TOPICAL ARTICLES

The Challenge to Cumulative Learning: Do Introductory Courses Actually Benefit Advanced Students?

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Previous research has questioned the educational value of taking introductory courses in psychology. Study 1 confirmed the usual null to negative associations between taking introductory psychology and performance in a subsequent psychology course. Study 2 showed that, after controlling for IQ, there was actually a positive association between taking introductory psychology and performance on a psychology knowledge pretest, which, in turn, was positively associated with course performance. Partial correlation analyses suggested that the apparent disadvantages of introductory psychology are an artifact of self-selection. Specifically, although taking introductory psychology provides beneficial knowledge, having chosen to take the course may indicate a maladaptive scholastic style—possibly antiscientific mindedness. We recommend advertising psychology courses more properly as science-oriented to avoid misleading potential students.

Teachers, leave them kids alone!

—Pink Floyd,
Another Brick In The Wall,
Pt. 2 (Waters, 1979)

Standard pedagogy holds that the learning curriculum is cumulative. Introductory courses should provide building blocks for more advanced courses in the same subject. These building blocks include basic facts, familiarization with terminology, and a framework for thinking in a particular subject area, for example, psychology. Together these benefits supposedly facilitate acquisition of further knowledge. Consistent with these assumptions, the majority of psychology and educational psychology departments require a general introductory course as a prerequisite for more advanced courses.

Researchers have studied the mechanisms whereby prior knowledge facilitates learning in some detail (e.g., Alexander & Judy, 1988; Dochy, 1992). Some of these researchers have argued that domain-specific knowledge contributes more to academic performance than do general thinking skills (e.g., Glaser, 1984; Sternberg, 1988). Research showing that prior knowledge in an area is correlated positively with performance in a subsequent course in that area (Schutz, Drogosz, White, & DiStefano, 1998; Thompson & Zamboanga, in press) is consistent with such claims.

Paradoxically, the empirical literature on psychology courses does not support the value of taking a prior course toward performance in subsequent courses. Several studies have shown that students taking a prior course do no better (or worse) than those who have no previous course (Carstens & Beck, 1986; Federici & Schuerger, 1976; Griggs & Jackson, 1988; cf. Hedges & Thomas, 1980).

The notion that introductory courses provide no benefit struck us as so odd that we decided to conduct research on the topic. Such a pessimistic conclusion cannot fairly be drawn from the earlier studies. For one thing, the earlier research was based on the comparative performance of college students who did or did not take a previous course in psychology. As with most real-world research, this lack of random assignment to conditions raises interpretational ambiguity. We cannot tell from the extant research how well students randomly assigned to take or not take an introductory course would perform in a subsequent course. Put differently, the influence of self-selection is unknown. In addition, the fact that students took the previous psychology course in high school may explain the lack of subsequent value (Carstens & Beck, 1986; Federici & Schuerger, 1976; Griggs & Jackson, 1988; Griggs, Jackson, & Meyer, 1989). The difference in course content between high school and university psychology courses may be too dramatic. To date, there are no published studies on the influence of college-level psychology courses on subsequent psychology courses.

We set out to remedy these problems by conducting two studies on a total of 326 students. We were fortunate to have access to data from several second-year psychology courses where a large fraction of the students had not taken an introductory course because it was not a prerequisite. In Study 1, we examined data from two classes to determine the relation between taking an introductory psychology course and performance in the current course. The follow-up, Study 2, also included an IQ test and a pretest of psychology knowledge collected at the beginning of the term. Thus, we could follow the accumulation of knowledge from raw cognitive ability through the choice of an introductory psychology course through to the pretest performance and, finally, to exam performance in the later course.

Study 1

In Study 1, we examined the association between taking an introductory psychology course and course performance in a second-year psychology course. In two second-year courses, we collected data on prior courses taken and overall performance in the current course.

Given that the two courses were both college level and even within the same institution, we had greater reason to be more optimistic about knowledge transfer. Therefore, we hypothesized a positive association between taking the prior course and performance in the second-year course.

Method

Participants

Participants were students enrolled in two sections (N = 114, 60) of a second-year undergraduate psychology course (Introduction to Personality and Social Psychology) at a large northwestern university. The classes were 68% and 65% women, respectively. In the first class, 40% had taken an introductory course whereas, in the smaller class, 51% had taken an introductory course.

Procedure

Early in both courses, the course instructor requested biographical information, including what prior psychology courses students had taken. The courses included a midterm exam and a final exam.

Results and Discussion

We created a dichotomous variable, Intro Taken, to differentiate those who had taken introductory psychology (1) from those who had not (0). Scores on the midterm exam and final exam each served as dependent variables. In the first class, there was a significant negative association between Intro Taken and final exam score, $r(58) = -.29$, $p < .05$, two-tailed, and marginally significant with the midterm score, $r(58) = -.22$, $p < .10$. In the second class, both correlations were negative (–.05, and –.14), although neither reached significance. Combining both sections produced similar results: $r(174) = -.10$, $p = ns$, for the midterm, and $r(174) = -.18$, $p < .05$, for the final exam.

Our hypothesis was clearly rejected. None of the correlations were even positive, let alone significantly positive. Instead, our results supported earlier studies that challenged the assumed benefits of taking a prior course, even if both were within the same college curriculum. Given that our only significant result was negative, the outcome appeared even worse than in previous research. Having taken an introductory psychology course may have actually been detrimental for success in a subsequent psychology course!

Two bodies of research cast doubt on this "negative learning" conclusion from Study 1. First, prior research has demonstrated that there is knowledge transfer from an introductory psychology course to a subsequent psychology course (Hedges & Thomas, 1980). Second, level of prior knowledge is positively associated with subsequent course performance (Dochy, 1992; Thompson & Zamboanga, in press). A reconciliation of these more optimistic findings with the pessimistic findings of Study 1 would require a similar study where the role of prior knowledge is determined. Therefore we conducted a second, more complex study that included a pretest measure of psychology knowledge and an IQ test.

Study 2

The key to understanding the paradox of negative learning lies in tracking the flow of knowledge from prior levels of cognitive ability through the introductory course and on to final performance in the later course. This goal requires the addition of two variables to those collected in Study 1: (a) a measure of general cognitive ability and (b) a measure of knowledge taken after the introductory course but before the subsequent course. It is no surprise that students' cognitive ability is confounded with most educational variables including those under consideration here (Brody, 1997; Lavin, 1965). To permit statistical control of this confound, we administered a standard IQ test. Note that we assume the effects of cognitive ability to have been at work before any of the other variables measured here and, therefore, stand first in the causal chain. The second added variable, a measure of prior knowledge, is required to determine (a) the residual gain from taking introductory psychology and (b) the impact of that prior knowledge on course performance.

Based on the research reviewed earlier, we hypothesized that having taken an introductory course would predict knowledge scores (H1). On the same basis, we also hypothesized that prior knowledge would predict overall performance in the current course (H2). These effects should appear above and beyond the effects of IQ scores.

It seems to follow that we should also have predicted a positive association between having taken an introductory psychology course and subsequent course performance. Yet we had to side with the previous evidence including the two samples from our own Study 1 in predicting a negative (or, at best, a null) association (H3). This pessimistic hypothesis did not contradict the more optimistic hypotheses H1 and H2 because a host of self-selection factors may have operated to induce the negative relation between taking introductory psychology and subsequent course performance. Those self-selection factors could easily be strong enough to override the expected beneficial effects. Again, it was the prior results that justified the direction of our hypothesis.

Method

Participants

Participants were 142 students enrolled in a second-year undergraduate psychology course (Introduction to Personality and Social Psychology) at a large northwestern university. Seventy-one percent of the students were women. Forty-nine percent of participants had taken an introductory course. All participants received course credit for their participation.

Materials

Psychology knowledge pretest. This test included content from a broad range of topics in psychology. The items selected were from various psychology study books with difficulty ratings ranging from low to moderate. By choosing items of this level, we sought to avoid the problem raised by Furnham and Rawles (1993) that difficult or obscure items lead tests of prior psychology knowledge to overestimate ignorance relative to actual knowledge.

The test had two sections: a multiple-choice test and a Likert-style familiarity test. Administration took roughly 20 min with items presented both visually and orally. The first section was a 23-item multiple-choice test with each question having one correct and four incorrect options. The alpha reliability in this sample was .74. The second section was a 75-item test exploiting the recent overclaiming technique (Paulhus & Bruce, 1990; Paulhus & Harms, in press). Based on signal detection theory, this test presents some items that are real (e.g., "Stanley Milgram") and some that are fictitious (e.g., "stepwork effect"). Participants indicate their familiarity with the items presented on a 5-point Likert scale ranging from 1 (*never heard of it*) to 5 (*completely familiar*). We calculated accuracy using d', a standard signal detection formula (Paulhus & Harms, in press), which represented the difference between an individual's hit rate (proportion of real items claimed) and false-alarm rate (proportion of fictitious items claimed). The alpha reliability for our 75-item measure was .63.

Intelligence test. To evaluate raw cognitive ability, we administered the Wonderlic IQ Test (Wonderlic, 1983) early in the course. The instrument contains 50 items drawn from verbal, quantitative, and analytic domains. Although a 12-min time limit is imposed, the Wonderlic behaves like a power test because items are presented in ascending order of difficulty. The measure has shown high test–retest reliabilities ranging from .82 to .94 (Geisinger, 2001) and correlates .90 with the WAIS–R, a much longer standard IQ test (Schraw, 2001). Previous research has shown the Wonderlic to have predictive validity for college grades (McKelvie, 1989). In our sample, we obtained an alpha reliability of .83 via the odd–even method.

Procedure

The method of obtaining information about completion of the introductory course as well as the two course exams was the same as in Study 1. For simplicity, we combined the two exam scores into an overall grade. We administered the Psychology Knowledge test in the classroom early in the 12-week course. Some time later, all participants completed the IQ test in a supervised laboratory setting.

Results

We constructed a composite pretest measure of psychology knowledge by adding the standardized scores (z scores) from the two components of the knowledge test. Performance on the familiarity test was operationalized as the accuracy (d') scores. The multiple-choice score was simply the proportion of correct items. The alpha reliability of this composite was .58. To indicate a prior psychology course, we assigned scores on the variable *Intro Taken* as per the method used in Study 1.

As expected, IQ scores and pretest scores showed significantly positive correlations with subsequent grade, $r(140) = .47$; $r(140) = .22$, both ps $< .05$, respectively. Also, as expected, Intro Taken was positively associated with pretest scores, $r(140) = .28$, $p < .01$. Note that the correlation between IQ and Intro Taken, $r(140) = -.13$, was not significant ($p > .10$). Finally, as predicted, Intro Taken correlated negatively with overall grade, $r(140) = -.16$, $p < .05$, replicating the results of Study 1.

Partial correlations provided further information about the associations between our predictor and outcome variables. After controlling for IQ and Intro Taken, pretest scores remained a significant predictor of subsequent grade, $r(140) = .30$, $p < .01$. Therefore, the association of prior knowledge with course performance was not just an artifact of generally good performance by high-IQ individuals.

After controlling for IQ, the association of Intro Taken with pretest scores remained significant, $r(140) = .34$, $p < .01$. Therefore, there was knowledge transfer from introductory psychology independent of the impact of IQ. Finally, after controlling for IQ and pretest scores, the association of Intro Taken with subsequent grade not only remained significant but increased in value, $r(140) = -.34$, $p < .01$.

Discussion

Our results demonstrate the misleading nature of the apparent negative effects of taking introductory psychology. We confirmed the pattern but can now see why such results give the wrong impression. The key to appropriate interpretation lies in distinguishing causal educational effects from correlational self-selection effects. To clarify these arguments, we must review the findings of Study 2.

First, we replicated the null to negative association of taking a prior course with course performance. This replication adds confidence that our present sample behaved no differently from previous samples (including those in our Study 1) in showing the paradoxical effects of a prior course. Researchers who reported such disappointing findings often tried to explain them in terms of a qualitative difference between high school and college course content (Carstens & Beck, 1986; Federici & Schuerger, 1976; Griggs & Jackson, 1988; Griggs et al., 1989). Our results, even more dismal, cannot be so explained because both the prior and current courses were college level, in fact, at the same college.

Our finding that IQ score was the strongest predictor of later course performance is typical (e.g., Gagné & St. Père, 2001; McCabe, 1991; McCann & Meen, 1984) and should surprise no one. Because high IQ individuals are likely to perform well in prior courses, on prior knowledge tests, current courses, and any other academic task, the impact of that confound must be measured and removed before one can begin to determine the impact of prior courses.

After this control procedure, we were able to reaffirm the genuine flow of knowledge. First, those who took the introductory course scored higher on the prior knowledge test.

Second, those who scored higher on the knowledge test did better in the course. Thus the introductory course contributed to prior psychology knowledge, which in turn aided performance in the later course. This pattern supports our original hypotheses and replicates previous findings (Carstens & Beck, 1986; Hedges & Thomas, 1980).

Thus all our results are consistent with previous research but now have a much more salutary interpretation. It was reassuring that our introductory psychology instructors are successfully performing their job of transmitting foundational knowledge about psychology to their students and, moreover, that this knowledge subsequently serves their students well.

The disturbing results of previous studies can now be seen to result from an adverse self-selection. If students had been randomly assigned to conditions where one group took the prior course and one group did not, then the beneficial effects would have been clear. For ethical reasons, however, it is unlikely that this critical experiment will ever be conducted. Nonetheless, with appropriate controls in a correlational design, we were able to tease apart the necessary variables without benefit of an experimental manipulation.

It appears that students who chose to take introductory psychology are handicapped with some academic quality that impedes their performance in subsequent courses. They do not lack intelligence. Our collection of IQ scores was critical to demonstrating that the groups were equivalent on overall IQ scores: Our Intro Taken variable was not significantly correlated with IQ. So what is their handicap? One suspicion that we pursued was the possibility that students choosing introductory psychology courses are more arts-minded than science-minded.

Previous research has indicated that a background in natural science courses is beneficial to performance in psychology courses (Kornbrot, 1987). Because the emphasis in university-level psychology courses is on psychology as a science (Federici & Schuerger, 1976), students who are scientifically minded should possess a performance advantage independent of prior knowledge and intelligence (Carstens & Beck, 1986; Griggs & Jackson, 1988). In the words of Carstens and Beck "the superiority of students with strong backgrounds in … natural science does not appear to be due solely to their knowledge of psychology … or to differences in academic [and cognitive] ability" (p. 118). In our words, scientifically minded students are likely to be comfortable and facile with the style of thinking encouraged in science courses: Hence, they are better able to understand, frame, and recall the material presented in advanced psychology courses.

To evaluate the impact of science orientation in our data, we conducted some follow-up analyses on data from Study 2. We retrieved enrollment data to determine the participants' majors. We assigned a score of 1 if participants were in the school of Arts and 2 if participants were in the school of Science. We excluded students who were in other schools (e.g., Business, Nursing) from analysis, leaving 114 students. There was a strong negative association, $r(112) = -.56$, $p < .001$, between having taken the introductory course and enrollment in the school of Science. That is, science students were not selecting psychology as their arts option.

There was also a significant positive association between enrollment in the school of Science and subsequent grade, $r(112) = .35$, $p < .01$. In short, science students performed better in our course. To control for this strong effect, we examined the pattern of associations separately for arts and science students. Within these groups, the negative association between having taken the prior course and overall grade disappeared (arts students: $r(55) = .01$; science students: $r(55) = -.03$, both $p = ns$). In short, the relatively poor performance of students who took introductory psychology appears to ensue from the fact that science students avoided that course.

Exactly what advantageous qualities do these science-oriented students possess? It is not global intelligence. Apart from the scientific style of thinking noted earlier, there is evidence that science students also exhibit exceptional conscientiousness and tough-mindedness (Kline & Lapham, 1992). These factors could only be teased apart in longitudinal research.

In sum, the oft-replicated paradoxical association is not the result of harmful teaching. It appears that the negative association is a spurious result of the fact that introductory psychology largely attracts students who are not science-oriented. It could be argued, however, that the particular subsequent courses used in these studies, a social–personality psychology course, is "soft science" in comparison to other courses like biopsychology or cognitive science. Yet the fact that we obtained significant and replicable findings in courses such as these suggests that our results might be even stronger in more "hard science" courses.

These notions have implications for the presentation of psychology in university catalogs. Despite the typical presentation of psychology as an "arts" discipline, the reality is often otherwise, especially in more advanced courses. It is likely that many students low in scientific-mindedness naively take introductory psychology to avoid the rigors of science. The empirical science that they subsequently encounter is not only unexpected, but also difficult for them. Support for this speculation appears in polls of introductory students: The "hard science" aspects of psychology are neither what they expect nor prefer (Zanich & Grover, 1989).

One interpretation is that psychology may be attracting the "wrong" types of students, that is, wrong for scientifically oriented courses. It would be more forthright as well as beneficial for course catalogs to present psychology as "science" rather than "arts." Not only would the discipline be presented more accurately but it would also attract students with the appropriate training and attitude.

Conclusions

It is reassuring to confirm that completing an introductory psychology course does not produce "negative learning" but, indeed, has a positive effect on subsequent course performance. Advisors can now feel more confident in responding to students asking whether taking the introductory course is useful. We can assure them that the introductory course does indeed contribute to their knowledge, which in turn aids their performance in later courses. At the same time, we can advise students about the benefits of a scientific attitude toward psychology. Psychology departments might consider the proactive encouragement of science students to enroll in psychology courses. At the very least, we recommend a more accurate representation of the scientific nature of psychology in

course catalogs: These course descriptions can have a crucial effect on the career trajectories of naive undergraduates.

References

Alexander, P. A., & Judy, J. E. (1988). The interaction of domain-specific and strategic knowledge in academic performance. *Review of Educational Research, 58,* 375–404.

Brody, N. (1997). Intelligence, schooling, and society. *American Psychologist, 52,* 1046–1050.

Carstens, C. B., & Beck, H. P. (1986). The relationship of high school psychology and natural science courses to performance in a college introductory psychology class. *Teaching of Psychology, 13,* 116–118.

Dochy, F. J. R. C. (1992). *Assessment of prior knowledge as a determinant for future learning: The use of knowledge state tests and knowledge profiles.* Utrecht, The Netherlands: Kingsley.

Federici, L., & Schuerger, J. (1976). High school psychology students versus non-high school psychology students in a college introductory class. *Teaching of Psychology, 3,* 172–174.

Furnham, A., & Rawles, R. (1993). What do prospective psychology students know about the subject? *Psychologia: An International Journal of Psychology in the Orient, 36,* 241–249.

Gagné, F., & St. Père, F. (2001). When IQ is controlled, does motivation still predict achievement? *Intelligence, 30,* 71–100.

Geisinger, K. F. (2001). Review of the Wonderlic Personnel Test and Scholastic Level Exam. In B. S. Plake & J. C. Impara (Eds.), *The fourteenth mental measurements yearbook* (pp. 1360–1363). Lincoln, NE: The Buros Institute of Mental Measurements.

Glaser, R. (1984). Education and thinking: The role of knowledge. *American Psychologist, 39,* 93–104.

Griggs, R. A., & Jackson, S. L. (1988). A reexamination of the relationship of high school psychology and natural science courses to performance in a college introductory psychology class. *Teaching of Psychology, 15,* 142–144.

Griggs, R. A., Jackson, S. L., & Meyer, M. E. (1989). High school and college psychology: Two different worlds. *Teaching of Psychology, 16,* 118–120.

Hedges, B. W., & Thomas, J. H. (1980). The effect of high school psychology on pre-course knowledge, midterm grades, and final grades in introductory psychology. *Teaching of Psychology, 7,* 221–223.

Kline, P., & Lapham, S. L. (1992). Personality and faculty in British universities. *Personality and Individual Differences, 13,* 855–857.

Kornbrot, D. E. (1987). Science and psychology degree performance. *Bulletin of the British Psychological Society, 40,* 409–417.

Lavin, D. E. (1965). *The prediction of academic performance: A theoretical analysis and review of research.* New York: Sage.

McCabe, M. P. (1991). Influence of creativity and intelligence on academic performance. *Journal of Creative Behavior, 25,* 116–122.

McCann, S. J. H., & Meen, K. S. (1984). Anxiety, ability, and academic achievement. *Journal of Social Psychology, 124,* 257–258.

McKelvie, S. J. (1989). The Wonderlic Personnel Test: Reliability and validity in an academic setting. *Psychological Reports, 65,* 161–162.

Paulhus, D. L., & Bruce, M. N. (1990, June). *The over-claiming questionnaire: Claiming more than we can know.* Poster session presented at the meeting of the Canadian Psychological Association, Ottawa, Ontario, Canada.

Paulhus, D. L., & Harms, P. D. (in press). The over-claiming technique: Measuring cognitive ability independent of bias. *Intelligence*.

Schraw, G. (2001). Review of the Wonderlic Personnel Test and Scholastic Level Exam. In B. S. Plake & J. C. Impara (Eds.), *The fourteenth mental measurements yearbook* (pp. 1363–1364). Lincoln, NE: The Buros Institute of Mental Measurements.

Schutz, P. A., Drogosz, L. E., White, V. E., & DiStefano, C. (1998). Prior knowledge, attitude, and strategy use in an introduction to statistics course. *Learning and Individual Differences, 10,* 291–308.

Sternberg, R. J. (1988). *The triarchic mind: A new theory of intelligence.* New York: Viking.

Thompson, R. A., & Zamboanga, B. L. (in press). Prior knowledge and its relevance to student achievement in introduction to psychology. *Teaching of Psychology*.

Waters, R. (1979). Another brick in the wall, Pt. 2. [Recorded by Pink Floyd]. On *The Wall* [record]. New York: Columbia.

Wonderlic, E. D. (1983). *Wonderlic Personnel Test manual.* Northfield, IL: Wonderlic.

Zanich, M. L., & Grover, D. E. (1989). Introductory psychology from the standpoint of the consumer. *Teaching of Psychology, 16,* 72–74.

Note

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