B.S. Research Paper Example (Empirical Research Paper)

This is an example of a research paper that was written in fulfillment of the B.S. research paper requirement. **It uses APA style for all aspects except the cover sheet (this page; the cover sheet is required by the department).** It describes research that the author was involved in while taking the PSYC 199 course.

The Effects of Interleaving Versus Blocking for

Learning to Conjugate Verbs in the Spanish Language

Article title

Jon Student, Psychology 199, Spring and Fall 2016

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College, faculty advisor

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Faculty advisor signature Date

Your faculty advisor will have to read the completed paper prior to submission. Their signature and date, indicating approval of the paper, is required.

This example was written by a student who had the opportunity to assist with multiple aspects of experimental research in a laboratory at UCSD (including completion of data collection and subsequent data analysis).

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UC San Diego PSYCHOLOGY

This is the title page in traditional APA style.

The Effects of Interleaving Versus Blocking for Learning to Conjugate Verbs in the Spanish Language

Article title

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This article was completed in fulfillment of the requirements for the author's Bachelor of Science (B.S.) degree in Psychology at the University of California, San Diego. The author was advised by Steven C. Pan and Professor Timothy C. Rickard.

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Author Notes have up to four paragraphs. These often discuss author affiliation, any change affiliation, acknowledgments, and addresses for correspondence.

Abstract

Interleaving, a learning technique which involves practicing on multiple skills in parallel, goes against the standard method of blocking (or blocked training) that is common in schools and in many types of implicit skill training (for example, practicing a sport). While blocked training is convenient for many learners, several previous studies have shown that interleaving can yield statistically significant advantages in learning and in improving memory over blocking. The present study explored the effects of interleaving versus blocked training for learning Spanish verb conjugation skills. Participants with many different language backgrounds (excepting Spanish) learned to conjugate verbs in the Spanish imperfect and preterite tenses in either a blocked format or interleaved format (in a between-subjects design). After a one-week delay, a verb conjugation test was administered. On average, participants learned Spanish verb conjugation skills better if they had been trained using interleaving. This result suggests that interleaving can be beneficial for foreign language learning.

The Abstract is typically no more than 250 words in length. It is prefaced with the centered word “Abstract”, and is a one-paragraph summary. It is not indented.

The Effects of Interleaving Versus Blocking for Learning to Conjugate Verbs in the Spanish Language

Article title

For over a decade, learning scientists have compared the effects of learning one skill or topic at a time (blocking or blocked training) against a technique in which two or more skills are learned simultaneously by switching back and forth between them (interleaving or interleaved training). Some studies have found benefits of interleaving and others have found benefits to blocking. For instance, interleaving benefits have been observed for learning algebraic rules (e.g., Mayfield & Chase, 2002) and geometric concepts (e.g., Taylor & Rohrer, 2010), whereas blocking benefits have been observed for learning to identify degrees of varying line segments (e.g., Goldstone, 1996) and French pronunciation rules (e.g., Carpenter & Mueller, 2013).

Most schools implement blocking for a variety of topics because classes typically do not have enough time during the day to get through entire lesson plans. The use of blocked scheduling, wherein only one skill or concept is covered at one time, alleviates these types of problems. Other reasons include the fact that it is easier for both teachers and students to use blocking because it involves simpler schedules. But is this type of training method optimal for learning, and more importantly, does it yield better retention of learned information and skills over time than interleaving?

To date, there has been little evidence of benefits of interleaving for language learning, relative to blocking. Specifically, in an experiment where English-speaking participants learned French pronunciation rules (e.g., Carpenter and Mueller, 2013), practice occurred in blocked or interleaved format and was immediately followed by a final test. Performance was better after blocked training. However, that study measured the direct and immediate retention of learned information and not necessarily the information that would still be remembered after participants

The Introduction section is the first major section of text. It introduces the topic under investigation, reviews prior research on it, and discusses the research that is to follow.

were able to spend time doing other everyday tasks. By contrast, in the present study, which examined the use of blocked or interleaved training for learning Spanish verb conjugation skills (i.e., a type of grammar), such time was given by forcing participants to wait a week before another practice session and another week before testing measures were conducted. This was implemented to ensure that participants were retaining learned information in long-term memory over an extended period and not just immediately after exposure. The differences between blocked learning and interleaving were then measured and compared between subjects after the testing session to see which yielded better learning and memory of that learning.

Method

Level 1 and 2 headings are used for these two section titles

Participants

Ninety-six participants with no prior Spanish experience whatsoever participated in order to earn experimental credit for psychology classes taken at the University of California, San Diego. Forty-one participants were randomly assigned into the blocked learning group and 47 participants were randomly assigned into the interleaved learning group. About half were native English speakers and the remainder spoke a variety of different languages.

Design

The experiment was split into three sessions that consisted of two learning sessions followed by a testing session. Each session was separated by exactly one week (7 days) of time. Across both sessions, participants in the blocked and interleaved learning groups learned to conjugate verbs in the Spanish preterite and imperfect tenses. Across both groups, assignment of tense (preterite or imperfect) to the first or second sessions was counterbalanced, some participants had learned the imperfect rules first and preterite rules second, while others had learned the reverse order.

The Method section details how the study was performed. It typically details Participants, Design, Materials, and Procedure.

Materials

The materials included four rules each for the preterite and imperfect tenses, written as single sentences in English; three rules for each tense which describe conjugating verbs paired with the 'I', 'you', and 'we' forms of Spanish pronouns; three example sentences in English and Spanish for each of those rules; 32 short answer fill-in-the-blank practice questions in English and Spanish; and 30 multiple-choice final test questions in English and Spanish, with six answer choices each. All materials were shown in English and accompanied by their exact Spanish translations.

Procedure

During the first session, participants began by reading instructions on a computer screen informing them that they would be learning to conjugate verbs in the Spanish language. For participants assigned to the blocked learning group, the first session was spent learning to conjugate verbs in one tense only. For example, in the first session, the rules for conjugating verbs in the preterite tense were shown. Participants then learned to conjugate verbs paired with the 'I', 'you', and 'we' forms of Spanish pronouns in the preterite tense and with respect to three different verbs each. They then practiced conjugating verbs in the preterite tense by completing 16 short answer fill-in-the-blank practice trials. On each trial, after an answer was typed, the correct answer was shown. After the practice trials were finished, the first session concluded. A week later during the second session, the process was repeated for the imperfect tense.

At the end of each learning session, participants were asked two questions in a survey. The first question asked them to rate how difficult it was for them to learn Spanish conjugation that day. The possible ratings were available on a 5-point scale ranging from 'Very Easy' to 'Very Difficult'. The second question asked them to judge how well they thought they had

The Method section should include a level of detail that would be necessary for another researcher to replicate the study.

learned Spanish verb conjugation skills during that session. The possible ratings were also available on a 5-point scale, this time ranging from 'Excellent' to 'Poor'.

For participants assigned to the interleaved learning group, the preterite and imperfect rules were both presented as the first session began. After the rules were shown, participants learned to conjugate verbs paired with the 'I', 'you', and 'we' pronouns for both the preterite and imperfect tenses. They then practice conjugating verbs in both tenses by completing 16 short answer fill-in-the-blank practice trials. After the practice trials were finished, the first session concluded. Critically, participants were exposed to both the preterite and imperfect tenses, unlike the participants in the blocked learning group. During the second session, the participants again practiced conjugating verbs in preterite and imperfect tenses. Thus, during this session, participants were re-exposed to both tenses. After each learning session was concluded, participants were asked the same two questions as the participants in the blocked learning group. Both questions also had the same available responses as the ones mentioned before.

In the final session, all participants were tested on how well they learned and remembered to conjugate verbs in both tenses. This test consisted of 30 multiple-choice questions wherein they had to choose one of six verbs with the correct pronoun as well as form of the pronoun. After this testing block, the experiment ended and results were measured.

Results

Test results were analyzed for both the blocked and interleaved learning groups after both groups had concluded the same test. Figure 1 shows the proportion of correct responses on the multiple-choice test in both groups. As shown, the interleaved learning group answered correctly 64% of the time whereas participants in the blocked learning group answered correctly at rate of 52%. This shows that participants in the interleaved learning group answered verb

The Results section details how data were analyzed and what the results were. Statistical tests are recommended but optional for B.S. degree research papers.

conjugation questions more accurately than participants in the blocked learning group.

At the end of each learning session, participants in both groups were asked the question, "How difficult was it to learn Spanish conjugation today?". Figure 2 shows that the answers 'Very Easy' and 'Easy' were chosen more often in both learning sessions in the blocked learning group compared to the interleaved learning group in response to how difficult it was for them to learn verb conjugation skills. In contrast, the answers 'Very Difficult' and 'Somewhat Difficult' were chosen more often in both learning sessions in the interleaved learning group compared to the blocked learning group.

Again at the end of each session, a second survey question was asked. This question was, "How well do you believe you learned Spanish conjugation today?". Figure 3 shows participants' responses to this question. The results show that the answers 'Excellent' and 'Good' were chosen more often in both learning sessions in the blocked learning group compared to the interleaved learning group. In contrast, the answers 'Poor' and 'Fair' were chosen more often in both learning sessions in the interleaved learning group compared to the blocked learning group.

Discussion

Previous studies have shown that blocked learning can yield better results compared to interleaving, including for language learning. However, such experiments (e.g., Carpenter & Mueller, 2013) have not tested the long-term effect of interleaving. As such, the finding that blocked learning sometimes yields better results may reflect recent exposure to practice. Indeed, the present study demonstrated that interleaving has benefits for language learning when such learning is measured after a delay as compared to right away. When participants learned both tenses in session one and were then able to re-practice those tenses during a second session,

The Discussion section summarizes what was learned from the study and what the practical and theoretical implications were.

results were much better compared to learning one tense in the first session and then learning a new tense in the second session. This indicates that participants in the interleaved learning group were able to more fully learn the rules of when to use the imperfect and preterite tenses and what those tenses corresponded to in the Spanish language, vs. the blocked learning group. In both groups however, there was learning being accomplished. On the final test, since there were six possible multiple-choice responses per question, a chance rate would be 16.66% of responding correctly, and both groups scored on average substantially better than that.

Why Interleaving Improved Language Learning

It seems unintuitive that the participants who did better on the final test, namely those in the interleaved learning group, thought that the material was more difficult to learn as compared to the blocked learning group. It would seem logical to think that if participants thought material was easier to learn, then they would perform better on the final test than individuals who thought the material was hard to learn. However, a major theoretical explanation for the benefits of interleaving is that it strengthens memory associations by changing the solution to the practice problem with each attempt (Rohrer, 2012). That is, because of the switching between different skills or concepts that occurs during interleaving, the solution to any given practice problem is not the same as the previous problem. This makes with using interleaving seem difficult. By contrast, if the practice problems in a single session have the same pathway to get to a similar solution each and every time, as occurs during blocking, then answering such problems seems much easier. However, this method is less effective at strengthening memory associations. Thus, in this case, the easier method of training does not yield better learning.

How exactly might interleaving strengthen memory associations? One possibility is that the brain requires a higher level of functioning during interleaved learning as compared to

There should be evidence of critical thinking about the research. For example, here the author postulates theoretical explanations for the results that were observed.

blocked learning. By having to answer using different responses, the brain is engaged in the materials all the way through a learning session. In the current study, as the learning session continued, this process was likely repeated over and over again, and in doing so, it reinforced neuronal connections in the brain associated with responding in a correct manner to the proper Spanish verb conjugation rules. By contrast, under blocked training, participants are responding in the same way each and every time. Their short-term memory is sufficient to answer questions and it seems easier as compared to the interleaved learning group, but less long-term learning occurs as a result.

Another possibility is that participants in the blocked learning group were only learning to conjugate verbs for a particular tense instead of learning both tenses and the rules for when to use one tense over another in a proper sentence (as the interleaving participants learned to do). As such, in addition to not adequately learning how to use the two particular tenses by themselves, participants in the blocked learning group probably did not adequately learn how to discriminate between them.

The logic behind these explanations reappear when participants are asked how well they thought that they learned the material. After participants in the blocked learning group finished a training session, they usually had a higher tendency to think that they had learned the material well than participants in the interleaved learning group because the material was easier to learn. This is likely because of the fact that as they were moving through a learning session, they were providing the same types of responses over and over again repeatedly (and executing the same type of response yields a higher chance of being correct). But this type of responding is redundant. Overall, participants in the blocked learning group thought that they had learned the material better, but they actually did not.

Overall, the B.S. degree research paper should have at least 6 pages of text. This example has 8.5 counting the Abstract.

Study Implications

Overall, many learning techniques seem to be easier for people, but this does not always mean that they yield better results. When a learning process is more difficult, it can mean that there was an increase in effort during learning (as long as the participants actually tried learning to the best of their ability). This can indicate that the brain has higher levels of activation throughout the cortex and that neuronal connections associated with learning occur more often as compared to a learning process that seems easy.

Everyday, people try to better themselves by learning a particular skill, language, or subject of interest. The present study suggests that the time that is needed to learn and relearn materials can be drastically reduced, and the chance of long-lasting learning improved, if people learn the material through a process of interleaving instead of blocking. If these results are true, and hold true in other areas of learning, then academic success in schools could be heightened as with post-graduate research, skills such as learning a sport or a particular type of medical procedure could be learned quicker and with higher success, and learning different languages could be faster and with longer-lasting effects. The possibility for higher academic achievement as well as other successes has vast implications that this world has yet to even imagine. However, at present more studies need to be conducted and end with the same conclusion in order to generalize these results to the world population. Interleaving also needs to be investigated for different types of materials in order to determine whether it has similar dramatic effects on teaching and learning.

It is common for Discussion sections to mention any limitations of the study and/or directions for future research.

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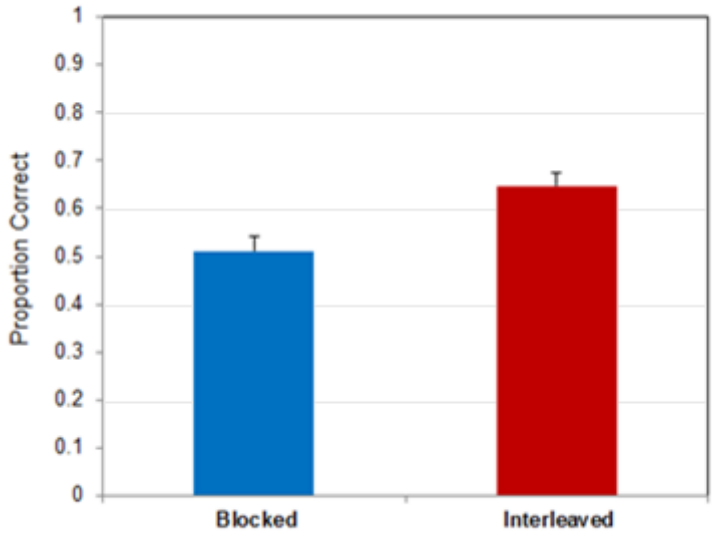

Figure 1. Percentage of correct responses during Spanish verb conjugation test after exposure during interleaving and blocked learning sessions. The participants in the interleaving group, on average, answered questions on this test more accurately compared to participants in the blocked learning group.

In this example, figures are placed at the end of the paper in accordance with APA style. However, in an exception from that style, figures, tables, and graphs can be embedded in the text (if the author and their advisor prefers to do so).

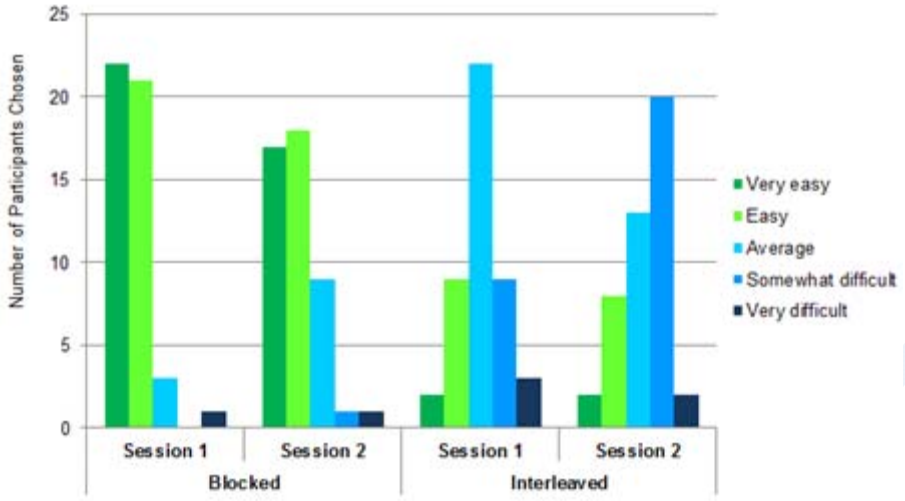

Figure 2. Participants' rankings of how difficult it was for them to learn Spanish verb conjugation skills during each session. Participants in the blocked learning group on average thought that it was easier to learn Spanish verb conjugation skills in both sessions compared to participants in the interleaved learning group.

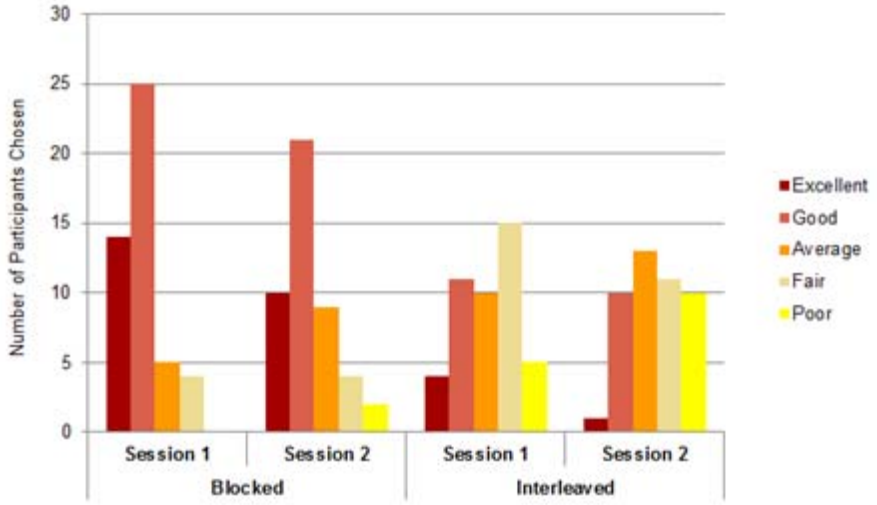

Figure 3. Participants' rankings of how well they thought they learned Spanish verb conjugation skills after each learning session. Participants in the blocked learning group on average thought that they learned Spanish verb conjugation skills better than participants in the interleaved learning group.