due to copyright restrictions, these materials cannot be deposited into an online repository; please e-mail the corresponding author to inquire about access to the materials. The experiment was conducted on a computer and programmed with Adobe Flash [11].

Procedures

The experiment comprised three phases: (1) study phase, (2) category-learning judgment phase, and (3) classification phase. There were no delays between any phase; the entire experiment was completed in one session. The text of the experiment instructions can be found in the Appendix.

In the study phase, each bird was presented for 8 s, and the name of the family to which the bird belonged appeared underneath. In the blocked condition, subjects studied six birds from each family; each group of six was studied separately for each of the 12 families. The six birds of a family were selected randomly from the 12 birds of that family from the stimulus set; families were presented in a random sequence. In the intermixed condition, subjects were presented with six birds from each of the 12 families in random sequence. In the blocked-intermixed condition, subjects studied three birds from each family, blocked by category, and then the remaining three birds from each family were presented in a random sequence. Last, in the intermixed-blocked condition, subjects studied three birds from each of the 12 families in a random sequence, then saw the remaining three birds from each family presented in a blocked sequence. Each subject saw 72 birds total. In all cases, the order of species was random, and the assignment of birds to study (and subsequent test) was also random.

During the study phase, after a bird appeared on the screen, subjects were instructed to press the space bar on the computer keyboard when they felt that the bird had been learned fully. The bird remained on the screen for the remainder of the 8 s after the space bar was pressed. If the subject did not press the space bar within 8 s, the bird disappeared from the screen, and subjects were asked to click a button indicating why they did not press the space bar. The options were (1) *learned*, meaning the bird was learned, but the space bar was not pressed; (2) *not learned*, meaning that the bird was not learned; and (3) *not paying attention*, meaning that the subject "zoned out" and forgot to press the space bar. After the space bar was pressed or a button was clicked, a 500-ms blank screen followed before the next bird was presented. There were no additional pauses or stops during the study phase.

In the category-learning judgment phase, subjects were asked to judge how well they believed they would be able to classify new birds belonging to studied families on an upcoming classification test. All family names appeared on the screen beside sliding scales that ranged from 8% (indicating chance, i.e., ≈ 1 ÷ 12) to 100%. Subjects predicted their future classification performance by using these sliding scales. Judgments were self-paced.

In the classification phase, subjects were presented with the remaining six birds from each of the 12 categories in random order. Beside each bird was a list of all the studied bird families. Subjects attempted to classify the bird appearing on the screen by selecting the correct family name. Classification attempts were self-paced and no feedback was provided. After the subject attempted to classify all 72 birds, the experiment was completed and the subject was debriefed.

Quality Control

The experiment was conducted in a quiet research lab. Subjects participated individually. Five experimenters (including Cecilia Votta) collected the data. Subjects were told that they could ask the experimenter if they had any questions.

Ethical issues

The research was conducted under the oversight of the Washington University in St. Louis Institutional Review Board. The data are anonymous and contain no demographic or other identifying information.

(3) Dataset description

Object name

The data file is named "Data.xlsx."

Data type

The data are processed. They have been formatted from what was captured by the experiment initially.

Format names and versions

The data are saved as an open XML spreadsheet file (Excel file; .xlsx).

Data Collectors

K. Andrew DeSoto (graduate student at the time of data collection) and Christopher Wahlheim (postdoctoral fellow) supervised data collection. Cecilia Votta (undergraduate student) and four research assistants in the Aging, Memory, & Cognitive Control Laboratory at Washington University in St. Louis, MO, collected the data.

Language

The data file is annotated in English.

License

Repository location

http://doi.org/10.6084/m9.figshare.1570940

Publication date

The data were published on *figshare* on December 12, 2015.

(4) Reuse potential

These data are of potential interest to cognitive psychologists, educational psychologists, computer scientists, or other researchers interested in modeling human learning. They describe the order in which subjects learned specific stimuli belonging to different categories and provide information on both common ways of scheduling learning (i.e., blocked and intermixed schedules) as well as on an underexplored type of study schedule (hybrid schedules). The data also reflect performance on a classification test of natural categories, a topic of both theoretical and applied interest.

In addition to having reuse potential for learning researchers, the data may also be useful for metacognition researchers. Subjects' category-learning judgments and subsequent classification performance allow the assessment of measures of metacognitive monitoring such as calibration and resolution [12].

Last, the data presented here are suitable for inclusion in meta-analyses investigating any of the topics described above. We encourage researchers to use this dataset for teaching or collaboration purposes, too.

Competing Interests

The authors declare that they have no competing interests.

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Appendix

Experiment instructions

Study phase

In this part of the experiment, pictures of birds will appear individually with the name of the family to which they belong. Each bird will appear for 8 s, and your primary task will be to study them for an upcoming test. During this time, your secondary task will be to indicate when you think you have completely learned each bird and the family to which it belongs. You can consider learning complete at the point when you think that additional time studying would no longer improve your ability to later remember the bird and the family to which it belongs.

For each bird, you can indicate complete learning by pressing the SPACE BAR. Once you have done so, an asterisk (*) will appear above the family name to indicate that the response has been recorded. The bird will then remain on the screen for the remainder of the 8 s. Although you will have judged learning as completed at this time, you should still use the remaining time to study the bird. After 8 s, you will move on to the next bird unless you did not indicate complete learning.

If you do not respond before 8 s has elapsed, another screen will appear asking if: you learned the bird completely (learned), did not have enough time to learn completely (not learned), or if you were just not paying attention in general (not paying attention). The buttons labeled "Learned," "Not Learned," and "Not Paying Attention" will appear. Make your response by clicking on one of the buttons, and you will then move on to the next bird.

Do you have any questions?

Category learning judgments phase

Later in this experiment, you will be asked to classify new species of birds belonging to the families that you just studied. These birds will have not been presented earlier in the experiment. In this next part, your task will be to predict the likelihood that you will later be able to correctly classify these new birds into the appropriate families. Twelve family names will appear on the screen vertically, and your task will be to make a prediction of future classification of new birds for each family.

A sliding scale will be presented to the right of each family name. Your task will be to make your prediction on a scale ranging from 8% (guessing) – 100% (certain correct). Because you will have 12 families from which to choose on the later classification task, the chance that you will correctly classify birds by guessing is 8%. Consequently, you should give a rating of 8% if you predict that you will only correctly classify new birds from a family by guessing, whereas you should give a rating of 100% if you predict that you will be able to correctly classify all the new birds from a family. Please use the whole range of the scale, including intermediate values, when making your ratings.

Before you can move on to the next part of the experiment, you must move the slider for each family. Once you have made a rating for each family, click on the "Submit" button to move on.

Do you have any questions?

Category learning judgments prompt

Please indicate the likelihood of correctly classifying new birds from a family.

Classification test phase

In this next part, new species of birds from studied families will appear. Each bird will be presented individually along with a list of family names to the right. Your task will be to classify each bird into the family that you think it belongs by clicking on the family name. Clicking a family will make the background of the name turn blue. You can change your initial response by clicking another name. Once you have made your final decision, click on the "Submit" button to move on.

Do you have any questions?

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