COMPARING THE EFFECTS OF BLOCKING AND INTERLEAVING SCHEDULES ON STUDENT LEARNING OF THE IMPERFECT AND PRETERITE SPANISH GRAMMAR TENSES

by

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ABSTRACT

The preterite and imperfect past tenses, which do not have exact English equivalents, exemplify grammatical nuance in the Spanish classroom. These nuances evoke questions regarding effective ways to present this material to students. Some evidence suggests that interleaved schedules of practice – in which material is presented in a mixed order during learning – benefit learning of grammar in a non-native language (Nakata & Suzuki, 2019; Pan et al., 2019); however, other evidence suggests that blocked schedules of practice benefit pronunciation learning (Carpenter & Mueller, 2013). Given these mixed outcomes, I compared blocked and interleaved schedules of practice on learning of the preterite and imperfect tenses in Spanish. Participants were randomly assigned to interleaved or blocked practice, in which they classified verb constructions as imperfect or preterite (when conjugated to Spanish) and were given feedback following each item. Participants then completed multiple tests assessing their grammar learning. The interleaved and blocked groups did not significantly differ in their test performance; however, both groups showed significantly improved performance compared to a pre-test, indicating that learning did occur. These outcomes can inform pedagogical practice. Future research should consider time processing feedback, and extend these outcomes to Spanish language learners, with materials translated into Spanish.

Introduction

The Spanish language classroom is one of great, and unfamiliar grammatical nuances – particularly to the non-native speaker. These grammatical nuances are especially applicable when considering the easily confusable preterite tense and imperfect tense, past tenses in the Spanish language, which do not have English equivalents. This prompts the question: how can instruction of these tenses, in an educational setting, be most beneficial to student learning? In the current study, I examine the impact of two established learning schedules on learning and distinguish the use of the imperfect and preterite tenses. The goal of this study is to expand upon prior understanding of the effects of learning schedules on foreign language grammar learning to potentially inform presentation of these materials in the classroom.

The order in which learning material is presented can impact learning outcomes. This idea is exemplified in explorations regarding two learning schedules: blocking and interleaving. In the blocked learning schedule, material is presented by category (i.e., presentation of all of category A, followed by presentation of all of category B). Interleaving, on the other hand, alternates the order of the items by category (i.e., presentation of item from category A, presentation of item from category B, presentation of item 2 from category A, presentation of item 2 from category B, etc.). When studying the impact of interleaving and blocking on the learning of two Spanish grammar tenses (preterite and imperfect), procedures mirror this methodology. In the blocking group, material is presented by verb tense (i.e., presentation of all sentences in which the verb is in the preterite tense, followed by presentation of all sentences in which the verb is in the imperfect tense, when translated). In the interleaving group, the tense of the verb in the sentences alternates (i.e., presentation of a sentence reflecting the preterite tense,

followed by presentation of a sentence reflecting the imperfect tense, then presentation of a sentence reflecting the preterite tense, etc.).

To appreciate the fundamentals of research on interleaving, it is important to understand the methodology and outcomes of a fundamental study exploring the concept. In their seminal study, Kornell and Bjork (2008) explored the effects of blocking and interleaving on category learning of 72 paintings, created by 12 artists (i.e., there were 6 paintings per artist). Artists were randomly assigned to either the blocked condition or the interleaved condition, as were the participants. In the blocked condition, all paintings of a given artist were presented in a sequence before the next artist's paintings, whereas in the interleaved condition, paintings by different artists were presented in a mixed fashion. In the test phase, a novel painting by one of the artists was portrayed, and participants selected the artist they believed to match the painting and received feedback. Results showed that performance on the tests was higher in the interleaved condition compared to the blocked condition, revealing that interleaving was more beneficial for learning.

Interleaving has been found to be effective in some areas of learning, and less effective in others. A meta-analysis of research conducted on the impact of interleaving on students' learning found that the technique is somewhat helpful for text material (Brunmair & Richter, 2019). However, Brunmair and Richter could not aggregate outcomes for the impact of interleaving on foreign language grammar learning, due to substantially less research in this area.

Few studies have evaluated the impact of interleaved study order on foreign language learning. Carpenter and Mueller (2013) had students study French pronunciations under either the blocked or interleaved conditions, in preparation for a multiple-choice test. Pronunciations were separated into 4 rules, and participants were randomly assigned to either the blocked

condition or interleaved condition, in which a participant would be presented with 4 words from a particular rule, followed by 4 words that each come from a different rule, and 4 more words that each demonstrate the same rules as the foregoing interleaved group of words (Carpenter & Mueller, 2013). Blocking proved to be helpful, especially for selecting the completely correct pronunciation of a word, rather than one that solely represented the rule under which the pronunciation falls.

By contrast, prior research has found a memory advantage for an interleaved schedule of practice compared to a blocked schedule of practice when participants are acquiring grammar for a non-native language (Nakata & Suzuki, 2019). Nakata and Suzuki (2019) evaluated the utility of interleaving for Japanese university students learning English grammar usage. In a practice phase, researchers presented 50 exemplar sentences representing 5 similar grammar concepts in the English language, with blanks where the verb belonged and a list of four verbs/verb phrases from which the participants could choose. Some participants experienced this training in a blocked condition, others in an interleaved condition, and some in an "increasing" condition (i.e., blocking of the first half of the questions, followed by interleaving of the second half). Researchers also provided the Japanese translation and an explanation of the correct answer for every practice item. Post-practice tests took place immediately and one week following practice. On the delayed posttest, interleaving produced better performance, compared to blocking; however, there was no significant interleaving or blocking benefit for performance on the immediate test.

Pan et al. (2019) is the only study (to my knowledge) that has investigated the effects of the interleaved and blocked schedules on Spanish verb conjugation and grammar learning, and they did so by examining learning of the preterite and imperfect tenses. Participants experienced

two learning sessions per week. Participants in the blocked condition studied one tense at every learning session, whereas those in the interleaved condition studied both tenses at each session. Results from two experiments found that those in the interleaved condition performed better than those in the blocked condition in a test that occurred one week after the study sessions. In two of their other experiments, however, blocking was either just as, or even more advantageous than interleaving. This study reveals some instances in which interleaving benefits learning of two past tenses in Spanish (alternating order during study and randomized practice trials). However, interleaving did not always benefit foreign language learning, and it remains an open question as to the impact of interleaving when learning the imperfect and preterite tenses.

Although Pan et al. (2019) arrived at valuable conclusions, several complexities may have contributed to mixed outcomes. For instance, more than one variable was measured, including tense rules, verb suffix learning, and conjugation practice. The current study approaches the research question differently than Pan et al. (2019), with a tight experimental control to isolate study order (interleaved vs. blocked) during learning. Under these conditions, I expect interleaving to be beneficial, which is consistent with outcomes from other studies using text-based materials (e.g., Pan et al., 2019).

Given the mixed outcomes of the impact of interleaved study order on foreign language learning, more research is warranted to explore the interleaved and blocked schedules as they relate to verb tense usage and grammar learning. The current study aims to explore and compare the effects of blocking and interleaving schedules on the learning of two past tenses in Spanish (i.e., the preterite tense and imperfect tense). These tenses are easily confusable for English speakers, as there is no exact analog in the English language. I hypothesized that an interleaved practice schedule, which typically helps learners distinguish between related categories, will lead

to greater learning benefits than a blocked practice schedule. The current study aims to dive into the research question in novel ways which have not yet been represented in prior literature, such as through the manipulation of the learning task, and the addition of near transfer and far transfer tests for foreign language to gain a comprehensive understanding of the impact of interleaving on foreign language grammar rule learning.

Method

Participants and Setting

Given that the research questions for the current experiment were applied, particularly in an educational context, I was only interested in effects that are at least moderate in size. Thus, I powered for a medium effect. An a priori power analysis was conducted using G*Power (Faul et al., 2007) to determine the necessary sample size to detect a medium effect (Cohen's $d = 0.5$) with 80% power and an alpha error probability of .05 for a one-tailed independent samples t-test. The analysis indicated that the current study's target sample size should be 102 participants, with 51 participants randomly assigned to each group. I planned to oversample (no more than 10%) in anticipation of dropping some participants from analyses due to pre-determined exclusion criteria. Participants whose first language was not English were excluded from the study, as the study's purpose was to gauge student learning of Spanish grammar tenses, which were translated into English.

Participants included 134 undergraduate students at Texas Christian University in Fort Worth, Texas, recruited via the Department of Psychology's Human Subject Pool. Fourteen participants reported that English was not their first language, and thus were excluded, leaving 118 participants for analyses. Within these 118 participants, 62 were randomly assigned to the blocked group, and 56 to the interleaved group.

Participants were primarily young adults (*M* age: 19.79 years; *SE* = 0.24) in their second year of college (*M* = 2.27 years, *SE* = 0.10), with the following reported gender and ethnic/racial breakdowns: 83.9% women, 15.3% men, 0.8% non-binary; 67.8% White, 10.2% Asian, 5.9% Hispanic/Latino, 5/9% Black/African American, and 9.3% mixed race/ethnicity. Participants rated their familiarity with the Spanish language on a 4-point scale ranging from "not at all familiar" to "very familiar," with an average response of 2.09 (*SD* = 0.84).

Participation in the research study took place in a controlled lab setting under the supervision of trained undergraduate research assistants in the TCU Metacognition, Memory, and Aging Lab. Research assistants posted participant sign-up timeslots by week, creating approximately 40 slots per week for participants to select. Eligible students who elected to participate in the study were granted partial course credit in their Psychology course as compensation for participation.

Study Design

The current study involved a between-participants design with one factor (practice schedule) and two levels (blocked and interleaved). Participants were randomly assigned to either the blocked or interleaved group.

Materials

Primary materials for this study included 128 English sentences, created by research personnel, with verb constructions representative of the preterite (64 sentences) and imperfect (64 sentences) tenses in Spanish. For example, in the sentence, "She **talked** with her mom yesterday," "talked" corresponds to the preterite tense. In the sentence, "Jacob **enjoyed** going out to dinner," "enjoyed" corresponds to the imperfect tense. After drafting these sentences initially, they underwent a thorough revision process by research team members to meet several goals of

the project, including consistency within tense rules (see Appendix A, Table A1), and modifying sentence length to ensure consistency across tenses. This also included consultation with an expert in Spanish and Linguistics (Dr. Stephen Parker of Dallas International University), to confirm that my English-translated materials were respectively representative of the preterite and imperfect tenses in Spanish. The full list of sentences used in the present study can be viewed in Appendix A (Table A2). Research personnel conducted statistical analyses through the English Lexicon Project (Balota et al., 2007) to ensure there were no significant differences between preterite and imperfect sentences concerning the number of letters of words in each sentence ($Min_{overall}$ = 3.27, $Max_{overall}$ = 6.40, $M_{preterite}$ = 4.53, $SD_{preterite}$ = 0.68, $M_{imperfect}$ = 4.62, $SD_{imperfect}$ = 0.57; $t(126) = 0.77$, $p = .44$), the number of words in each sentence ($Min_{overall}$ = 6.00, $Max_{overall}$ = 24.00, $M_{preterite}$ = 12.33, $SD_{preterite}$ = 3.72, $M_{imperfect}$ = 11.73, $SD_{imperfect}$ = 2.95; $t(126) = 1.00$, $p = .32$), and the frequency of words in each sentence[1] ($Min_{overall}$ = 10.35, $Max_{overall}$ = 13.66, $M_{preterite}$ = 12.02, $SD_{preterite}$ = 0.66, $M_{imperfect}$ = 12.19, $SD_{imperfect}$ = 0.61; $t(126) = 1.52$, $p = .13$). These sentences were divided into a prior knowledge test (8 sentences), which was the same for all participants, and a practice learning task, non-transfer test (80 sentences), and near-transfer test (40 sentences) which were randomized for each participant.

The total number of sentences created (128) were divided among eight different tense rules (4 for the preterite tense and 4 for the imperfect tense), with 16 sentences representing every rule. See Appendix A, Table A1 for the full list of tense rules and Table A2 for the 128 sentences matched with their corresponding rules.

[1] Frequency was quantified as Log_Freq_HAL from the English Lexicon Project. Freq_HAL refers to the Hyperspace Analogue to Language (HAL) frequency norms (Lund & Burgess, 1996), based on the HAL corpus, which consists of approximately 131 million words gathered across 3,000 Usenet newsgroups during February 1995. Log_Freq_HAL refers to log-transformed HAL frequency norms.

The current study also utilized a Cinderella story passage (modified from Course Hero, 2018) for a far transfer test to preterite and imperfect tenses in a text passage (see Appendix B). This passage was edited by study personnel to include 30 bolded verb constructions that align with the preterite and imperfect rules taught to participants during the learning phase of the experiment. This was done to ensure an equal number of sentences in each tense (i.e., 15 sentences in the preterite tense and 15 sentences in the imperfect tense). As well, any sentences in the original passage that did not align with the tense rules developed for this project were eliminated.

A printed Sudoku puzzle was also utilized and presented as a distractor material between the learning phase and testing phases.

Procedure

Upon arrival to the lab, students were asked to leave all belongings in the waiting area, and entered a room with a computer and a blank Sudoku puzzle. Participants were first presented with a digital consent form and were prompted to provide their signature and the date. After consenting to participation, participants took a prior knowledge pre-test to assess their understanding of the imperfect and preterite tenses. All test measures in this study were self-paced. In this initial pre-test, they were asked to classify the tense used in a bolded verb construction in eight sentences. Participants were prompted to respond to the question, "When conjugated to Spanish, which tense would best correspond to the **bolded** verb construction in this sentence? Preterite or Imperfect?" for each of the eight sentences. All participants saw the same eight sentences (e.g., "Jacob never **enjoyed** going out to dinner."), with each sentence corresponding to one of the eight tense rules. Participants responded by clicking on a button that said preterite or imperfect. The placement of these buttons was counterbalanced across

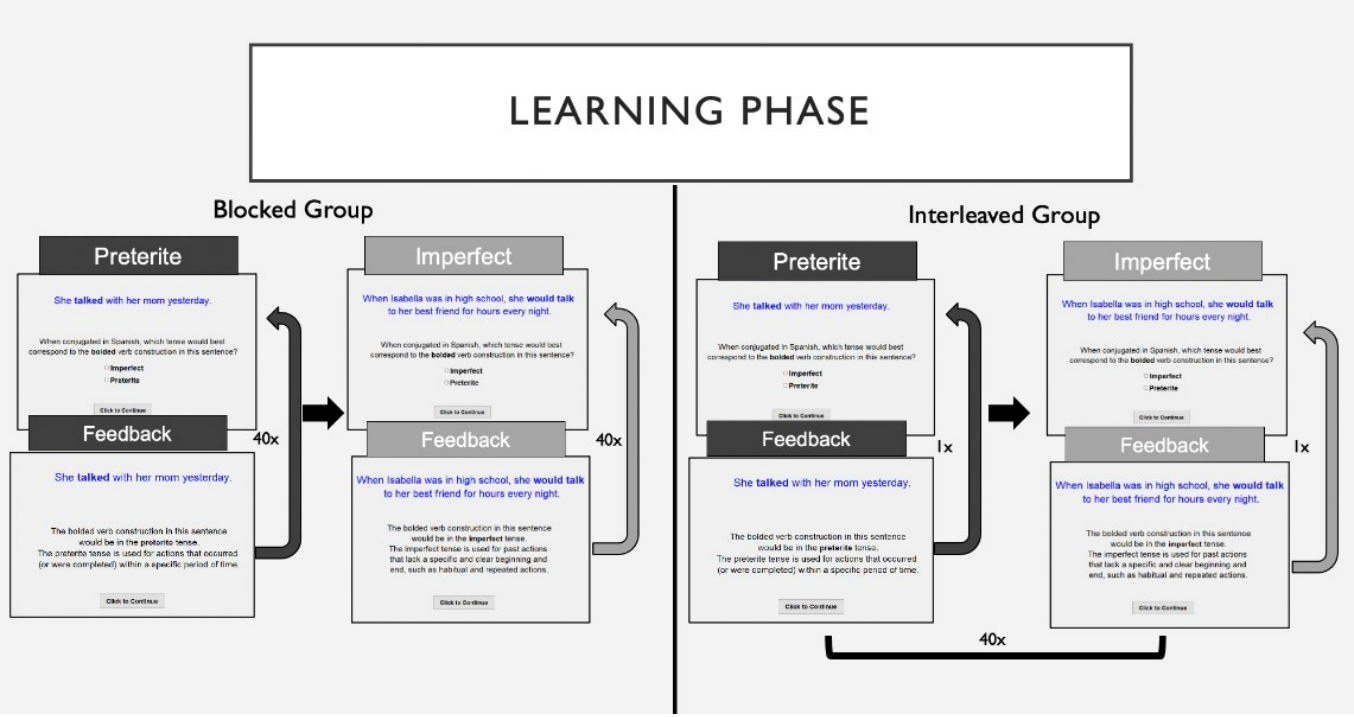
participants, such that sometimes the ‘preterite’ button was presented above the ‘imperfect’ button, and other times the ‘imperfect’ button was presented above the ‘preterite’ button. The placement of these buttons was the same for all tests throughout the experiment (i.e., if a participant saw the ‘preterite’ button above the ‘imperfect’ button for the prior knowledge test, they also saw the ‘preterite’ button above the ‘imperfect’ button for the learning phase, near transfer test, and far transfer test, described below.) The order of the sentences was randomized for each participant, and participants had unlimited time to complete the test. None of the items on the prior knowledge pre-test appeared on the main learning task.

Following the prior knowledge pre-test, the learning phase began, in which participants learned 80 sentences (40 with preterite verb construction and 40 with imperfect verb construction). These sentences were presented one at a time, and for each, participants were given the question, “When conjugated to Spanish, which tense would best correspond to the **bolded** verb construction in this sentence? Preterite or Imperfect?” The tense order during the learning stage was counterbalanced across participants. After selecting a response by clicking either “Preterite” or “Imperfect,” participants received feedback, consisting of the correct answer as well as a brief explanation corresponding to the conditions under which one should use that tense (e.g., “The bolded verb construction in this sentence would be in the **preterite** tense. The preterite tense is used for actions that occurred (or were completed) within a specific period of time.”) This feedback shifted with and was dependent on the tense rule associated with the sentence displayed. Eight rules were presented during feedback (i.e., 4 rules for each tense); practice and feedback-viewing time were self-paced. All participants encountered the same sentences with bolded verb constructions; however, the specific 80 sentences presented during practice (versus during the non-transfer and near-transfer tests described below) were randomly

assigned by the computer program, with the constraint that an equal number of preterite and imperfect sentences representing each of the 8 tense rules were presented during each phase. In addition, the order of presentation of specific sentences during practice was randomized by the computer program, with the constraint that the tenses presented were either blocked or interleaved.

Figure 1

Procedure for the Learning Phase in the Blocked and Interleaved Groups



See Figure 1 for an overview of the learning phase procedures for the blocked and interleaved groups. During the learning phase, participants assigned to a blocked schedule of learning saw all 40 sentences with verb constructions of one tense type first before moving on to the next 40 sentences of the other tense (e.g., all preterite sentences followed by all imperfect sentences). Participants assigned to an interleaved schedule of learning alternated between preterite and imperfect sentences.

Following completion of the learning phase, participants were instructed to engage in the 5-minute distractor task of solving a pen-and-paper Sudoku puzzle. After the distractor task, participants completed a non-transfer test for the previously practiced 80 verb constructions, in which participants were to identify the tense used in the bolded verb construction in the sentences they saw during the practice stage. The study presented these sentences (for both groups) in a random order and did not provide feedback to participants. Participants then completed a near transfer test, in which they identified the tense used in the bolded verb construction in 40 new sentences. The 40 sentences presented during the near-transfer test were randomized again for each participant. The order of presentation of specific sentences during the tests was randomized by the computer program, with no constraints.

Participants did not receive feedback on this test. Following the near transfer test, participants completed a far transfer test. A Cinderella story passage was used with 30 bolded verb constructions throughout the story. Participants identified the tense used in each bolded verb construction. This test provided students an opportunity to transfer their knowledge of the two tenses into an application-based task, one which is likely to appear in a Spanish classroom (when translated) and is intended to simulate the use of the two tenses in a fluid story. All items were embedded in the story and appeared on the screen at the same time. Participants had the option to

respond in any order desired. Finally, participants completed a tense rules test, in which they were prompted to answer two open-ended questions, "Under what conditions should one use the preterite tense?" and “Under what conditions should one use the imperfect tense?" Some participants were prompted to answer the question about the preterite tense first, whereas other participants answered the imperfect tense question first.

After completing the dependent measures, participants completed a survey regarding their demographic characteristics. Specifically, participants responded to: “Is English your first language?”. If the answer to this question was “no,” participant data were excluded from analyses. Questions regarding language experience were also explored, including: “How familiar are you with the Spanish language?”, which was measured on a scale including “Not at all familiar,” “Somewhat familiar,” “Moderately familiar,” and “Very familiar.” We predicted that these measures would provide helpful insight on result analysis and rationale. Participants were also asked to report other demographic measures (e.g., age in years, year in college, descriptions of gender and race/ethnicity, etc.).

Results

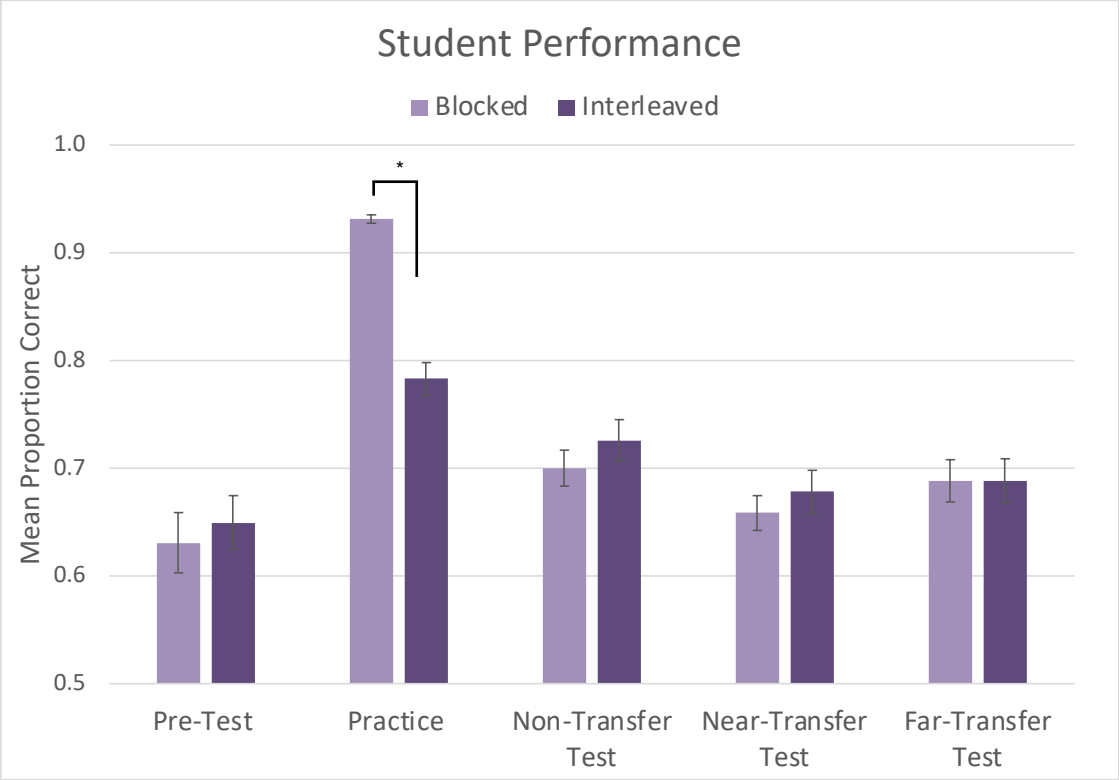
Figure 2 contains a depiction of the primary outcomes by group assignment.

Prior Knowledge Pre-Test of Spanish

As expected, there was not a significant difference between the blocked group (M = .63, SD = .22) and the interleaved group (M = .65, SD = .19) on pre-test performance, $t(116) = 0.49$, $p = .63$.

Figure 2

Mean Proportion Correct on the Primary Outcome Measures for the Blocked and Interleaved Groups



Performance on Final Tests

An independent samples *t*-test on the mean percent correct on the non-transfer test indicated that there was not a significant difference in performance between the blocked group ($M = .70$, $SD = .13$) and interleaved group ($M = .73$, $SD = .14$), $t(116) = 1.02$, $p = .31$. Similarly, there was no significant difference between the blocked group ($M = .66$, $SD = .13$) and interleaved group ($M = .68$, $SD = .15$) on the near-transfer test, $t(116) = 0.78$, $p = .44$. Likewise, on the far transfer test, in which participants were presented with the Cinderella passage (modified from Course Hero, 2018), the groups did not significantly differ (blocked group: $M = .69$, $SD = .15$, interleaved group: $M = .69$, $SD = .15$; $t(116) = 0.02$, $p = .99$).

Performance During Practice

On the practice task, the blocked group ($M = .93$, $SD = .03$) significantly outperformed the interleaved group ($M = .78$, $SD = .11$), $t(116) = 9.86$, $p < .001$, $d = 1.83$.

Performance Compared to Chance

A one-sample *t*-test demonstrated that all outcomes of performance in the blocked group were significantly higher than chance (pre-test performance: $t(61) = 4.64$, $p < .001$; practice performance: $t(61) = 101.60$, $p < .001$; non-transfer test performance: $t(61) = 12.25$, $p < .001$; near-transfer test performance: $t(61) = 9.97$, $p < .001$; far transfer test performance: $t(61) = 9.59$, $p < .001$). Similarly, for the interleaved group, a one-sample *t*-test of all outcomes indicated that performance on all measures was significantly higher than chance (pre-test performance: $t(55) = 6.04$, $p < .001$; practice performance: $t(55) = 18.74$, $p < .001$; non-transfer test performance: $t(55) = 11.72$, $p < .001$; near-transfer test performance: $t(55) = 8.90$, $p < .001$; far-transfer test performance: $t(55) = 9.18$, $p < .001$).

Pre-Test Performance Compared to All Other Measures

A paired samples *t*-test on the mean percent correct for both the blocked and interleaved group indicated that practice performance was significantly different from pre-test performance (pre-test performance: $M = .64$, $SD = .20$, practice performance: $M = .86$, $SD = .11$; $t(117) = 10.49$, $p < .001$, $d = 0.97$). Similarly, performance on the non-transfer test was significantly different than pre-test performance (pre-test performance: $M = .64$, $SD = .20$, non-transfer test performance: $M = .71$, $SD = 0.14$; $t(117) = 3.69$, $p < .001$, $d = 0.34$), as was performance on the far transfer test (pre-test performance: $M = .64$, $SD = .20$, far transfer test: $M = .69$, $SD = .15$; $t(117) = 2.53$, $p = .013$, $d = 0.14$). This demonstrates that learning did occur due to our experiment. There was not a significant difference, however, between the near-transfer test and pre-test performance (pre-test performance: $M = .64$, $SD = .20$, near-transfer test: $M = .67$, $SD = .14$; $t(117) = 1.56$, $p = .12$).

Performance on Tense Rules Test

To score participants' responses for the tense rules test, participants were awarded 0, 0.5, or 1 point per scoring rule. Two research personnel (E.S. and M.R.) scored each response independently. I examined Pearson's *r* correlation between scores, as to gauge inter-rater reliability. After discovering an initially weak reliability for scores of two of the tense rules (i.e., preterite rule 2 and imperfect rule 4), the raters modified the rubric and re-scored the responses independently for those two tense rules across multiple iterations until reliability scores were acceptable. Correlations ranged from 0.84 to 0.97 for each tense rule, with the following range of average reliability values: (overall preterite: $r = .95$; preterite rule 1: $r = .92$; preterite rule 2: $r = .84$; preterite rule 3: $r = .90$; preterite rule 4: $r = .92$; overall imperfect rule: $r = .95$; imperfect rule 1: $r = .93$; imperfect rule 2: $r = .87$; imperfect rule 3: $r = .91$; imperfect rule 4: $r = .97$). The

scores were averaged across the two raters and a proportion was calculated for each participant for the preterite rules and the imperfect rules.

For the preterite rules test, performance did not differ for the blocked group (M = .22, SD = .18) versus the interleaved group (M = .25, SD = .16); $t(116) = 0.86$, p = .39. For the imperfect rules test, performance did not differ for the blocked group (M = .23, SD = .19) versus the interleaved group (M = .25, SD = .16); $t(116) = 0.80$, p = .43.

Timing Spent Answering Questions and Processing Feedback

An independent samples t-test on the mean time spent (in seconds) indicated that the interleaved groups spent significantly longer (M = 4.08, SD = 1.38) answering practice questions relative to the blocked group (M = 2.91, SD = 1.03; $t(116) = 5.25$, $p < .001$, d = 0.96). There was not a significant difference between the groups in time spent processing feedback during practice (blocked group: M = 1.45, SD = 0.67, interleaved group: M = 1.60, SD = 0.93; $t(116) = 1.00$, p = .32). There was also no significant difference between the blocked and interleaved groups on time spent answering pretest questions (blocked group: M = 4.91, SD = 1.92, interleaved group: M = 4.65, SD = 1.66; $t(116) = 0.78$, p = .44), time spent answering non-transfer test questions (blocked group: M = 3.53, SD = 1.23, interleaved group: M = 3.41, SD = 1.18; $t(116) = 0.55$, p =0.58), time spent answering near-transfer test questions (blocked group: M = 3.39, SD = 1.07, interleaved group: M = 3.50, SD = 1.38; $t(116) = 0.50$, p = .62), and time spent completing the far-transfer test (blocked group: M = 133.15, SD = 42.03, interleaved group: M = 126.73, SD = 44.31; $t(116) = 0.81$, p = .42). Finally, there was no significant difference between groups on time spent completing the tense rules test, including describing the preterite tense rules (blocked group: M = 33.30, SD = 28.75, interleaved group: M = 30.32, SD = 18.32; $t(116) = 0.66$, p = .51),

and describing the imperfect tense rules (blocked group: $M = 32.86$, $SD = 32.09$, interleaved group: $M = 32.04$, $SD = 32.09$; $t(116) = 0.17$, $p = .86$).

Discussion

The aim of the current study was to evaluate and compare the effects of the interleaved and blocked schedules of learning on student learning of the imperfect and preterite Spanish grammar tenses. Contrary to my hypotheses, the results of this study revealed no significant difference on test performance between the interleaved and blocked groups, including outcomes on the non-transfer, near-transfer, and far-transfer tests. The outcomes of the current study do not replicate the outcomes of the literature utilized as the basis for my hypothesis. Prior research on English grammar learning and immediate testing of performance, however, also found no significant performance differences between learning schedule conditions (Nakata & Suzuki, 2019). This also aligns with prior research on the effects of learning schedules on Spanish grammar and verb conjugation learning, which found insignificant differences between conditions on some experiments (Pan et al., 2019).

Prior research has also produced outcomes that were not consistent with the results of the current study, including within the foregoing studies discussed. The results of the current study contradict the delayed test results presented in the research of Nakata & Suzuki (2019), which found an interleaving advantage when testing on English grammar learning one week following practice. Other experiments conducted within the research of Pan et al. (2019) also found an interleaving advantage, which is inconsistent with my results. Furthermore, the current study's results do not align with Carpenter and Mueller's (2013) finding of a blocking advantage in French pronunciation learning. Ultimately, the current study contributes to the mixed outcomes previously identified by the foregoing prior research.

In addition to student performance outcomes on the test measures, student performance on the practice phase of the experiment elicited interesting results. I found that students in the blocked group significantly outperformed those in the interleaved group on the 80-sentence practice task. This outcome is consistent with prior research which found that participants learning English grammar in a blocked learning fashion significantly outperformed those learning in an interleaved manner during a practice, or "treatment" phase (Nakata & Suzuki, 2019). Potential reasoning for this blocking advantage during practice could be the nature of the blocked learning schedule itself and its capacity to be perceived as the easier or more beneficial technique. This perspective is supported by metacognitive outcomes of prior research, revealing that participants perceived a blocked style of practice to be more effective than interleaving, even though it was not (Kornell & Bjork, 2008). Furthermore, it is possible that the students in the blocked phase were better able to identify a pattern during learning relative to the students in the interleaved phase, which might have contributed to their higher accuracy.

Limitations and Future Research

There are limitations to this study which could have contributed to its null and mixed outcomes. The present experiment was self-paced with an average time spent processing feedback of 1.45 seconds and 1.60 seconds in blocked and interleaved groups, respectively. With this limited time spent processing feedback, it can be hypothesized that student learning may have been hindered. Also, extending the outcomes of the current study to a longer delay – as in prior work which found different results (Nakata & Suzuki, 2019) – would be a useful direction for future research, as students are often tested after a longer delay. Furthermore, future research should explore the current research question with a participant group including students of a Spanish classroom. This may also extend to students with further motivation to learn the Spanish

language, such as those preparing for a study abroad experience in a Spanish-speaking country, or those with family and friends who speak Spanish. These differences may influence participant motivation to learn, and thus, performance. On that note, in order to truly evaluate learning of the usage of the imperfect and preterite Spanish grammar tenses, future research should translate all materials into Spanish.

Implications

The outcomes of the current study have potential to reveal pedagogical implications for second-language learners as well as instructors. The practice effect – a significant blocking advantage during the practice phase – particularly should be considered when determining the best ways to present the imperfect and preterite Spanish tenses to students. Participants in the blocking group significantly outperformed the interleaving group in practice, but did not perform significantly better in the testing phase. This juxtaposition in practice and test performance may be misleading for students who are being presented material and studying in a blocked fashion. Perhaps, while a student may feel confident when learning in the blocked schedule of practice, effective learning might not be taking place. Thus, I would caution against immediately utilizing a blocked schedule of learning in instruction of the preterite and imperfect tenses. Of course, I believe it is important to consider all mixed outcomes from prior literature in evaluating this; however, the results of the current study can provide insight that may be formative to second-language grammar learning and instruction.

Conclusions

The current study demonstrated that although there was no significant difference in test performance for groups practicing material in a blocked or interleaved manner, there are nuances that can be considered when evaluating the utility of the two schedules of learning in foreign

language grammar learning. The presence of a blocking advantage in practice, yet absence thereof in testing, should spark inquiry in instructors considering which schedule of learning would be most effective in a second-language learning classroom. It is also important to consider, in future research, the implications of a self-paced learning experiment, as well as the motivational factors that may have influenced the present study's results. Ultimately, while the current study indicates aspects to consider in determining the most effective strategies to promote student learning of the preterite and imperfect Spanish grammar tenses, it also reveals a need for further tightly controlled research on this topic.

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Appendix A

Tense Rules and Sentences Used in the Study

Table A1

Tense Rules for Preterite (P1-4) and Imperfect (I1-4) Sentences

Tense Rule	Tense Rule
P1	The preterite tense is used for actions in the past that occurred (or were completed) within a specific period of time.
P2	The preterite tense is used to describe a past event that happened more than once but had a definite and specific end point.
P3	The preterite tense is used for sequentially occurring or ordered actions in the past, such as a chain of events where one event happened and was completed before the next one began.
P4	The preterite tense is used when an ongoing event was interrupted by another event. In such a case, the interrupting event uses the preterite tense.
I1	The imperfect tense is used for past actions that lack a specific and clear beginning and end, such as habitual/repeated actions.
I2	The imperfect tense is used to describe people, things, places, and situations in the past in terms of their permanent, ongoing (unchangeable) characteristics.
I3	The imperfect tense is used to describe a continuous (non-completed) condition or state of being in the past, such as an emotion, a feeling, or a cognitive process.
I4	The imperfect is used for actions that occurred simultaneously in the past. In these cases, the ongoing event uses the imperfect tense.

Table A2

Sentences Presented during Prior Knowledge Pre-Test, Practice, Non-Transfer Test, and Near Transfer Test

Sentence Number	Tense Rule	Sentence
1	P1	She **talked** with her mom yesterday.
2	P1	On Thursday, he **walked** past the dog park on his way home from work.
3	P1	Lily **ate** soup for dinner last Wednesday.
4	P1	Earlier today, the grocery store **sold out** of chips.
5	P1	The teacher's pen **ran out** of ink.
6	P1	Henry just **took** his Spanish test.

7	P1	Carrol **drank** a protein shake this morning.
8	P1	For the first three years of her life, Emma **lived** in Italy.
9	P1	James **sat** in a throne at a castle last year.
10	P1	She **used** her notes to complete her lab report on Friday.
11	P1	Quinn **pondered** Greece as the destination for their senior trip.
12	P1	Navi **wrote** a letter to her sister last week inviting her to visit.
13	P1	Last night, Preethi **read** thirty pages of her assigned reading.
14	P1	The horse **jumped** over the pond to avoid getting his hooves wet.
15	P1	Last week, Rory **called** her dad to catch up on his life.
16	P1	He **went** to a new class for his major this week.
17	P2	The researcher **spoke** at the conference three years in a row.
18	P2	Due to the rain, he **cleaned** his car twice last week.
19	P2	The professor **taught** the class three times.
20	P2	Kendra **purchased** soup from Trader Joes two weeks in a row.
21	P2	Sarah **needed** medicine every day last week.
22	P2	The Lee family **traveled** to Florida every spring break for 10 years.
23	P2	Fran **borrowed** her friend's hair spray four times before buying her own.
24	P2	The school's football team **won** the last five games.
25	P2	Amir's mom was furious when she found out that her son **lost** his backpack not once, but twice on his trip.
26	P2	Alexa **dressed** like a princess every day last week.
27	P2	The undergraduate student **observed** the surgeon twice every week during the fall semester.
28	P2	My mom **coached** the volleyball team two weeks in a row because the coach was out of town.
29	P2	Tina **explained** the concept to her friend five times before she understood.
30	P2	The goat **escaped** from his pen three times.
31	P2	Ally **kicked** the air twice before her foot struck the soccer ball.
32	P2	Hassan **sang** the same piece in two recitals.
33	P3	Jenny **woke** up and then went outside.
34	P3	He **packed** for his field trip before going to bed.
35	P3	I **finished** my essay, ate dinner, and then went to the movie theater with my friends.
36	P3	Sally **practiced** the speech by herself and then presented it to her class.
37	P3	Amari **rescued** the dog on the side of the road and took him to the vet.
38	P3	Rebecca **startled** her younger sister, who then hid in their parents' room.
39	P3	He **tried** a bite of the pasta and proceeded to spit it into his napkin.
40	P3	Sharon and her partner **watched** the movie, went to dinner, and afterwards got ice cream.
41	P3	The fisherman **waited** for a fish, caught one, and released it back into the river.
42	P3	Jada **worked** on her assignment, rested, and then continued diligently.
43	P3	The accountant **calculated** the risks of the investment and advised her client to make a different decision.

44	P3	Diego **turned** off his alarm, fell back asleep, and got up with barely enough time to get ready for class.
45	P3	Snoopy **played** with his toys, barked at the squirrels outside, and chased his tail.
46	P3	He **cooked** pasta for dinner and saved the rest for lunch the following day.
47	P3	The toddler **showed** her mom her artwork, then began creating her next project.
48	P3	Abby **washed** the dishes, then relaxed outside.
49	P4	When Vishal was having dinner, his sister **cried** for attention from the other side of the table.
50	P4	As Destiny was curling her hair, she **burned** her hand on the iron.
51	P4	Ama **reached** for the cookies just as they were coming out of the oven.
52	P4	While Jenny was headed across campus, she **heard** a baby bird chirping for his mother.
53	P4	He **listened** attentively as the professor was lecturing.
54	P4	While Ken was presenting his poster, the judge **asked** him a question.
55	P4	As the toddler was stumbling through his grandmother's house, he accidentally **broke** her favorite vase.
56	P4	While the couple was driving to the movie theater, they **decided** to go to a diner instead.
57	P4	As she followed her tour guide around campus, Laura **picked** a flower outside of the dorm.
58	P4	Sally **stepped** in a big puddle while dashing to her car in the rain.
59	P4	While Maji was celebrating her twentieth birthday, her friends **gave** her the presents they bought.
60	P4	While everyone arrived at the party, the party planner **left** the room.
61	P4	As Erica was looking at her phone on the way to class, she **tripped** over the edge of the sidewalk.
62	P4	While Margaret was on her way to class, she **moved** an earthworm from the hot sidewalk to the cool grass.
63	P4	Just as the tornado was increasing in power, the windows **shattered** in the house.
64	P4	The dog **stopped** at the scent of a nearby squirrel as he was chasing the frisbee.
65	I1	When Isabella was in high school, she **would talk** to her best friend for hours every night.
66	I1	When she was younger, her best friend **walked** her home every day after school.
67	I1	Gracie **used to eat** a sandwich for lunch every day of middle school.
68	I1	Football tickets always **sold out** early.
69	I1	When Erin was younger, she **would run** around the playground.
70	I1	Her mom **took** her homework to school every time she forgot it.
71	I1	Cheyenne usually **drank** ten glasses of water per day when training as an athlete.
72	I1	They **would go** to their grandparent's house for every holiday.

73	I1	Haley **lived** in Dallas, near the science museum.
74	I1	Zach's grandma **would read** to him before bed every night when he was a young boy.
75	I1	The chef **would burn** all the food she made at her first restaurant.
76	I1	She **used to hear** cats meowing in her backyard.
77	I1	Malik **used to listen** to pop music before he discovered country music.
78	I1	Carter often **jumped** on the trampoline as a child.
79	I1	Olivia frequently **purchased** vegetables from the store to make her salads.
80	I1	He almost always **sat** with his best friend at the lunch table.
81	I2	The Jones' home **was located** right on the lake outside of town.
82	I2	Birthday parties **were** her favorite, especially when they were for family members.
83	I2	From what Xavier could remember, his grandfather **was** tall and kind.
84	I2	The situation **was grave** when the crisis began.
85	I2	Adriel's car **was parked** in the parking lot across from the store.
86	I2	The carpet **was** dirty from years of use and countless spills.
87	I2	The exterior of the house **was finished** with stunning red brick.
88	I2	Lily **had** dark brown hair before she got light blond highlights.
89	I2	Maria's purple cup **had** sparkling water, lemon, and ice in it.
90	I2	The poster for the environmental science club **was** green and blue.
91	I2	Her favorite flowers **were** daisies, which often bloomed near her house.
92	I2	His computer **worked** poorly after water spilled onto it and the keyboard broke.
93	I2	Her middle name also **belonged** to her grandmother and her aunt.
94	I2	Jenny's flowers **were** so beautiful, they received an award at the fair.
95	I2	He **understood** the basics of social, developmental, and cognitive psychology.
96	I2	The sun **was shining** brightly across the field of yellow daisies.
97	I3	She **believed** in herself and her preparation for the test.
98	I3	Tommy's cat **was** always angry when he couldn't catch the mouse.
99	I3	Talia's dog **was** excited when she came home from work every day.
100	I3	Noah **was** thrilled with his scores on his Spanish tests throughout his senior year.
101	I3	The family **was** very sad due to missing their pet.
102	I3	He **was** ecstatic because he was going to go to TCU.
103	I3	Kim **was** tired after her long work days.
104	I3	The team **was** nervous as they entered the semifinals.
105	I3	The baby **was** unhappy whenever her parents dropped her off at her grandparent's house.
106	I3	Kelly **loved** her job at the bank on the corner.
107	I3	She **disliked** the homework exercises assigned in math class.
108	I3	Jo **was** worried about his sister because she was going to start school.
109	I3	He **was** unconcerned about his scores on the exam.
110	I3	Mateo **needed** a date for the school dance.
111	I3	Beatriz **wanted** a friend to play board games with in the evenings.

112	I3	Jacob never **enjoyed** going out to dinner.
113	I4	While he **cleaned** his car, the man noticed a scratch on the hood.
114	I4	As the doctor **spoke**, the patient's mother recorded notes.
115	I4	Claire consulted a thesaurus while she **wrote** her essay.
116	I4	As the safari guide **taught** the group about hyenas, one appeared from behind a tree.
117	I4	When Jane **was picking** up trash found on the sidewalk, an older woman thanked her.
118	I4	While the baby **cried**, his mother looked for the bottle.
119	I4	While **pondering** what to cook for dinner, Bryan chose to make a sandwich.
120	I4	While **asking** questions in class, the student dropped their pencil.
121	I4	When Carlos **was deciding** what to tell his parents about the broken vase, he realized it would be best to tell them the truth.
122	I4	While Meredith **stepped** out of the car, she thanked the driver for driving her all that way.
123	I4	While Liliana **moved** her car across the parking lot, she waved at her roommate.
124	I4	When she **reached** for the glass, she knocked over a plate.
125	I4	When Daniel **was calling** out for his son, he strained his voice.
126	I4	As Addison **was fixing** the washing machine, a loud sound made her realize the machine just broke.
127	I4	While the professor **gave** her lecture, the students summarized the content in their notes.
128	I4	As Louis **was leaving** the room, he realized he forgot his notebook.

Note. During each test, participants were presented with the sentence and asked, "When conjugated to Spanish, which tense would best correspond to the *bolded* verb construction in this sentence? Preterite or Imperfect?" The last sentence of each tense rule was always used for the prior knowledge pre-test. Otherwise, sentences were randomly assigned to be presented during practice, the non-transfer test, or the near-transfer test for each participant, with the constraint that an equal number of preterite and imperfect sentences representing each of the 8 tense rules were presented during each phase.

Appendix B

Cinderella Passage Used for Far-Transfer Test

Participants were presented with the instructions, "The passage below contains 30 bolded verb constructions. For each verb construction, answer the following question: When conjugated in Spanish, which tense would best correspond to the bolded verb construction, preterite or imperfect?"

Cinderella Story

Once upon a time there (1) **was** a young, beautiful girl who (2) **was** also very poor. She (3) **had** a wicked stepmother who (4) **was** very mean to her.

One day the king (5) **announced** a grand ball at the palace. The handsome prince (6) **wanted** to choose a wife. On the day of the ball, Cinderella's stepmother (7) **made** her work extremely hard. Cinderella (8) **was** so tired from working day after day that she instantly (9) **thought** of simply forgetting the ball.

Suddenly a fairy godmother (10) **appeared** and (11) **told** Cinderella that she (12) **needed** to go to the ball. Poor Cinderella (13) **had** nothing to wear. So, the fairy godmother (14) **waved** her magic wand and in that moment Cinderella (15) **became** even more beautiful than ever.

When she (16) **arrived** at the palace, the band (17) **was playing** and all the people (18) **were dancing**. Almost immediately, the prince (19) **asked** Cinderella to dance. As they (20) **were dancing**, the happy prince fell madly in love with her.

But at the stroke of midnight, Cinderella (21) **ran** from the room. While she (22) **was running** down the steps, she (23) **lost** her glass slipper. The prince (24) **picked** it up and (25) **ordered** his guards to search the kingdom until they found the person to whom it (26) **belonged**.

Cinderella's ugly stepsisters (27) **tried** to squeeze their feet into the shoe. When Cinderella (28) **stepped** into the shoe, the guard knew that here (29) **was** the beautiful girl the prince (30) **wanted** for his wife. Soon afterwards, Cinderella and the prince married and lived happily ever after.

Table B1

Correct Responses for the Far-Transfer Test

Verb Construction	Tense	Tense Rule(s)
1 – was	Imperfect	I2
2 – was	Imperfect	I2
3 – had	Imperfect	I2 (I1)
4 – was	Imperfect	I1 (I2)
5 – announced	Preterite	P1
6 – wanted	Imperfect	I3 (I1)
7 – made	Preterite	P1
8 – was	Imperfect	I1 (I3)
9 – thought	Preterite	P1 (P3)
10 – appeared	Preterite	P1 (P3)
11 – told	Preterite	P1, P3
12 – needed	Imperfect	I3 (I1)
13 – had	Imperfect	I2 (I1, I3)
14 – waved	Preterite	P3 (P1)
15 – became	Preterite	P1 (P3)
16 – arrived	Preterite	P4 (P1, P3)
17 – was playing	Imperfect	I4
18 – were dancing	Imperfect	I4
19 – asked	Preterite	P1 (P3)
20 – were dancing	Imperfect	I4
21 – ran	Preterite	P1 (P3)
22 – was running	Imperfect	I4
23 – lost	Preterite	P4 (P1)
24 – picked	Preterite	P3 (P1)
25 – ordered	Preterite	P1 (P3)
26 – belonged	Imperfect	I1 (I2, I3)
27 – tried	Preterite	P2 (P1)
28 – stepped	Preterite	P1
29 – was	Imperfect	I2 (I1, I3)
30 – wanted	Imperfect	I3 (I1, I2)

Note. Participants only needed to identify the tense (i.e., preterite or imperfect), not the tense rule. Some verb constructions correspond to multiple tense rules, as indicated by the rules included in parentheses.