Learning Styles to the Test:

An Experimental Investigation of the Effect of Matching Learning Preferences with Learning Context

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Background

- The term "learning styles" refers to the idea that individuals differ in which mode of instruction or study is most effective for them. There are a variety of models, such as the Dunn and Dunn model (Dunn, 1990) and Kolb's Learning Styles Inventory (Kolb, 1984), and a host of educational materials that are built around the idea that to optimize learning, students must be given instruction that matches their preferences (e.g., lecture for auditory learners and "hands on" practice for kinesthetic learners).
- Despite the popular appeal of the learning styles idea, controlled experiments are lacking, and those that have been conducted have not shown clear support (as reviewed by Pashler, McDaniel, Rohrer, & Bjork, 2009: Cook, Thompson, Thomas, & Thomas, 2009; Massa & Mayer, 2006). Moreover, educational psychologists and cognitive scientists have raised grave concerns about the logical coherence of the concept of learning styles (Snider, 1992; Willingham, 2009). Even supposed meta-analytic support for the popular Dunn and Dunn model (Dunn, Griggs, Olson, & Beasley, 1995; Lovelace, 2005) is built almost entirely on dissertation data from investigations within Dunn and Dunn's university and non-experimental investigations labeled as experimental.
- One learning preference that may be important to investigate is the use of cooperative learning structures. First, cooperative learning is frequently used in academic settings. Second, students differ in their preference for engaging in group work, and the existing literature concentrating on cooperative learning suggests that effective group work is difficult to obtain (Cantwell & Andrews, 2002; Karau & Elsaid, 2009; Slavin, 1983; Webb, 1991). Finally, there is some research to suggest that lower performing students may actually prefer group work (Furnham, Christopher, Garwood, & Martin, 2008), so preference for cooperative learning might be tied to actual level of achievement.
- The current study, then, uses a true experimental manipulation to determine whether learning is optimized by matching (a) *students' learning style* (in this case, preference for practicing new material alone or cooperatively) with (b) *the mode they are assigned to practice new material*. We utilized a 2 (prefer to practice alone or in groups) x 2 (assigned to practice alone or in groups) between-subjects expericorr design.
- Based on previous research on individual preferences and on instructional research that has utilized controlled experimental designs, we generated the following hypotheses:

1. Stronger academic history (GPA, ACT) will be associated with higher pre-test and post-test performance.
2. Matching practice preference with practice context (as opposed to mismatching) will induce a more favorable affective evaluation of the practice session.
3. However, matching practice preference with practice context (as opposed to mismatching) will *not* induce an advantage in actual performance on the post-test or the degree of pre-post gain.

Method

- Participants were 151 students in three sections of Psychology 100 during the Spring 2011 semester. The procedure took place over two class sessions. A total of 140 students were in class for both sessions and completed a pre-test on classical conditioning, a practice session, and a post-test on classical conditioning.
- Students were informed of the basic objectives of the research through standard IRB procedures. Students gave researchers permission to access their GPA and incoming ACT scores via their student ID number. Once all assessments were in place, all information tied to their personal identity was erased from the dataset. Students were also informed that their performance on the pre- and post-tests would not count toward their course grade.
- Participants first completed a pre-test on classical conditioning (range 8%-100%). The test included both multiple-choice and short answer questions on classical conditioning. They then reported their preferred mode of practicing with new material: alone, or in a small group (2-3 other students).
- After receiving formal instruction on the topic from a guest faculty (one of the researchers), participants were randomly assigned, via the color of their practice sheet, to one of two practice context conditions: practice alone or practice in a small group of 3 students. All students completed the same practice sheet and were given the same amount of time to work through it.
- On 0 to 100% scales, students reported their enjoyment of the practice session and estimated how they would do on a post-test. Then, they completed an actual post-test (range 23%-100%) that was parallel in form to the pre-test. The questions were of similar form but not identical.

Pre-test, Practice, and Post-test Materials

The pre-test on classical conditioning was worth 13 points. A sample question (worth 4 points in all) is displayed below:

Joey goes to his favorite taco joint, Sam's Place, one evening for dinner. Later that night, he wakes up sick. His sickness is limited to vomiting, however, and he sees on the news that Sam's Place has put out a warning that they found contaminated meat. Hence, Joey's vomiting was due to food poisoning. Three months later, though, Joey is still nauseated at the thought of eating tacos from anywhere.

What is the UCS (unconditioned stimulus)?
What is the UCR (unconditioned response)?
What is the CS (conditioned stimulus)?
What is the CR (conditioned response)?

After the pre-test, Dr. Goodman provided formal instruction and examples of classical conditioning. Then, students practiced either alone or in small groups with cases such as the following:

Marie is driving in her car down I-94 on her way to school one morning. As she is making her turn onto Hwy53, she hears a loud horn blaring somewhere nearby. She looks around but sees nothing but the light, early morning traffic. The sound gets louder and as she pulls up to the next stop light she looks in her rearview mirror just in time to see a huge truck racing out of control towards her. Marie panics as she desperately tries to get out of the way. Her heart is racing and pounding and she's sweating profusely but she manages to pull out of the way just in time. Although she avoided the disaster, Marie now notices her heart racing and her palms sweating whenever she hears a car horn.

What is the unconditioned stimulus (UCS)?
What is the unconditioned response (UCR)?
What is the conditioned stimulus (CS)?
What is the conditioned response (CR)?
What other objects or sounds could Marie's fear of car horns generalize to?

After the practice session, students reported how much they enjoyed the practice session (0 to 100%) and how well they thought they would do on a post-test (0 to 100%). Then, they took a post-test worth 13 points. A sample question is displayed below:

Joey was put on a medication that smells like bubble gum. Unfortunately, the medicine induced vomiting as a side effect. Now when a friend offers him a piece of bubble gum, he feels nauseated.

What is the UCS?
What is the UCR?
What is the CS?
What is the CR?

Participant Characteristics

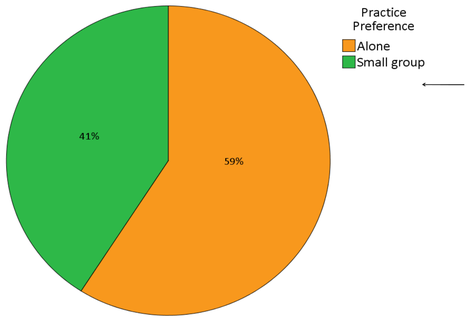
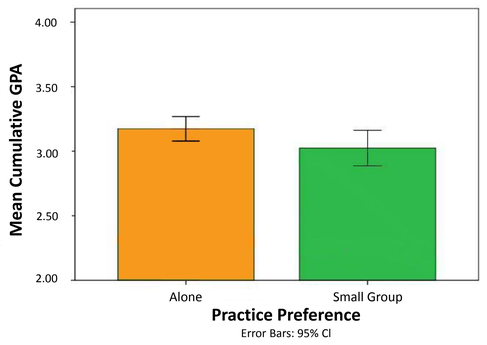


Figure 1 (left). Students were more likely to report a preference for practicing new information alone than in small groups (with 2 or 3 other people).

Figure 2 (right). Students who reported a preference for practicing new material on their own tended to have higher cumulative GPAs (M = 3.17, SD = 0.45) than did students who preferred to work in groups (M = 3.02, SD = 0.53), $t(146) = 1.84$, $p = .068$, $d = 0.30$.



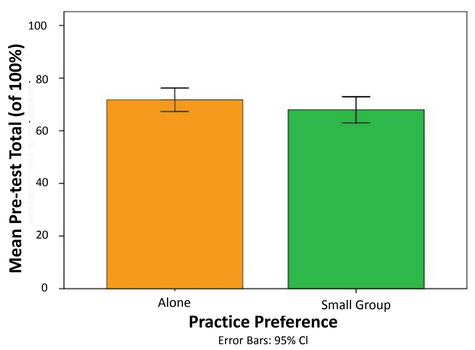
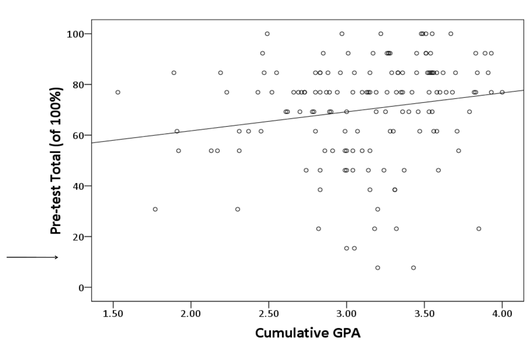


Figure 3 (left). On the classical conditioning pre-test scores, students who preferred to practice new material on their own (M = 71.77, SD = 21.05) did not differ significantly from those who preferred to work in small groups (M = 67.97, SD = 19.32), $t(147) = 1.12$, $p = .265$, although the direction of the means favored those who preferred to work alone, $d = 0.18$.

Figure 4 (right). Students with higher cumulative GPAs performed better on the classical conditioning pre-test, $r(149) = .18$, $p = .03$. See figure at right.
(Students with higher GPAs also did better on the post-test, $r(141) = .18$, $p = .03$.)



Effects of Matching Practice Preference with Practice Context

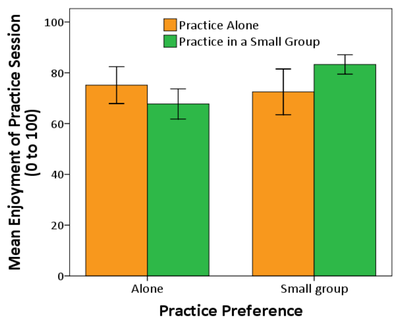


Figure 5 (left). As expected, matching preferred mode of practice with actual form of practice was tied to enjoyment of the practice session, $F(1, 135) = 7.23$, $p = .008$, partial $\eta^2 = .05$. Those who preferred to work in groups enjoyed the session more if they worked in a small group rather than alone ($p = .03$). Those who preferred to work alone tended toward a more favorable response if they worked alone rather than in a small group ($p = .11$).

Figure 6 (right). Matching preferred mode of practice with actual form of practice was not tied to foreseen performance on post-test, $F(1, 135) = 0.42$, $p = .517$, partial $\eta^2 = .003$. There was a marginal main effect of practice context, however, such that those who practiced in a small group (M = 84.29, SD = 12.97) expected to do better than did those who completed the practice activity on their own (M = 80.99, SD = 10.19), $F(1, 135) = 3.03$, $p = .084$, partial $\eta^2 = .02$.

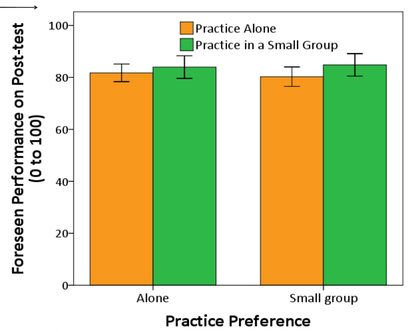
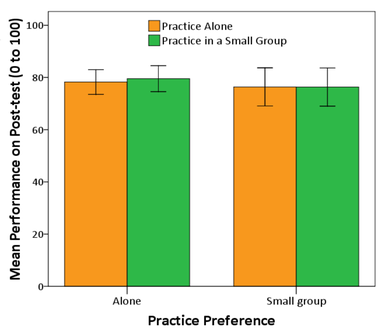


Figure 7 (right). As we expected, matching preferred mode of practice with actual form of practice was *not* tied to post-test performance, $F(1, 134) = 0.05$, $p = .822$, partial $\eta^2 = .000$. There was no main effect of practice context on post-test performance, $F(1, 134) = 0.04$ $p = .833$, partial $\eta^2 = .000$, nor was there a main effect of practice preference on post-test performance, $F(1, 134) = 0.76$, $p = .385$, partial $\eta^2 = .006$.



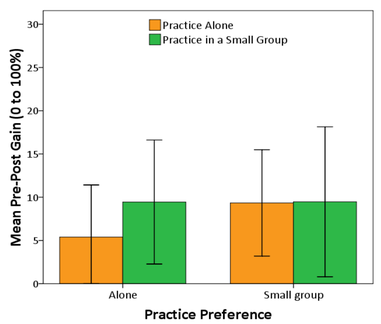


Figure 8 (left). Matching preferred mode of practice with actual form of practice was not tied to pre-post gain, either, $F(1, 134) = 0.30$, $p = .583$, partial $\eta^2 = .002$. There was no main effect of practice context on pre-post test gain, $F(1, 134) = 0.34$, $p = .559$, partial $\eta^2 = .003$, nor was there a main effect of practice preference on pre-post gain, $F(1, 134) = 0.31$, $p = .578$, partial $\eta^2 = .002$.

Discussion

- The current research used an experimental manipulation to test the hypothesis that matching the students' preferred mode of practice with their assigned mode of practice optimizes learning. Although we showed that matching practice preference and actual practice context optimizes enjoyment, matching did *not* optimize student learning, as assessed via pre-post test gain. Our research adds to the existing experimental designs that have tested learning styles models, yet have failed to support them (Cook et al., 2009; Massa & Mayer, 2006). Students have learning style preferences, and those preferences may be linked to the students' enjoyment of various forms of instruction, but matching those preferences to various forms of instruction does not translate to differences in learning. As implicated by authors of a recent review on the learning styles hypothesis (Pashler et al., 2009), we suggest that educators review the experimental literature carefully before framing their classroom instruction around learning styles.
- Further tests of matching practice preferences with actual practice context could be improved in several ways. First, the pre- and post-test assessments could include items that have been previously validated and that have documented inter-item consistency. Second, researchers could allot points towards student performance on the post-test assessment in order to assure high levels of student motivation. Third, researchers could select material for which students are sure to have no previous exposure. (In our sample, pre-test scores averaging 70% suggest that some students had previous exposure to classical conditioning.) Finally, one concern in the current investigation is that students may have overheard one another while they were completing the practice session, such that those who were assigned to work alone may have gained from those who were discussing aloud in groups. In the current study, the potential for cross-talk to have occurred was minimized because the classroom was a large lecture hall.

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Acknowledgements

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