

*EFFECTS OF THE CONTINGENCY FOR HOMEWORK
SUBMISSION ON HOMEWORK SUBMISSION AND
QUIZ PERFORMANCE IN A COLLEGE COURSE*

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Effects of the contingency for submission of homework assignments on the probability of assignment submission and on quiz grades were assessed in an undergraduate psychology course. Under an alternating treatments design, each student was assigned to a points condition for 5 of 10 quiz-related homework assignments corresponding to textbook chapters. Points were available for homework submission under this condition; points were not available under the no-points condition. The group-mean percentage of homework assignments submitted and quiz grades were higher for all chapters under the points condition than in the no-points condition. These findings, which were replicated in Experiment 2, demonstrate that homework submission was not maintained when the only consequences were instructor-provided feedback and expectation of improved quiz performance.

DESCRIPTORS: college, homework, quiz grades, teaching behavior analysis

It is common wisdom that completion of homework assignments related to course work facilitates learning of the assigned material; however, the results of large-scale studies on the effects of homework are decidedly mixed (for a review, see Cooper, Lindsay, Nye, & Greathouse, 1998). The methodological challenges posed in conducting educational research are great (Cooper & Valentine, 2001; Trautwein, Köller, Schmitz, & Baumert, 2002); nonetheless, at least three studies suggesting positive effects of homework on achievement are notable for their methodological rigor. Trautwein et al. used statistical procedures and careful selection of outcome and predictor

variables to enhance internal validity in a correlational design. Harris and Sherman (1974) and Olympia, Sheridan, Jenson, and Andrews (1994) used within-subject reversal designs to manipulate homework procedures in elementary school classrooms. Harris and Sherman demonstrated that rate of in-class performance on mathematics problems and social studies questions was higher when consequences were provided for accurate completion of homework assignments. The data of Olympia et al. suggest that the number of mathematics problems completed accurately during in-class probe tests was systematically related to presence of a student-managed procedure to improve homework completion and accuracy. Although within-subject designs were used in the latter two studies, experimental effects on academic performance were evaluated using a statistical-inferential approach applied to group-mean data.

The present study is similar to that of Olympia et al. (1994) in that the primary target response was completion of homework assignments. Individual college students enrolled in an advanced undergraduate course in psychology were exposed to two levels of a contingency for submission of homework

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assignments under an alternating treatments design. The effect of the manipulation could be observed on probability of homework submission and on subsequent performance on a related quiz. Unlike prior studies, the effects of a contingency for homework completion on quiz performance were analyzed for individual participants. Experimental effects were also evaluated for group-mean performance. The within-subject design addressed the ethical dilemma associated with assignment of some students to a condition potentially associated with a reduced opportunity to learn (Haggas & Hantula, 2002). In the current study, each student was exposed to each level of the independent variable equally often. Furthermore, even when students were not required to submit homework assignments, they were encouraged to do so to improve their quiz performance. Feedback was provided for all submitted assignments.

Only two prior studies on the effects of homework assignments for college-level teaching were located (Fleming, 2002; Gurung, 2003), and both relied on self-reported measures. In addition to problems of accuracy (Trautwein & Köller, 2003), such measures are vulnerable to potentially confounding variables, such as demand characteristics (Orne, 1962) when research participants are concerned about their course grades. In the present study, this problem was handled by requiring students to submit their completed homework assignments, thereby providing a direct measure of procedural reliability.

The contingency for homework submission was manipulated in Experiment 1 and was replicated in Experiment 2. The design permitted us to determine whether instructor-provided feedback and the expectation of improved quiz grades were sufficient to maintain homework submission. To the extent that they were not, we were also able to measure indirectly the effect of homework submission on quiz grades.

EXPERIMENT 1

METHOD

Participants, Setting, and Materials

Nineteen college students (17 women and 2 men, aged 19 to 47 years old) participated during the Spring 2002 semester. All were psychology majors registered for an undergraduate advanced research course in learning for which statistics and experimental psychology courses were prerequisites. All enrolled students participated, and none dropped out of the course during the semester. The course met for three 110-min meetings per week. The study was conducted at an urban commuter college campus.

The textbook used for the course was Domjan's *The Principles of Learning and Behavior* (1998). Chapter homework assignments and quizzes were based on the textbook and were written by the first author of this study, who was the course instructor. Homework assignments were comprised of two to four essay questions requesting students to provide such information as definitions, terms, descriptions of empirical phenomena, and experimental evidence to support conclusions. Each 10-item quiz included completion, definition, and true-and-false questions. Points were assigned for each quiz item based on the complexity of the item; points per item ranged from 0.5 to 2.0; total number of points available for each quiz was 10. Quiz questions corresponded to the content of the homework; however, wording and format of the items differed to some extent from that of the homework assignments.

Procedure

Required reading for the course included chapters from Domjan's (1998) textbook. For each chapter, students were presented with a written homework assignment designed to prepare them to take a chapter-related quiz. Students were provided with individual printed schedules indicating those chapter assignments

for which they could earn 5 points for correct homework completion. Earned points contributed to the final course grade according to a schedule printed in the course syllabus; the maximum number of points that a student could earn based on all course requirements, including quizzes, exams, and research papers, was 510. Students were encouraged to complete all of the assignments, regardless of whether they could earn points for doing so, and were told that they would receive written feedback for all assignments completed. They were also informed that the homework assignments would assist them in preparing for quizzes.

The experimental design incorporated the assignments associated with 10 textbook chapters (chap. 2 through 11). For each student, points were available for 5 of the 10 chapters, according to an alternating treatments design. The chapters for which points were available (the points condition) were randomly assigned individually for each student, using a table of random numbers. For pairs of consecutive chapters, each student was randomly assigned to the points condition for one chapter and to the no-points condition for the other chapter. The same procedure was followed for the next two chapters, and so on for the remaining chapters. In addition to conforming to an alternating treatments design for individual participants, this procedure resulted in a random-blocks-of-two group design in which, for each chapter, 50% of the students were assigned to the points condition and 50% were assigned to the no-points condition.

The instructor presented feedback on homework assignments during the class session following assignment submission. Feedback written on students' assignments included affirmative comments based on correct information and corrective comments specifying incorrect or missing information for each homework item. If corrective feedback was presented, students under the points condition were required to correct and resubmit the

homework assignment to receive the 5 points available for the assignment (partial credit was not allotted). In all instances, students who were required to do so submitted acceptable revisions.

Scoring and Interrater Agreement

All quizzes and homework assignments were objectively scored by the first author and by a second independent grader. The graders independently scored every quiz and homework assignment using a standardized answer key. Subtracting the higher score from the lower score and dividing by 100% to obtain a percentage was used to calculate level of agreement. The agreement between graders never deviated from 100%.

Student Satisfaction Questionnaire

The instructor administered a 13-item student satisfaction questionnaire to the students, with two items pertaining to the homework assignment procedure. Students were asked to indicate whether the procedure was the same or different from other psychology courses (stating *same* or *different*), and whether they preferred the current procedure (indicating *preferred*, *no preference*, or *not preferred*). The questionnaire was administered twice during each semester; the first presentation was after Quiz 5 and the second presentation was after Quiz 10. Questionnaires were submitted anonymously.

RESULTS AND DISCUSSION

Figure 1 (Panels A and C) illustrate group-mean performance for individual chapters in the points and no-points conditions. Mean percentage of homework assignments submitted (Panel A) was higher for all chapters in the points condition and declined sharply across chapters in the no-points condition to near-zero levels. Mean quiz grades across participants (Panel C) are reported as the percentage of available points earned. Quiz performance was higher in the points condition than in the no-points condition for 10 of the 10 chapters for

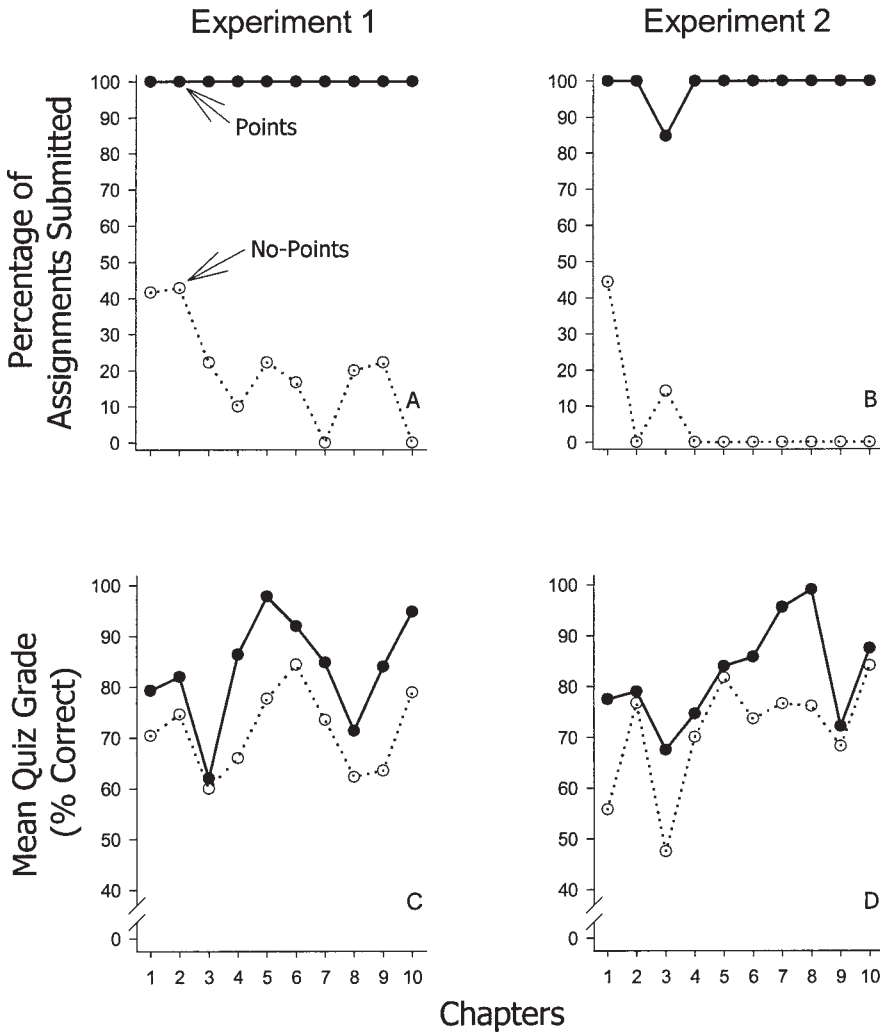


Figure 1. Group-mean data for Experiments 1 (left) and 2 (right). Panels A and B show the percentage of students who submitted homework assignments as a function of chapters in the no-points and points conditions; Panels C and D show mean quiz grades (percentage correct) across chapters in the no-points and points conditions.

which the experimental manipulation was in effect. Dependent samples t tests applied to the group data showed that the percentage of homework assignments submitted was significantly higher in the points condition ($M = 100\%$, $SD = 0$) than in the no-points condition ($M = 24\%$, $SD = 0.21$); $t(18) = 13.8$, $p < .001$. In addition, quiz scores were significantly higher in the points condition ($M = 82\%$, $SD = 0.87$) than in the no-points condition ($M = 72\%$, $SD = 0.86$); $t(18) = 1.6$, $p = .008$.

Effect size of the independent variable was obtained for the two dependent variables using the formula described by Ramsey and Ramsey (1994). Effect sizes for homework completion and quiz grades were .91 (large effect) and .13 (medium-to-large effect), respectively.

Figure 2 presents quiz grades as a function of chapter and condition for each of the 19 students. Level of experimental control for individual participants was variable; however, it was clearly present for some. Level of experimental

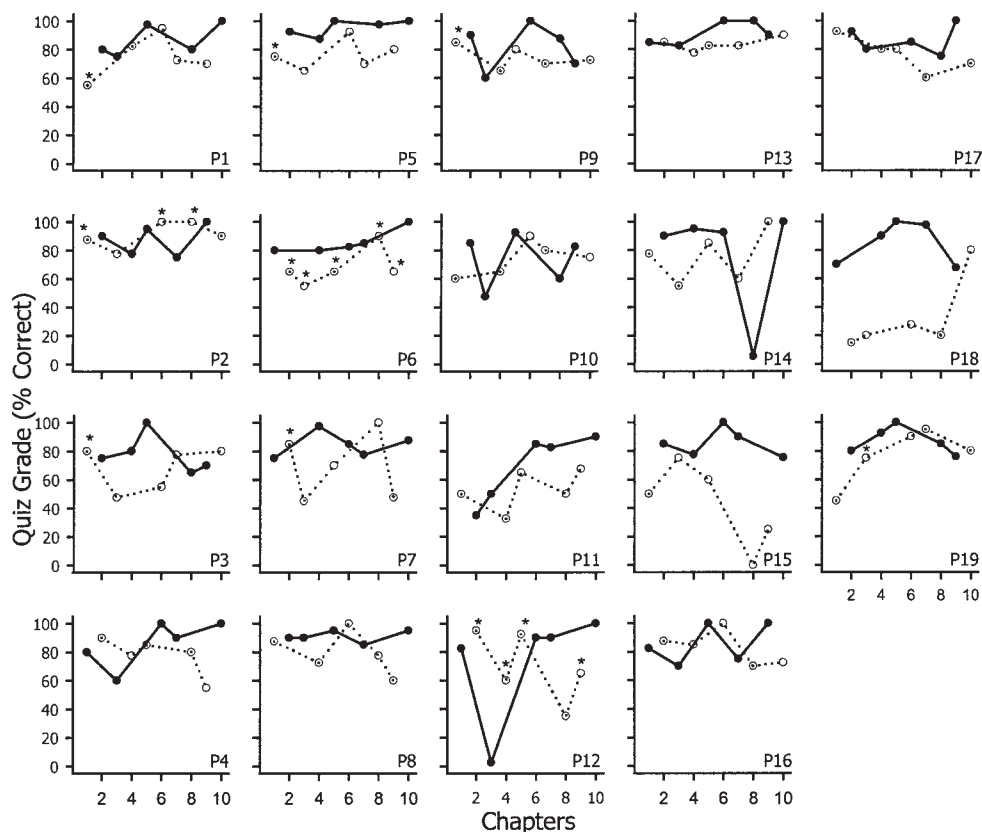


Figure 2. Quiz grades (percentage correct) as a function of chapters in the no-points and points conditions for individual participants in Experiment 1. Asterisks above data points for the no-points condition (open circles) indicate chapters for which an assignment was submitted. Note that for the points condition, all students submitted all assignments.

control was assessed for each participant by determining the number of values in the points condition that were lower than the median quiz grade for the no-points condition. Similarly, the number of values in the no-points condition that were higher than the median quiz grade for the points condition was also determined. The sum of these two determinations is referred to as *number of overlapping values*. There were no overlapping values for Participants 5 and 15; one overlapping value for Participants 4, 6, 7, 8, 11, 13, and 18; and two overlapping values for Participants 1, 14, and 17. The remaining 7 participants produced three to six overlapping values.

Asterisks above data points for the no-points condition indicate chapters for which an

assignment was submitted. Note that for the points condition, all assignments were submitted by all participants. It can be seen that 10 of the 19 participants submitted no homework assignments in the no-points condition, and only 4 submitted any assignments for chapters 2 through 10. Because the frequency of homework submission was low, it is difficult to evaluate the relation between this variable and quiz performance. Nonetheless, an independent samples *t* test was conducted for the no-points condition of chapter 1, for which 5 of the 11 participants submitted homework ($M = 76\%$; $n = 5$) was higher than for those who did not ($M = 69\%$; $n = 6$);

however, this difference was not statistically significant, $t(9) = 0.745$; $p = .475$.

As an indication of the social validity of the procedures used in this study, all responses to the two student satisfaction questions showed that (a) all students recognized that the homework assignment procedure used in the current course differed from procedures used in other psychology courses, and (b) they all preferred the current procedure.

EXPERIMENT 2

To investigate the robustness of the findings of Experiment 1, Experiment 2 was conducted as a direct replication.

METHOD

Experiment 2 was conducted during the Fall 2002 semester. Seventeen college students (15 women and 2 men, aged 19 to 45 years old) participated. All were psychology majors registered for the same undergraduate course that was studied in Experiment 1. All enrolled students participated, and all completed the course. With the following exceptions, the setting, procedure, and experimental design were the same as those of Experiment 1. In contrast to Experiment 1, in which there were three 110-min meetings per week, in Experiment 2 the course met twice per week for 165 min per meeting. Owing to this difference in meeting schedule, two rather than three class

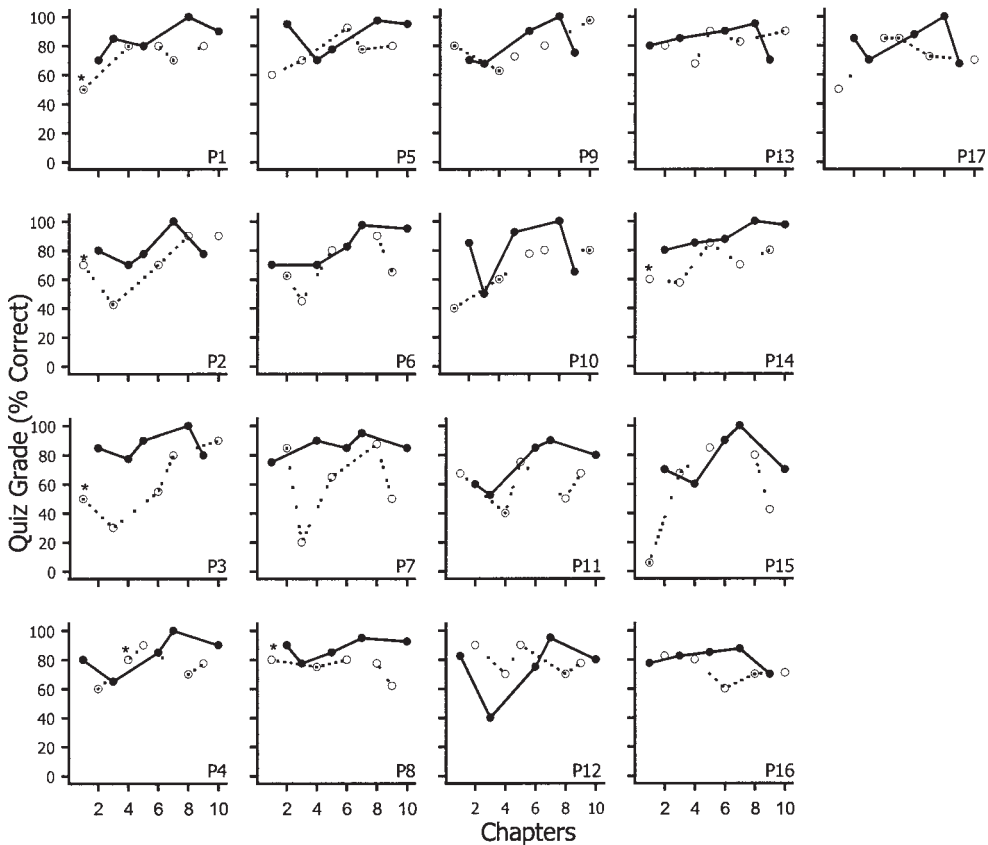


Figure 3. Quiz grades (percentage correct) as a function of chapters in the no-points and points conditions for individual participants in Experiment 2. Asterisks above data points for the no-points condition (open circles) indicate chapters for which an assignment was submitted. Note that for the points condition, all students submitted all assignments.

meetings were devoted to individual chapters in Experiment 2.

RESULTS AND DISCUSSION

The results replicated those of Experiment 1. Group-mean data for individual chapters in the points and no-points conditions are presented in Figure 1 (Panels B and D). Percentage of homework assignments submitted (Panel B) was higher for all chapters in the points condition; in the no-points condition it abruptly declined after the second chapter to zero levels. In comparison to Experiment 1, rate of homework submission in the no-points condition was low after chapter 1. This interexperiment difference is attributable to the number of participants who reliably submitted homework after chapter 1 (2 in Experiment 1 and none in Experiment 2; see Figures 2 and 3). Mean quiz grades (Panel D) were also higher for all chapters in the points condition than in the no-points condition. Data on this measure are very similar to those of Experiment 1. Statistical analyses revealed significant effects of the points contingency for both measures. Group-mean percentage of homework assignments submitted was significantly higher in the points condition ($M = 98\%$, $SD = 0.05$) than in the no-points condition (17%); $t(16) = 17.25$, $p < .001$. Mean quiz scores were also significantly higher in the points condition ($M = 82\%$, $SD = 1.01$) than in the no-points condition ($M = 72\%$, $SD = 1.03$); $t(16) = 3.49$, $p = .007$. The effect sizes for homework completion and quiz grades were .07 (medium effect) and .3 (large effect), respectively (Ramsey & Ramsey, 1994).

Quiz performance as a function of chapter and condition is shown in Figure 3 for the 17 participants. Based on a criterion of two or fewer overlapping values (as defined for Experiment 1), evidence for experimental control was present for Participants 8 and 14 (no overlapping values); for Participants 2, 3, 5, 6, 7, and 16 (one overlapping value); and for Participants 1, 4, 11, and 17 (two overlapping

values). The remaining 4 participants produced three to seven overlapping values. Asterisks above data points for the no-points condition indicate chapters for which an assignment was submitted. Eleven of the 17 participants submitted no assignments in the no-points condition, and only 1 submitted an assignment after chapter 1. For chapter 1, the mean quiz grade for those who submitted homework in the no-points condition ($M = 62\%$; $n = 5$) was not significantly different from the mean grade of those who did not ($M = 50\%$; $n = 6$); $t(9) = 0.893$; $p = .395$ (independent samples t test).

As in Experiment 1, student satisfaction scores showed that in all cases, participants distinguished between the procedures used in the current course and in other psychology courses, and, compared to the procedures of other psychology courses, the current method was preferred by all participants.

GENERAL DISCUSSION

Two experiments with college students showed that delivery of points contingent on homework assignment submission increased the percentage of assignments submitted in comparison to a no-points condition. In addition, higher quiz grades were produced when the students were exposed to the points versus the no-points condition. In both experiments, the magnitude of the latter difference was about 10% (averaged across participants and chapters), amounting to a full letter grade—a socially significant effect. Experimental control over quiz performance by the points contingency was clearly demonstrated by the group-mean data, and to a lesser extent by data from individual participants. The intersubject variability in the latter analysis notwithstanding, the present study is the first to contribute data from individual participants on the relation between academic performance and a contingency for homework submission. For approximately 69% of the participants in Experiments 1 and 2,

there was a systematic relation between these variables. Failure to demonstrate experimental control for the remaining participants may be attributable to factors that have been shown to moderate the relation between homework and achievement, such as prior knowledge and aptitude (Trautwein et al., 2002), and student attitudes about homework (Cooper et al., 1998). Intersubject variability is consistent with the conclusions of Trautwein and Köller (2003), whose literature review revealed that, at the individual level, the relation between homework and achievement is not well understood.

Because participants almost always submitted homework assignments in the points condition (100% submission in 19 of 20 observations across experiments) but did so infrequently in the no-points condition, it is plausible that completion of homework improved quiz performance. Quiz grades were higher for participants who submitted homework in the no-points condition for chapter 1; however, this difference was not statistically significant in either experiment. In addition, causality cannot be asserted based on this quasiexperimental comparison. Nonetheless, the systematic variation of quiz grades with level of the contingency for homework submission indicates that the variable or variables that mediate quiz performance are associated in some way with the independent variable.

An interesting, although perhaps not surprising, finding is that homework submission was not maintained by the availability of instructor-provided feedback and the expectation of improved quiz grades. This was true despite the fact that all students indicated preference for the requirements of this course over those of other courses. These data therefore encourage the common practice of requiring college students to do homework. A more general implication of this study relates to implementation of behavior-analytic principles and procedures in mainstream education where their impact has been

limited (e.g., Deitz, 1994; Hall, 1991; Maheady, Harper, Karnes, & Mallette, 1999). The present experimental design can be incorporated into the structure of a college (or secondary school) course and is relatively easy for the researcher (instructor) to implement. The independent and dependent variables involve measures that instructors routinely collect (homework and quiz performance), thereby facilitating analysis at the individual level and determination of procedural reliability. The within-subject manipulation avoids the ethical and internal validity problems noted above, and provides greater statistical power than a strictly between-groups design.

A limitation of the present study is our use of a dichotomous measure of homework behavior, a choice that may have limited the sensitivity of our analyses of the relation between homework and quiz performance. A continuous measure could be obtained by presenting homework in a computer-based fluency-building format (McDade & Goggans, 1993), for example. This format would yield measures of the amount of time engaged in homework, the amount of homework completed, and fluency (rate and accuracy of responding to homework items). These measures would distinguish between time spent on homework versus time needed to learn (Trautwein & Köller, 2003), variables that are likely to account for some of the intersubject variability in the effects of homework on achievement.

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STUDY QUESTIONS

1. Briefly describe the procedure for scheduling points for homework completion.
2. What procedures were used by the experimenters to ensure that homework assignments were completed correctly?
3. Summarize the results with respect to the influence of points on homework completion. What was the relation between homework completion and quiz performance?
4. Briefly describe the method used to evaluate experimental control for individual participants.
5. Why was it difficult to evaluate the relation between homework submission and quiz performance under the no-points condition?
6. What do the results of this study suggest about the effect of feedback per se on homework submission?
7. Not all of the participants' data showed a relation between the point contingency and homework completion. To what did the authors attribute these results, and why might their account be problematic?

8. Comment on the authors' statement that participants' responses to the questionnaire supported the practice of giving homework assignments in college classes.

Questions prepared by Sarah E. Bloom and Carrie M. Dempsey, University of Florida