An Intervention Partially Alleviates the Attitude Decrease In a Statistics Course

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Attitudes towards statistics were measured at the beginning and end of a statistics course in which an intervention to raise attitudes was administered. Overall attitudes decreased, but the intervention increased confidence. Also, there were differences in attitude change between instructors, with one instructor increasing students' value for statistics.

Psychology majors typically find statistics to be a very difficult course and one toward which they have negative attitudes (Mallow et al., 2010). Among the many reasons for this could be that they lack motivation to learn statistics because they do not value statistical knowledge and skill and they do not have confidence in their ability to succeed (Sorge, 2001).

In their review of social-psychological interventions in education, Yeager and Walton (2011) present examples of seemingly small interventions that did not even target acquisition or retention of academic material, and yet have had large and lasting effects on academic achievement. They argue that such effects are neither “magic” nor unworthy of serious consideration. Rather, they claim, they work because they are rooted in well supported theories, such as value and expectancy theory (Wigfield & Eccles, 2000).

I created an intervention designed to raise students' belief in both the value of statistics and their ability to do the required calculations. I administered the intervention between a pretest and posttest of attitudes towards statistics. The pretest and posttest were the Survey of Attitudes Towards Statistics (SATS-36 © Candace Schau) (Schau, 2003). I also collected the students' overall course grades as a measure of success in the course.

Method

Participants

It was originally intended that students from eight sections of an Introductory Statistics for the Behavioral Sciences course would participate. Four instructors taught two sections each. Due to problems described below, actually there were 84 students who provided both pretest and posttest data. The students were offered a small amount of extra credit in their statistics course for participating. They were allowed to earn the extra credit either by participating, or by doing an alternative activity. The alternative activity was to engage in the same activities as those who agreed to participate (the activities were no different from usual class activities), but to not provide any responses as data.

Materials and Procedure

In both the pretest and the posttest, students responded to 36 items about attitudes towards statistics on a 7 point Likert scale of agreement. They also answered several demographic questions such as their age, gender, and citizenship. They also answered questions

about their educational background, particularly in mathematics, the circumstances under which they were taking their statistics course and their reason for taking it, and their expected grade.

The planned procedure was to randomly assign one of each of the instructors' sections to an experimental condition and the other to a control condition. In both conditions there were to be six short activities spaced across the semester. For the experimental condition, the activities were to be three value raising and three confidence raising activities. The value raising activities were to be short entertaining videos illustrating interesting uses of statistics. The confidence raising activities were to be short math lessons on problems on which students typically fail, but for which they could be shown a procedure that would enable them to easily solve a previously confusing problem. For the control condition, there were to be three videos illustrating the history of statistics and three activities involving practicing the normal calculations used in the course.

Due to practical limitations, the pretest and posttest were only administered to five sections taught by three instructors. Also, only one instructor's students received both conditions, and not all of the activities were presented. Nevertheless, I was able to use just that instructor's data to produce the following findings.

Results

Experimental vs. Control Subjects

For one instructor, Instructor B, one of the classes received the experimental condition and the other received the control condition. Therefore, for that instructor, I was able to examine the effect of the intervention.

Achievement. The experimental students' grades (M = 90.33, SD = 7.43, N = 15) were slightly, but not significantly, higher than those of the control students (M = 88.33, SD = 9.00, N = 15), t (28) = .66, p > .05.

Overall attitudes. Overall pretest and posttest attitude scores were computed by averaging the 1 to 7 ratings across all the items on each test. An ANOVA was conducted on the overall attitude scores with time (pretest vs. posttest) as a within subjects variable and condition as a between subjects variable. Attitudes decreased significantly from pretest (M = 4.31) to posttest (M = 4.20), F (1, 29) = 6.97, p = .013, MSE = .026, η^2 = .19. There was no main effect of condition and no interaction ($F's$ < 1).

Components of attitude. A factor analysis of the attitude measure produced four components that were named Confidence, Value, Diligence, and Interest. An ANOVA was conducted on the scores for each of the components with time (pretest vs. posttest) as a within subjects variable and condition as a between subjects variable.

Confidence component. As shown in Figure 1, there was a significant time by condition interaction, F (1, 27) = 5.26, p = .030, MSE = .234, η^2 = .16. A pairwise simple effects test for only the experimental students showed that their Confidence increased significantly from pretest to posttest, F (1, 27) = 7.35, p = .012. On the other hand, the pairwise simple effects test for only the control students showed that their Confidence decreased slightly, although not significantly, from pretest to posttest, F < 1.

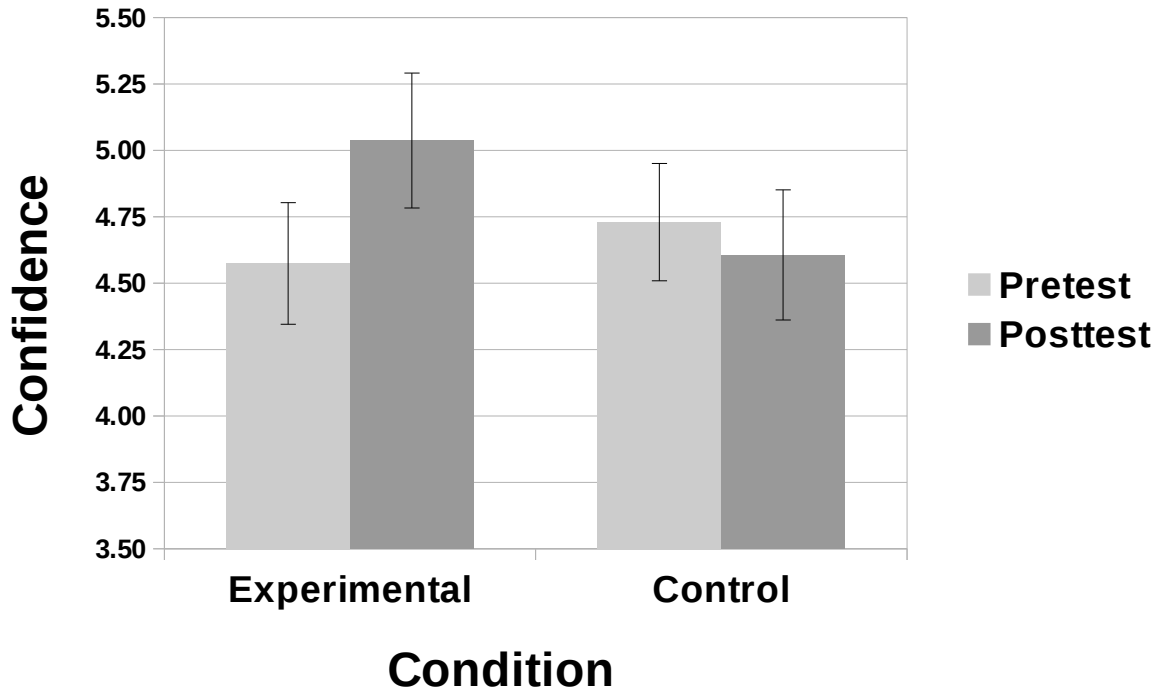

Figure 1. Mean Confidence on the pretest and posttest as a function of condition for Instructor B.

Value component. There was a marginally significant decrease in Value from pretest (M = 4.49) to posttest (M = 4.28), F (1, 29) = 3.57, p = .069, MSE = .190, η^2 = .11. However there was no main effect of condition F (1, 29) = 1.21, p = .281, or interaction, F < 1.

Diligence component. There was a significant decrease in Diligence from pretest (M = 6.54) to posttest (M = 5.91), F (1, 29) = 11.37, p = .002, MSE = .537, η^2 = .28. However there was no main effect of condition or interaction, $F's$ < 1.

Interest component. There were no main effects of time of test or condition, nor an interaction effect on the Interest component, $F's$ < 1.

Control Subjects Only

All three of the instructors' students received the control condition. Therefore, it was possible to examine attitude change for each component of attitude among control condition students across the three instructors. An ANOVA was conducted on the scores for each of the components with time (pretest vs. posttest) as a within subjects variable and instructor as a between subjects variable.

Confidence component. As shown in Figure 2, there was a marginally significant interaction in which Instructor A's students experienced an increase in confidence, whereas the other two instructor's students experienced a decrease, F (2, 35) = 2.66, p = .084, MSE = .254, η^2 = .13. There was no main effect of time or instructor, F's < 1.

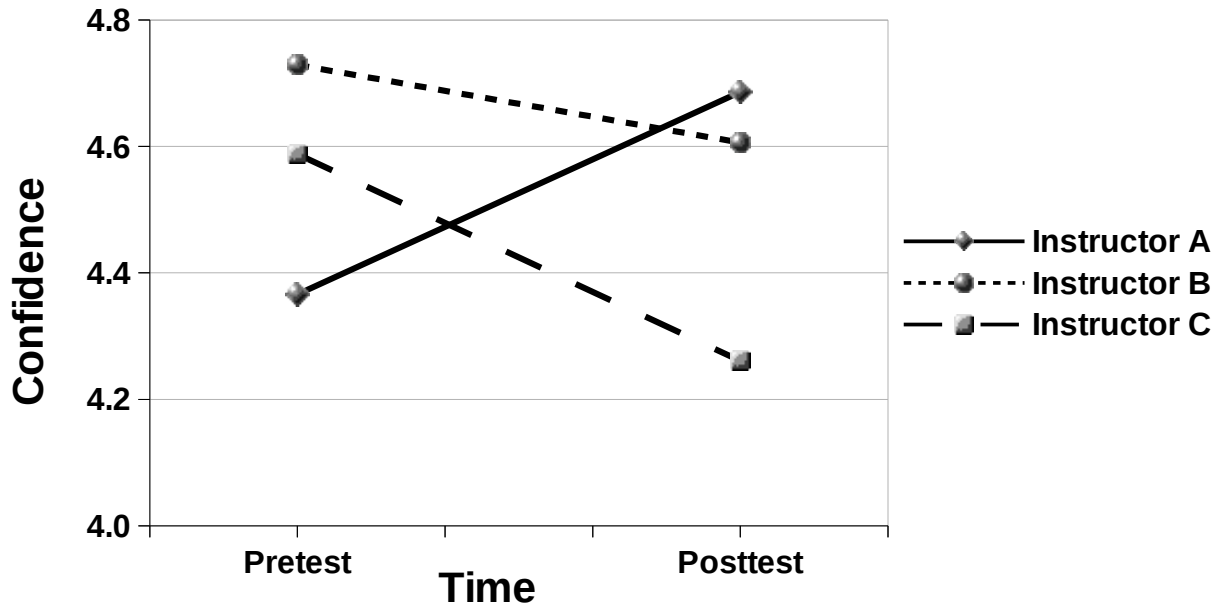

Figure 2. Mean Confidence on the pretest and posttest as a function of instructor for control students only.

Value component. As shown in Figure 3, there was a significant interaction in which Instructor A's students experienced an increase in Value, whereas the other two instructor's students experienced a decrease, F (2, 37) = 4.11, p = .024, MSE = .290, η^2 = .18. There was no main effect of time or instructor, $F's$ < 1.

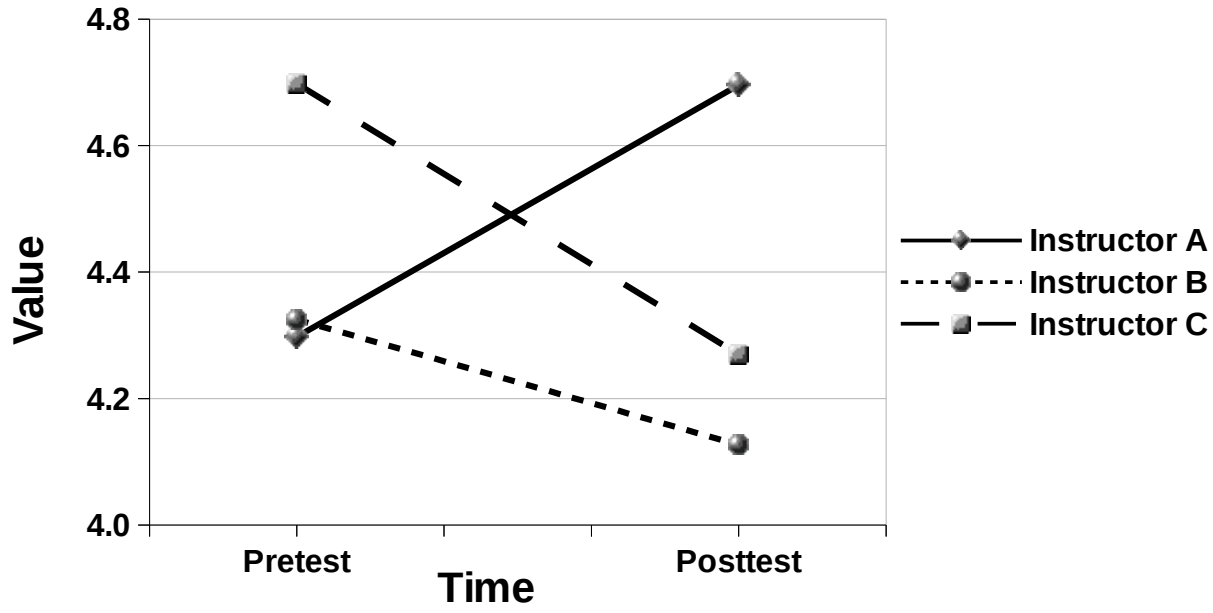

Figure 3. Mean Value on the pretest and posttest as a function of instructor for control students only.

Diligence component. There was a significant decrease in Diligence from pretest (M = 6.73) to posttest (M = 6.04), F (1, 38) = 18.75, p < .001, MSE = .426, η^2 = .33. There was no main effect of time or instructor, $F's$ < 1.

Interest component. There was a significant decrease in Interest from pretest (M = 4.35) to posttest (M = 3.90), F (1, 37) = 4.85, p < .034, MSE = .698, η^2 = .12. There was no main effect of time, F < 1, or interaction, F (2, 37) = 1.90, p = .164, MSE = .698, η^2 = .09.

Discussion

There was no evidence that the intervention increased overall achievement in statistics. However, for the one instructor for whom it was possible to measure the effect of the intervention, even though, overall, attitudes decreased from the beginning to the end of the course, there was a positive effect of the intervention on students' Confidence.

Also, although for the three instructors whose students received at least the control condition, there was an overall decrease in attitude, one of those instructor's students experienced an increase in their value for statistics and a marginal increase in their confidence.

Even with its severe limitations, this study showed that much more needs to be done to prevent students' attitudes toward statistics from being made worse by their experience with the course. Although at least one instructor was able to increase Confidence and Value even without the manipulation, and the manipulation did increase confidence for the one instructor for whom it could be measured, the overall results suggest that decreases in attitude toward the course over the semester could at least partially account for the generally poorer performance usually seen in statistics courses compared to other courses in the psychology major. The study suggests some promise for our intended experimental manipulation, which even in its abbreviated form, at least increased students' confidence. Also, it suggests that instructor differences should be examined further.

It should be noted that the Diligence measure was obtained by asking questions on the pretest about how much effort the students predicted that they would put forth, and then asking them on the posttest how much effort they actually put into the course. Thus, the decrease in that measure may have actually reflected that students are not good predictors of how much they will apply themselves.

Finally, although, as noted above, this study suggests that working on improving students attitudes may improve their achievement, the lack of effect of our manipulation on grades is consistent with studies showing that prior preparation is the strongest predictor of achievement in statistics (Hood, Creed, & Neumann, 2012).

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