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She Who Teaches Learns: Performance Benefits of a Jigsaw Activity in a College Classroom

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The present study investigated the effects of participating in a jigsaw activity on individual college student performance. Participants were 126 students enrolled in a Social Psychology course in one of four different semesters. Each student was assigned to teach one of three topics to their peers and learned about the other two topics in their jigsaw groups. Students were then tested on all three topics, or asked to choose which topic they would like to write about. Results showed that when given the option, a majority of students (62.96%) preferred to write about their assigned jigsaw topic. Furthermore, when forced to write about all three assigned topics, students performed better on the short-answer question related to the topic they had taught, compared with those not assigned to that topic for the subject of group dynamics, $F(4, 162) = 3.69$, $p = .007$, and the subject of attributional biases, $F(4, 58) = 4.10$, $p < .01$. These effects held for both short-term recall on a quiz as well as for longer-term recall on an exam a week later. Students also reported understanding the topic they taught better than those not assigned to that topic. These results highlight the benefits of students teaching, as part of a jigsaw activity, on their own learning.

Keywords: cooperative learning, jigsaw classroom, student performance

The Jigsaw Classroom is a cooperative learning strategy designed in the 1970s by Dr. Elliot Aronson to help desegregate the public schools in Austin, Texas. Like all cooperative learning strategies, students in the Jigsaw Classroom must "work together to help one another learn academic content" (Slavin, 2011, p. 1). According to Slavin (1983), the traditional Jigsaw Classroom can be categorized as a cooperative-learning method that utilizes task specialization and individual rewards. Task specialization refers to the fact that each member in a Jigsaw Group becomes an expert on one topic, which they must then teach to the other members of their group. Students are rewarded individually in that immediately following the jigsaw activity they are quizzed on the content of their assigned topic as well as on the topics assigned to the other members of their group. Therefore, to do well on the quiz, students must not only know their own topic well but must also pay close attention to the other members of their group and encourage them to effectively present the material.

Four decades of research has shown that implementing the Jigsaw Classroom helps to accomplish its primary intended goal of reducing students' prejudice (Aronson, 2002; Aronson, 2004; Aronson & Bridgeman, 1979; Aronson & Osherow, 1980; Levy, Elizabeth, Shin, & Rosenthal, 2017; Paluck & Green, 2009), although not without exception (e.g., Bratt, 2008). This success in reducing prejudice is attributed to the fact that the Jigsaw Classroom incorporates several key features for addressing intergroup tensions via contact (Allport, 1979). First, because the Jigsaw Classroom uses task specialization, each student learns a unique piece of

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information that enables them to come to the activity with equal status and power, at least with respect to the knowledge that they hold. Second, task specialization combined with the individual quiz makes students interdependent and provides them with a common, superordinate goal. That is, to achieve the common goal of doing well on the quiz, students must work together to learn all of the topics. It has been argued that the presence of a superordinate goal helps students in the Jigsaw Classroom to recategorize former out-group members as in-group members (Williams, 2004).

In addition to reducing interethnic prejudice, students participating in the Jigsaw Classroom experience other psychological benefits such as an increase in intrinsic motivation and feelings of competence (Hänze & Berger, 2007), increased self-esteem (Aronson & Bridgeman, 1979), and increased confidence and self-efficacy (Crone & Portillo, 2013; Darnon, Buchs, & Desbar, 2012). In a study by Hänze and Berger (2007), gains in feelings of competence were even more pronounced for 12th grade physics students who had a low academic self-concept. The cooperative nature of the Jigsaw Classroom seems to have provided students who previously saw themselves as unsuited to academic learning with the opportunity to feel more competent, compared with those who received traditional instruction from the teacher. Similarly, vocational trainees who received support for math and French in the form of the Jigsaw Classroom showed increased self-efficacy in these subjects compared with those who received individual instruction from the teacher (Darnon et al., 2012). Most recently, Crone and Portillo (2013) showed that, compared with students who received traditional instruction, jigsaw students were more confident in their ability to teach cognitive psychology topics to others and to present the material orally. Confidence gains were achieved when students completed as few as three jigsaw activities. After participating in nine jigsaw activities these students also showed an increase in the extent to which they saw themselves as scholars. Lastly, students often report increased liking for school and positive attitudes toward the Jigsaw Classroom (Aronson & Patnoe, 1997). For example, after participating in the Jigsaw Classroom, more than 85% of students in an undergraduate statistics course said that they would recommend it for future classes (Perkins & Saris, 2001).

The reported effects of the Jigsaw Classroom on academic performance are somewhat more tenuous. Although evaluations of the technique rarely yield deficits, with a few exceptions (e.g., Aronson & Bridgeman, 1979; Sezek, 2012), they are also unlikely to show gains (Crone & Portillo, 2013; Hänze & Berger, 2007; for a meta-analysis see Slavin, 1983). For example, no performance differences were found on items directly relevant to jigsaw content between undergraduate students enrolled in a statistics course that used the Jigsaw Classroom versus previous years' classes that had not. Although the authors did find significant differences on overall exam performance between classes that used and did not use the Jigsaw Classroom, it is unclear whether these gains were attributable to use of the Jigsaw Classroom or due to confounding factors such as exam difficulty or prior aptitude. Following a meta-analysis of cooperative learning techniques, Slavin (1983) concluded that there was little evidence to support gains in academic achievement as a result of participation in the traditional Jigsaw Classroom.

Other cooperative learning techniques have shown clearer evidence for gains in student performance. For example, in peer instruction, students read content before coming to class and then participate in a structured questioning process that includes having students discuss answers to a question with neighboring students (Crouch, Watkins, Fagen, & Mazur, 2007). Analysis of 10 years worth of data on peer instruction in college physics classes shows that peer instruction leads to greater gains in posttest scores on standardized measures of achievement compared with a lecture-based course (Crouch & Mazur, 2001). Another cooperative learning technique that has shown clear gains in student performance is interteaching (Saville & Zinn, 2011). Interteaching requires students to complete a prep guide for a reading assignment before coming to class. The prep guide then serves as the basis for discussing answers with a partner during class time. The instructor then asks students to identify difficult concepts and this information is used to inform the content of the lecture during the next class period. Research on interteaching shows that students who participate in interteaching perform better on

quizzes and exams compared with those who are taught via traditional lecture (Saville, Zinn, Neef, Van Norman, & Ferreri, 2006) and that the benefits of interteaching are even greater for students with low GPAs (Saville, Pope, Truelove, & Williams, 2012). A meta-analysis of active learning found that in addition to improving exam scores, active learning teachniques, like peer instruction and interteaching, also reduced failure rates in undergraduate STEM courses (Freeman et al., 2014). Unlike the Jigsaw Classroom, Peer Instruction and Interteaching do not make students interdependent. Thus, although Peer Instruction and Interteaching are clearly effective strategies for improving student performance in college classes, they would not be appropriate methods for instructors who had the dual goals of decreasing prejudice and improving academic performance. In fact, previous research has shown that merely engaging in group work without being interdependent is unlikely to yield the same positive effects on prejudice reduction (Walker & Crogan, 1998).

In addition to embracing the tenets of cooperative learning, the Jigsaw Classroom may also accurately be described as a form of peer tutoring. Research on peer tutoring shows that both tutors and tutees benefit academically from the experience (Devin-Sheehan, Feldman, & Allen, 1976; Le Boeuf, 1968; Topping, 1996). More important, both low- and high-achieving students benefit from tutoring others (Devin-Sheehan et al., 1976). In addition, participation in a tutoring program decreases absenteeism (Devin-Sheehan et al., 1976) and improves attitude toward the material (e.g., Leland & Fitzpatrick, 1993). Tutees are also less likely to be left behind or assigned to special education classes (Devin-Sheehan et al., 1976). Furthermore, the use of peer tutors in the Jigsaw Classroom might circumvent some of the problems associated with using tutors who are not members of the class (e.g., Colvin, 2007).

Folk wisdom tells us that "to teach is to learn twice," or *Qui Docet Discit*, which is Latin for "she who teaches learns." Thus, the benefits of peer tutoring for the tutor seem to come from "learning by teaching" (Topping, 1996), but exactly how does this process work? Tutoring requires tutors to simplify, clarify, and exemplify the material—all techniques that should aid in later recall. Indeed, experimental subjects who believed they would have to teach studied material to another student performed better on a quiz compared with those who studied only to learn the material for themselves (Bargh & Schul, 1980). These results suggest that students process the material differently when they expect to teach it versus simply being tested on it. Annis (1983) replicated the results of Bargh and Schul (1980) in a classroom setting while consistently maintaining length of exposure to the content across all of the treatment groups. She found that students who read with the expectation of teaching the material to other students performed better than those who only read but that students who read and actually taught the material outperformed both groups. These results suggest that it is both how students prepare to teach and the act of teaching that improve learning outcomes for "teachers."

The Jigsaw Classroom has been adopted in K–12 classrooms across the country. However, there is little research documenting the use and effectiveness of this technique in college classrooms. The studies that have been conducted in college settings (e.g., Crone & Portillo, 2013; Perkins & Saris, 2001; Sezek, 2012) typically compare students across classes that have and have not included the jigsaw activity or provide only an informal assessment of the technique (e.g., Jones, Graham, & Schaller, 2012; Molina, 2011). Comparing across students is valuable for a global assessment of the technique but provides only limited insight on the objective effectiveness of the technique at the individual level.

The primary purpose of the present study was to analyze students' individual performance on quiz and exam questions related to topics learned as part of the Jigsaw Classroom. We wanted to see whether the benefits observed among peer tutors may also be present for college student "experts" in the Jigsaw Classroom. Based on our review of the literature on peer tutoring, we hypothesized that students would perform better on the topic they were assigned to teach compared with those not assigned to that topic. Comparing students within the same class also helps to control for potential confounds present when comparing across classes, such as instructor, class time, and so forth. We also wanted to look at how students' ratings of the jigsaw activity, their reported self-understanding, and their ratings of other students' teaching ability correlated with their individual

performance. Although the Jigsaw Classroom was developed by a social psychologist and is often discussed as a prejudice reduction tool, to our knowledge this is the first reported use and evaluation of the technique in a social psychology course. Incorporating the Jigsaw Classroom into a social psychology course has the added benefit of providing students with hands-on experience with one of the prejudice-reduction techniques they will learn about later in the course.

Method

Participants

Participants were 126 students (92 females, 34 males) enrolled in one of four sections of a 200-level Social Psychology course between fall 2013 and fall 2016 at the University of Scranton. The University of Scranton is a mid-sized Catholic and Jesuit coeducational liberal arts university located in Northeast Pennsylvania. Approximately 78% of the student population identifies as white. The sample was a mix of freshman (20.63%), sophomores (29.37%), juniors (21.43%), and seniors (28.57%). The majority of the students were psychology majors (61.11%) with the remainder coming from 23 different majors, including exercise science, neuroscience, counseling, and biology. All sections were taught by the same instructor.

Materials and Procedures

All students completed two jigsaw activities. The first activity covered the subject of attributional biases. This activity included the topics actor–observer effect, fundamental attribution error, and the self-serving bias. The second activity covered the subject of group dynamics. This activity included the topics brainstorming, group polarization, and groupthink.

For the first jigsaw activity on the subject of attributional biases students received a double-sided handout on their assigned topic. Each handout included a photocopied excerpt from an earlier version (Aronson, Wilson, & Akert, 2010) of the introductory social psychology textbook that they had purchased for the class. The handout on the actor–observer effect included a definition of the concept along with an example and a discussion of the roles of perceptual salience and information availability in explaining this bias. The handout on the fundamental attribution error (correspondence bias) provided a definition and an example of the fundamental attribution error along with a description of the "Castro Study" conducted by Jones and Harris (1967). The handout on the self-serving bias provided a definition of the self-serving bias, a discussion of why we make self-serving attributions, and connected this topic to research on the just-world phenomenon and blaming the victim.

For the second jigsaw activity on the subject of group dynamics, students received a one-page instructor-generated handout on their assigned topic (available upon request). The brainstorming handout provided a summary of the study by Taylor and colleagues (1958), a summary of explanations for why groups generate fewer ideas, and a description of brainwriting as an alternative to brainstorming. The group polarization handout provided a brief summary of research on the risky shift, several empirical examples of group polarization, and two possible explanations for why group discussion leads to polarization. On the reverse of the group polarization handout were two decision dilemmas that could be used to illustrate the difference between group polarization and the risky shift. The groupthink handout identified Irving Janis as the primary researcher of groupthink, listed the antecedents of groupthink as well as how it could be prevented, and several historical examples. All of the handouts included a definition of the topic at the top of the page.

For each jigsaw activity, students were divided into groups of three, and each member of the group was randomly assigned to study and then teach one of the three topics. Students were provided with the handout on their topic and instructed to study it outside of class and to come prepared to teach it to their group during the next class period. Students also had access to similar (but not identical) content in the assigned reading from their introductory social psychology textbook.

When students arrived in class, the jigsaw activity began by having students assigned to the same topic meet in small groups (i.e., expert groups). Students were instructed to use the time in their expert groups to discuss their topic, to practice presenting it, and to clarify any mis-

understandings. When they were done meeting in their expert groups, students moved into their jigsaw groups. Like a jigsaw puzzle, students must present their piece to have an understanding of the "big picture" of the broader subject.

Students in all four sections completed both jigsaw activities and were tested on the topics associated with both attributional biases and group dynamics. However, the timing and format of the evaluations differed across the four sections. See Table 1 for a summary of assessment activities for each section. In Section 1, students were tested with three multiple-choice questions on the subject of attributional biases on their first exam. On their second exam, students were allowed to choose which one of the three topics from the group dynamics jigsaw activity they wanted to write about. These students also provided open-ended feedback in response to the following four questions after completing the second jigsaw activity (i.e., group dynamics): (a) did having to teach your topic help you to learn it better, (b) how did you like learning from your classmates, (c) how did you like the jigsaw activity overall, and (d) do you have any suggestions for improvement.

In Section 2, students were tested on each topic as part of an in-class exam a week or more after the activity. Similar to Section 1, students in Section 2 answered three multiple-choice questions on the subject of attributional biases. Instead of being able to choose the topic they wrote about on the subject of group dynamics, students in this section were required to write short responses to questions on all three topics.

In Section 3, students were quizzed with short-answer questions on each topic in the class period following each jigsaw activity. Students in this section also provided structured feedback after the first jigsaw activity (i.e., attributional biases). In section 4, students answered multiple choice exam questions about each of the three attributional biases and short answer quiz questions on all three topics. On their final exam, students were also asked to choose which one of the three topics from the group dynamics activity they wanted to write about. All short-answer questions were worth two points each and were graded on a continuous scale.

Data for all students were aggregated across sections. The primary dependent variable was student performance. Separate analyses were conducted for student performance on questions related to group dynamics versus attributional biases. Final grade in the course was used as a covariate for all of the performance-based analyses except the essay selection. Secondary analyses were conducted on student feedback data. This project began as part of standard assessment of student learning. Thus, data for this study were extracted from archived quizzes, exams, feedback forms, and final grade reports. This research was reviewed and approved by the psychology department research ethics committee of the first author.

Results

Topic Preference

In Sections 1 and 4, students were asked to choose one of the three jigsaw topics on the subject of group dynamics to write about for the short-answer portion of the exam. Student

Table 1
Summary of Assessment Activities for Each of Four Sections of Social Psychology

Section	Assessment of attributional biases	Assessment of group dynamics	Student feedback
1 (n = 33)	Multiple-choice exam questions on all three topics	Selected essay topic on exam	Open-ended feedback about group dynamics jigsaw activity
2 (n = 33)	Multiple-choice exam questions on all three topics	Short-answer exam questions on all three topics	None
3 (n = 35)	Short-answer quiz questions on all three topics	Short-answer quiz questions on all three topics	Structured feedback about attributional biases jigsaw activity
4 (n = 25)	Multiple-choice exam questions on all three topics	Short-answer quiz questions on all three topics, and selected essay topic on exam	None

choice of essay topic was significantly different than what would be expected by chance, $\chi^2(4) = 25.27$, $p < .001$ (see Table 2 for absolute and relative frequencies). Most students (51.85%) selected the topic of brainstorming, followed by group polarization (29.63%). Groupthink was the least popular selection for the short essay (18.52%). Closer examination of the results showed that students had a clear preference for writing on the topic they had been assigned (62.96%). Almost all of the students who had been assigned the topic of brainstorming chose to write their short essay on that topic (94.11%), and 57.89% of students who had been assigned the topic of group polarization chose to write their short essay on that topic. Although only 41.18% of students assigned the topic of groupthink chose to write about it, these students represented 70% of those who chose to write an essay on this least popular topic.

Student Performance

We predicted that students would perform better on their assigned jigsaw topic, compared with those not assigned to that topic. Support for this prediction would be evidenced by a two-way interaction between the student's assigned jigsaw topic and the topic being tested. For analyses on both subjects (i.e., group dynamics and attributional biases), tested topic was a within-subjects variable whereas assigned jigsaw topic and type of assessment (quiz vs. exam) were between-subjects variables.

Subject: Group dynamics. A 3 (assigned jigsaw topic: brainstorming, group polarization, groupthink) × 3 (tested topic: brainstorming, group polarization, groupthink) × 2 (assessment type: quiz vs. exam) mixed-model ANCOVA was used to test for differences in student performance. Final grade in the course was used as a covariate and was significant, $F(1, 81) = 28.72$, $p < .001$. Results showed the predicted two-way interaction between assigned jigsaw topic and the topic being tested, $F(4, 162) = 3.69$, $p = .007$.[1] Students assigned to a jigsaw topic performed better on the short-answer question related to that topic, compared with those not assigned to that topic (see Figure 1). For example, students who had been assigned to teach their classmates about brainstorming performed significantly better on a short-answer question on that topic, compared with students who had been assigned to teach about group polarization or groupthink. This was true for all three topics regardless of whether they were tested on a quiz or an exam.[2] There was also a significant interaction between the assessment type and the topic being tested, $F(2, 162) = 3.10$, $p = .05$. On the exam, students performed best on the question related to groupthink, whereas on the quiz they performed best on the question related to group polarization. The main effects for tested topic, assigned jigsaw topic, and the three-way interaction between tested topic, assigned topic, and assessment type were not significant: $F(2, 162) = 1.62$, $p > .05$; $F(2, 81) = 1.60$, $p > .05$; $F(4, 162) = 0.18$, $p > .05$, respectively.

Subject: Attributional biases. A 3 (assigned jigsaw topic: actor–observer effect, fundamental attribution error, self-serving bias) × 3 (tested topic: actor–observer effect, fundamental attribution error, self-serving bias) mixed-model ANCOVA was used to test for differences in student performance on the short answer quiz question. Final grade in the course was used as a covariate but was not significant, $F(1, 29) = 0.62$, $p = .44$. Results showed the predicted two-way interaction between assigned jigsaw topic and the topic being tested, $F(4, 58) = 4.10$, $p < .01$[i] (see Figure 2). The main effects for tested topic, and assigned jigsaw topic were not significant, $F(2, 58) = .067$, $p > .05$, $F(2, 29) = 0.92$, $p > .05$, respectively.

Because answers to the multiple choice questions were dichotomous (correct vs. incorrect) we used Fisher's exact probability test to test for

[1] The two-way interaction remained significant when the covariate was excluded.

[2] A separate analysis comparing student performance on "focal" (assigned and tested topic matched) versus "non-focal" (assigned and tested topic did not match) questions reinforced the mixed-model analysis, showing that students performed better on focal compared with non-focal questions. This was true for both the questions about group dynamics ($M = 1.67$ vs $M = 1.36$), $t(262) = 3.68$, $p < .001$; $d = .48$, and attributional biases ($M = 1.70$ vs $M = 1.15$), $t(97) = 3.30$, $p = .001$; $d = .70$. In addition, for the questions related to group dynamics, we found that there were no significant differences in performance on focal versus non-focal questions across the three different sections ($p > .05$). The analysis of scores on the questions related to attributional biases only included students in Section 3 so there was no comparison to be made across sections.

Table 2
Frequency of Group Dynamics Topic Assignment and Essay Selection

Group dynamics topics	Students assigned to jigsaw topic	Students who selected topic for essay	Students who chose to write about their assigned topic	Students who chose to write about assigned topic/Students who selected topic for essay
Brainstorming	17	28 (51.85%)	16 (94.11%)	57.14%
Groupthink	17	10 (18.52%)	7 (41.18%)	70.00%
Group polarization	19	16 (29.63%)	11 (57.89%)	68.75%
Total	54[a]	54	34 (62.96%)	62.96%

[a] One student did not complete the essay portion of the exam and therefore could not be classified as having selected one essay over another, and three students were absent on the day of this jigsaw activity and were thus excluded from the analyses.

differences between those assigned to teach the topic versus those who were not. Overall, students performed well on the multiple choice questions. A high percentage of students answered the multiple choice questions about the actor–observer effect (74.73%), fundamental attribution error (84.62%) and self-serving bias (90.11%) correctly. Unlike students' performance on the short answer questions, results showed no difference in performance between those who taught each topic versus those who did not on the multiple choice exam questions about the actor–observer effect, fundamental attribution error, and the self-serving bias (Fisher's exact two-tailed probability = .61, .37, and .27, respectively).

Student Feedback

In response to the first question, "did having to teach your topic help you to learn it better," most students (80.65%) clearly expressed that having to teach their topic on the subject of group dynamics helped them to learn it better. Students commented that preparing to teach their peers helped them to organize their thoughts and motivated them to "fully grasp the topic" to avoid embarrassment. In response to the second question, "how did you like learning from your classmates," 41.94% of students said they enjoyed learning from their classmates. These students cited the change of pace and interacting with other students as reasons for

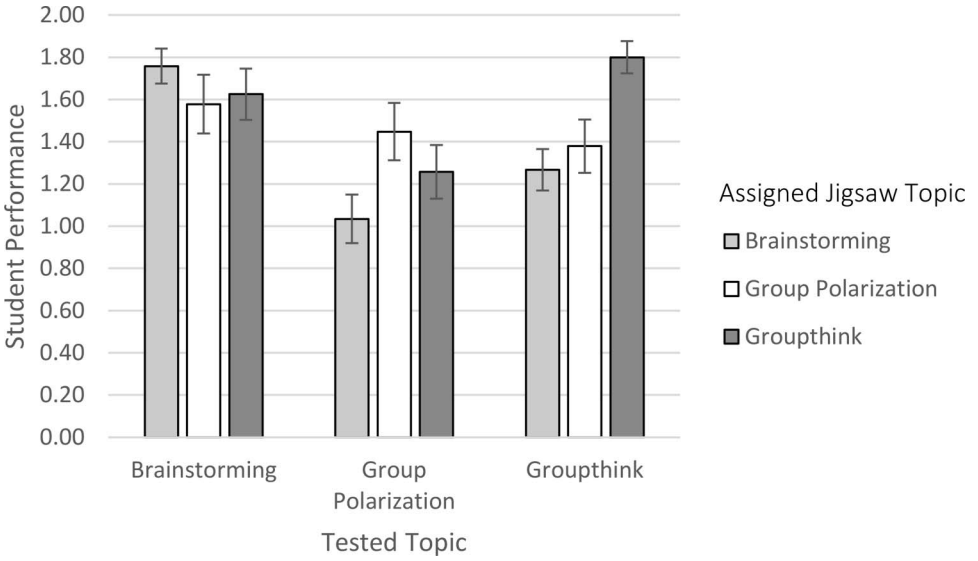

Figure 1. Means and standard errors for student performance scores on short-answer questions for group dynamics topics by assigned jigsaw topic.

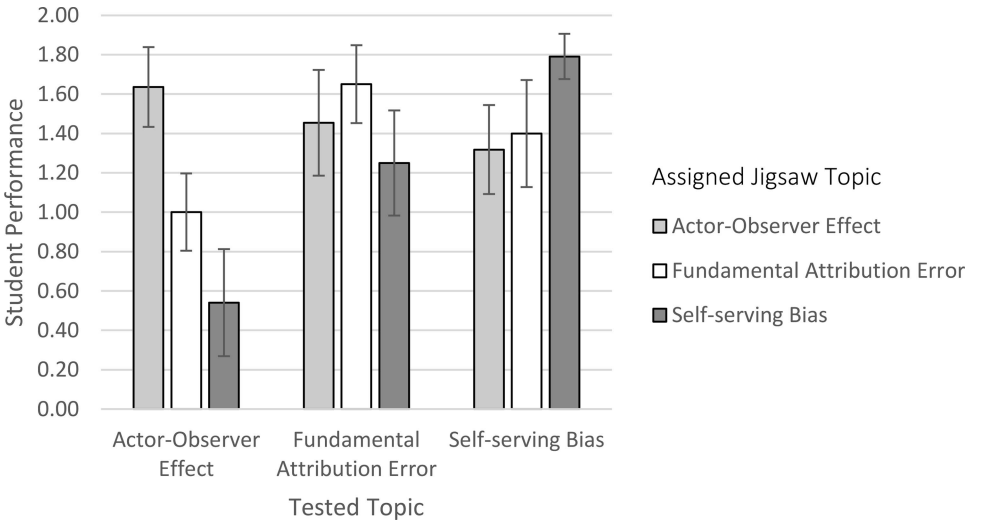

Figure 2. Means and standard errors for student performance scores following the attributional biases jigsaw activity.

their enjoyment. Only four students (12.9%) explicitly said that they did not enjoy learning from their classmates and the remainder (45.16%) were ambivalent. Many of these students did not trust their classmates to present the material well and were concerned that classmates might be "explaining something wrong." When asked how they thought the activity could be improved, students cited concerns about noise level and several requested that they receive copies of the handouts for all assigned topics.

In Section 3, students ($n = 34$) completed a structured feedback form that included measures of their attitude toward the jigsaw activity about attributional biases, ratings of how well they understood each topic, and how well they felt each topic was taught (see Appendix). Attitude toward the jigsaw activity was measured with 10 items (e.g., "I liked the jigsaw activity"), and students made their responses on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The aggregated scale had high internal consistency reliability (Cronbach's alpha = .91). Overall, students rated the activity favorably ($M = 3.87$, $SD = 0.61$), and there were no significant differences in attitude toward the activity across the three jigsaw topics, $F(2, 33) = 1.02$, $p = .37$.

Ratings of understanding were made on a 5-point scale that ranged from 1 (*I do not understand this topic at all*) to 5 (*I fully understand this topic*). Ratings of how well the topic was taught were also made on a 5-point scale that ranged from 1 (*was poorly taught*) to 5 (*was extremely well taught*). For each set of ratings, a 3×3 mixed model ANOVA was conducted with the topic associated with the rating as the within-subjects variable and the assigned jigsaw topic as the between-subjects variable. The results showed a significant interaction for students' ratings of how well they understood each topic and their assigned jigsaw topic, $F(4, 62) = 5.90$, $p < .001$. The interaction between students' ratings of how well they felt each topic was taught and their assigned jigsaw topic was not significant, $F(4, 60) = 0.98$, $p = .43$. Students reported understanding their assigned jigsaw topic better than those not assigned to that topic, but they did not rate themselves as better teachers than their peers (see Table 3 for means and standard deviations).

Discussion

The purpose of this research was to explore the impact of participating in the Jigsaw Classroom on individual learning. We hypothesized that teaching a topic to their peers would improve individual students' performance. Consistent with this prediction and the

Table 3
Means and Standard Deviations for Self-Reported Understanding of Topic and Ratings of How Well Each Topic was Taught by Assigned Jigsaw Topic

	Ratings of understanding of the topic				Ratings of how well the topic was taught			
Assigned jigsaw topic	Actor–observer	FAE	Self-serving	Average	Actor–observer	FAE	Self-serving	Average
Actor–observer effect	4.82 (0.40)	4.27 (1.19)	4.36 (1.21)	4.43	4.10 (0.57)	4.30 (0.82)	4.40 (0.70)	4.27
Fundamental attribution error	4.55 (0.69)	4.91 (0.30)	4.45 (0.93)	4.64	4.45 (0.69)	4.36 (0.67)	4.36 (0.67)	4.39
Self-serving bias	3.92 (0.90)	4.33 (0.65)	4.92 (0.29)	4.39	4.08 (0.67)	4.33 (0.65)	4.25 (0.62)	4.22
Average rating	4.41 (0.78)	4.50 (0.83)	4.59 (0.89)		4.21 (0.65)	4.33 (0.69)	4.33 (0.65)	

literature on peer tutoring, our results showed that participating in the Jigsaw Classroom served to increase students' confidence and mastery of their assigned jigsaw topic as evidenced by the fact that (a) when given the option, a majority of students (62.96%) preferred to write about their assigned jigsaw topic; (b) students asked to recall information about their assigned topic performed better than those not assigned to that topic both on quizzes that followed soon after the jigsaw activity as well as on exams that occurred at a delayed time; and (c) students self-reported understanding their topic better compared with those not assigned to that topic. Interestingly, no meaningful differences were found on (the relatively easier) recognition-based multiple-choice exam questions.

One possible explanation for why students show improved recall for their assigned jigsaw topic is that teaching (and preparing to teach) the material to others provides an opportunity for students to elaborate on the material (Annis, 1983). That is, to effectively teach their assigned topic to others, students are likely to follow the three-step theory of verbal learning. They must (a) pay attention to the material, (b) make the material personally relevant, and (c) relate the new material to material already stored in memory (Anderson, 1970). Research on cooperative learning has shown that students who benefited most from cooperative activities were those who provided elaborated explanations to others (Webb, 2008 as cited in Slavin, 2011).

The results of the present study may also help to reconcile the null results that are often found for the effects of the Jigsaw Classroom on academic performance. Our results suggest that teaching others about a topic, as part of the jigsaw activity, may boost performance on the assigned topic while compromising performance (at least in the short term) on the unassigned topics. This reasoning is consistent with the conjecture made by Slavin (2011) that because students in the Jigsaw Classroom have limited exposure to the unassigned material, the learning gains they experience for their assigned topic may be negated by the losses they experience on their groupmates' topics. However, one of the limitations of this study is that it was not possible to compare students who taught a topic versus learned a topic from a classmate with those who learned all three from a teacher. If possible, future research should randomly assign students within the same class to the Jigsaw Classroom format or to learn about all three topics from the teacher. If we take classroom instruction from a teacher as the baseline, this would allow us to more definitively conclude that teaching a topic as part of the Jigsaw Classroom does in fact produce gains and that learning unassigned topics from classmates produces deficits or if it is some combination of the two.

Assuming that students do experience a deficit in learning their unassigned topics, future research should also explore ways to buffer these effects. For example, one possible solution may be to use group rewards—either in lieu of or in addition to individual rewards (e.g., doing well on the individual quiz). Research on cooperative learning has shown that holding individuals accountable for their learning while providing a group reward tends to yield the biggest gains in performance (Slavin, 2011). This is the approach advocated in Jigsaw II. In

Jigsaw II, students read about all of the topics but are assigned to become an expert on one. Students take individual quizzes which are then used to create a team score. Teams that score above a certain threshold receive some sort of reward (e.g., certificates, extra credit, etc.).

Another suggestion for future research would be to dismantle the teaching role in the Jigsaw Classroom into its two component parts, preparation to become an expert and teaching the topic to others, to determine whether the relatively higher performance of students who taught a topic reflects a preparation effect, rather than an effect of teaching. This could be done by comparing the performance of students who participate in a full Jigsaw Classroom experience with those who are merely instructed to prepare to teach their topic. If the gains in performance come from preparing to teach, rather than actually teaching the topic, this could provide another avenue for addressing the potential deficits associated with learning a topic from peers.

Another limitation of this research was using final grade in the course as a covariate. Although this is a reasonable measure of ability, it is confounded by the material and the tests used in the class. Future research should use a more robust measure of academic performance as a covariate, such as students' grade point average (GPA). Including GPA in the data set would also allow researchers to determine if there were performance differences across the different sections.

In conclusion, despite the call for more widespread use of the Jigsaw Classroom to help improve race relations in higher education (Williams, 2004), to counter overt discrimination in classrooms (Wolfe & Spencer, 1996), and to increase active learning (Lom, 2012), the Jigsaw Classroom remains a relatively underutilized pedagogical approach in college classrooms. College instructors may be hesitant to adopt this technique for a variety of reasons, including the somewhat realistic fear that the extra effort may not yield overall benefits for student performance. Future research should explore how cooperative learning techniques, like the Jigsaw Classroom, can be implemented to ensure that college students will experience overall gains in learning.

References

Allport, G. W. (1979). *The nature of prejudice*. New York, NY: Basic Books.

Anderson, R. C. (1970). Control of student mediating processes during verbal learning and instruction. *Review of Educational Research, 40,* 349–369. http://dx.doi.org/10.3102/00346543040003349

Annis, L. F. (1983). The processes and effects of peer tutoring. *Human Learning: Journal of Practical Research & Applications, 2,* 39–47.

Aronson, E. (2002). Building empathy, compassion, and achievement in the jigsaw classroom. In J. Aronson (Ed.), *Improving academic achievement: Impact of psychological factors on education* (pp. 209–225). San Diego, CA: Academic Press. http://dx.doi.org/10.1016/B978-012064455-1/50013-0

Aronson, E. (2004). Reducing hostility and building compassion; Lessons from the jigsaw classroom (pp. 469–488). In A. G. Miller (Ed.), *The social psychology of good and evil*. New York, NY: Guilford Press.

Aronson, E., & Bridgeman, D. (1979). Jigsaw groups and the desegregated classroom: In pursuit of common goals. *Personality and Social Psychology Bulletin, 5,* 438–446. http://dx.doi.org/10.1177/014616727900500405

Aronson, E., & Osherow, N. (1980). Cooperation, prosocial behavior, and academic performance: Experiments in the desegregated classroom. *Applied Social Psychology Annual, 1,* 163–196.

Aronson, E., & Patnoe, S. (1997). *The jigsaw classroom* (2nd ed.). New York, NY: Longman.

Aronson, E., Wilson, T. D., & Akert, R. M. (2010). *Social psychology* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Bargh, J. A., & Schul, Y. (1980). On the cognitive benefits of teaching. *Journal of Educational Psychology, 72,* 593–604. http://dx.doi.org/10.1037/0022-0663.72.5.593

Bratt, C. (2008). The Jigsaw classroom under test: No effect on intergroup relations evident. *Journal of Community & Applied Social Psychology, 18,* 403–419. http://dx.doi.org/10.1002/casp.946

Colvin, J. W. (2007). Peer tutoring and social dynamics in higher education. *Mentoring & Tutoring, 15,* 165–181. http://dx.doi.org/10.1080/13611260601086345

Crone, T. S., & Portillo, M. C. (2013). Jigsaw variations and attitudes about learning and the self in cognitive psychology. *Teaching of Psychology, 40,* 246–251. http://dx.doi.org/10.1177/0098628313487451

Crouch, C., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *American Journal of Physics, 69,* 970–977. http://dx.doi.org/10.1119/1.1374249

Crouch, C., Watkins, J., Fagen, A., & Mazur, E. (2007). Peer instruction: Engaging students one-

on-one, all at once. *Research-Based Reform of University Physics, 1,* 1–55.

Darnon, C., Buchs, C., & Desbar, D. (2012). The jigsaw technique and self-efficacy of vocational training students: A practice report. *European Journal of Psychology of Education, 27,* 439–449. http://dx.doi.org/10.1007/s10212-011-0091-4

Devin-Sheehan, L., Feldman, R. S., & Allen, V. L. (1976). Research on children tutoring children: A critical review. *Review of Educational Research, 46,* 355–385. http://dx.doi.org/10.3102/00346543046003355

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *PNAS Proceedings of the National Academy of Sciences of the United States of America, 111,* 8410–8415. http://dx.doi.org/10.1073/pnas.1319030111

Hänze, M., & Berger, R. (2007). Cooperative learning, motivational effects, and student characteristics: An experimental study comparing cooperative learning and direct instruction in 12th grade physics classes. *Learning and Instruction, 17,* 29–41. http://dx.doi.org/10.1016/j.learninstruc.2006.11.004

Jones, E. E., & Harris, V. A. (1967). The attribution of attitudes. *Journal of Experimental Social Psychology, 3,* 1–24. http://dx.doi.org/10.1016/0022-1031(67)90034-0

Jones, T. N., Graham, K. J., & Schaller, C. P. (2012). A Jigsaw Classroom activity for learning IR analysis in organic chemistry. *Journal of Chemical Education, 89,* 1293–1294. http://dx.doi.org/10.1021/ed200334n

Le Boeuf, F. (1968). Qui docet discit—He who teaches, learns. *Science Teacher, 35,* 53–56.

Leland, C., & Fitzpatrick, R. (1993). Cross-age interaction builds enthusiasm for reading and writing. *The Reading Teacher, 47,* 292–301.

Levy, S. R., Elizabeth, J., Shin, A. L., & Rosenthal, L. (2017). Systemic approaches to reduce prejudice in schools. In E. C. Lopez, S. G. Nahari, G. B. Esquivel, & S. L. Proctor (Eds.), *Handbook of multicultural school psychology: An interdisciplinary perspective* (pp. 237–257). New York, NY: Routledge, Taylor & Francis Group.

Lom, B. (2012). Classroom activities: Simple strategies to incorporate student-centered activities within undergraduate science lectures. *The Journal of Undergraduate Neuroscience Education, 11,* A64–A71.

Molina, F. (2011, July). Conflict and cooperation: Teaching evolutionary biology using the Jigsaw Technique. *Proceedings of the EDULEARN11 Conference,* 2128–2133.

Paluck, E. L., & Green, D. P. (2009). Prejudice reduction: What works? A review and assessment of research and practice. *Annual Review of Psychology, 60,* 339–367. http://dx.doi.org/10.1146/annurev.psych.60.110707.163607

Perkins, D. V., & Saris, R. N. (2001). A "jigsaw classroom" technique for undergraduate statistics courses. *Teaching of Psychology, 28,* 111–113. http://dx.doi.org/10.1207/S15328023TOP2802_09

Saville, B., Pope, D., Truelove, J., & Williams, J. (2012). The relation between GPA and exam performance during interteaching and lecture. *The Behavior Analyst Today, 13,* 27–31. http://dx.doi.org/10.1037/h0100728

Saville, B. K., & Zinn, T. E. (2011). Interteaching. *New Directions for Teaching and Learning, 2011,* 53–61.

Saville, B. K., Zinn, T. E., Neef, N. A., Van Norman, R., & Ferreri, S. J. (2006). A comparison of interteaching and lecture in the college classroom. *Journal of Applied Behavior Analysis, 39,* 49–61. http://dx.doi.org/10.1901/jaba.2006.42-05

Sezek, F. (2012). Teaching cell division and genetics through jigsaw cooperative learning and individual learning. *Energy Education Science and Technology, Part B.* Social and Educational Studies, *4,* 1323–1336.

Slavin, R. E. (1983). When does cooperative learning increase student achievement? *Psychological Bulletin, 94,* 429–445. http://dx.doi.org/10.1037/0033-2909.94.3.429

Slavin, R. E. (2011). Instruction based on cooperative learning. In R. E. Mayer & P. Alexander (Eds.), *Handbook of research on learning and instruction* (pp. 344–360). London, UK: Routledge. http://dx.doi.org/10.4324/9780203839089.ch17

Taylor, D. W., Berry, P. C., & Block, C. H. (1958). Does group participation when using brainstorming facilitate or inhibit creative thinking? *Administrative Science Quarterly, 3,* 23–47. http://dx.doi.org/10.2307/2390603

Topping, K. J. (1996). The effectiveness of peer tutoring in further and higher education: A typology and review of the literature. *Higher Education, 32,* 321–345. http://dx.doi.org/10.1007/BF00138870

Walker, I., & Crogan, M. (1998). Academic performance, prejudice, and the jigsaw classroom: New pieces to the puzzle. *Journal of Community & Applied Social Psychology, 8,* 381–393. http://dx.doi.org/10.1002/(SICI)1099-1298(199811/12)8:6<381::AID-CASP457>3.0.CO;2-6

Williams, D. (2004). Improving race relations in higher education: The Jigsaw Classroom as a missing piece to the puzzle. *Urban Education, 39,* 316–344. http://dx.doi.org/10.1177/0042085904263063

Wolfe, C. T., & Spencer, S. J. (1996). Stereotypes and prejudice: Their overt and subtle influence in the classroom. *American Behavioral Scientist, 40,* 176–185. http://dx.doi.org/10.1177/0002764296040002008

Appendix

Structured Feedback Measure

For each statement, please circle the number that corresponds to the response that best reflects your opinion about the jigsaw classroom activity (1 = *strongly disagree*, 5 = *strongly agree*).

1. I enjoyed the jigsaw technique.
2. I would suggest that the instructor use the jigsaw technique in future semesters.
3. I wish more of my classes were in the jigsaw format.
4. The jigsaw class was a waste of time. (reversed)
5. I would recommend a class that is using the jigsaw format to a friend.
6. Overall, my classmates did a good job explaining class material during the jigsaw class.
7. I felt comfortable in class as a result of the jigsaw format.
8. I was more willing to participate in class as a result of the jigsaw format.
9. I wish this course had not included a class taught in the jigsaw format. (reversed)
10. I felt I got to know my classmates better as a result of the jigsaw class.

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