# Do Student Learning Styles Translate to Different "Testing Styles"?

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*Professors seem to be more aware of different student learning styles than ever before and are utilizing various teaching techniques in order to appeal to different students in their classes. Unfortunately, presenting materials is only one side of the coin, while the other side—assessment—has not received the same amount of attention. After all, if teachers can agree that students have different methods for learning, does it not stand to reason that they have different methods of reproducing this knowledge as well? This article makes a case for more diverse assessment techniques within the same course, connecting our knowledge on individual learning styles to a theory of "testing styles." By allowing students to choose between different formats for participation, exams, and other assignments, educators acknowledge students' individual styles and allow them to show what they really know as opposed to how well they take tests. The author's major claims are supported by the results of an experimental design that tests the connection between learning styles and students' performances in different testing formats. The article also includes findings taken from a survey on students' experiences with and hopes for different assessment techniques.*

Many learning theories suggest that learning is best conceived of as a process not an outcome. While the author readily agrees with this notion, the fact remains that assessing students' performances is a large part of professors' roles as educators, and an important one at that. In addition, many teachers are faced with university administrators who pressure them to produce results, to streamline assessment, and to make grading more systematic and transparent. In response to such pressures, the trend has been to develop more standardized tests, as they presumably offer the same conditions—and thus fair treatment—to all students, objective scoring, and effective assessment of knowledge. Within standardized tests, it is primarily the multiple-choice format that has become the most popular (cf. Aiken 1987; Becker and Watts 1996). This article is based on the assumption that standardized testing in any form, while expedient, does not take into consideration the unique differences among our students and therefore does not adequately measure whether or not learning has occurred. In particular, the author proposes that there is an observable connection between a student's learning style and his/her "testing style."

Most educators are well aware of the vast literature on learning styles (e.g., Myers 1962; Schroder et al., 1967; Paivio 1971; Kolb 1976; Messick 1976; Dunn and Dunn 1978; Keefe 1979; Riding and Sadler-Smith 1992; Larsen 1992; Jonassen and Grabowski 1993; Biggs 1993; Vermunt 1996; Morrison et al., 2003; Karns 2006; Morrison et al., 2006) and have adjusted their lectures and seminars to include pictures and graphs for the more visual learners, to have hands-on exercises for those who ''learn by doing,'' and various other strategies. Interestingly, despite all this effort, many still tend to rely on the same, often standardized tests to assess student learning (Swain 2004; Butler and Roediger 2008; Nichols and Berliner 2008; Johannesen and Habib 2010). Even when educators utilize different types of testing, the variety of student learning styles are likely to always disadvantage certain students whenever an assessment strategy is used excessively.

The main question this article addresses is: If students have different learning styles, does it not stand to reason that their preferred method of reproducing that knowledge also differs?

In order to shed light on the connection between learning styles and performance in various assessment measures, this article proceeds as follows. First, the author provides a brief overview of our theoretical knowledge regarding different assessment strategies. The literature reveals heated debates concerning the advantages and disadvantages of specific exam formats, but none address the issue of student learning styles and how they are connected to performance. After the review of the theoretical context, the author summarizes the results of a survey that asked students about (1) their learning styles through a series of questions related to their learning behavior, (2) their perception of their professors' assessment methods, and (3) their self-declared preferences for how they would like to be tested. Lastly, the author will report findings from an experiment that tested the impact of different learning styles on students' performances in a variety of tests (including multiple-choice exams, short answer/essay, applied case studies, and visual charts).

## Theoretical Background

The author first became interested in the question of ''testing styles'' as a graduate instructor, when students repeatedly complained that they ''knew the answers but still didn't do well'' or that ''the test wasn't fair.'' At first, the author met these complaints with a stoic expression and the firm (and rather self-righteous) belief that such protests were merely the result of a failure to study properly for exams. When some of the better students remarked on their inability to score as highly as they would have liked, however, the author began to focus less on her students' test-taking abilities and more on her test-writing ability.

From that point on, the author started experimenting—rather informally—with giving students choices on their exams, offering students the option of taking a multiple-choice/short answer exam or an essay exam. Students were allowed to see both formats on the day of their exam, but only had to complete one of them. The two formats typically asked about the same exact course content but gave students a choice in how they wanted to reproduce their knowledge of the material. While not statistically reliable, a comparison of grade distributions in courses before and after the experimentation began to reveal that students on average improved their scores by 4.2%. While external factors such as age, major, GPA, and other possible variables that might have affected the grade distribution from class to class cannot be ruled out, this

increase in average grades—as well as students' enthusiastic response—was enough to warrant further investigation of the matter.

In the literature, the question of assessment methods has arisen very frequently. In particular, the popular multiple-choice format has come under attack more often than other tests. Scholars have investigated the connection between gender and certain testing formats, concluding that multiple-choice exams tend to favor males over females due to differences in cognitive style between the sexes (Bolger and Kellaghan 1990; Ben-Shakhar and Sinai 1991; Hassmén and Hunt 1994), a tendency to change answers (Geiger 1990), and/or greater omission rates among females (Ben-Shakhar and Sinai 1991). Critics of the multiple-choice format also argue that such tests primarily measure static knowledge (Tatsuoka 1991) and fail to measure higher levels of cognitive skills such as interpretation and problem solving (e.g., Maier and Casselman 1970).

Proponents of multiple-choice exams claim that they—if diligently constructed—can measure very complex learning outcomes (Ebel 1972; Gronlund 1981). Studies have also found that students who take multiple-choice exams throughout a semester — as opposed to other forms of tests—perform better all around and exhibit greater retention rates of knowledge (Sax and Collet 1968). Many scholars have lauded multiple-choice exams for their objectivity and reliability/effectiveness (e.g., Collier and Mehrens 1985). Finally, a newer branch of the literature focuses on the improvement of multiple-choice exams by either including constructed response items or by including measures of students' self-assessment, that is, their perceived sureness about the correct answer (Hunt 1982; Bokhorst 1986).

Essay and short-answer exams have primarily been lauded for their ability to assess students' critical thinking, interpretation, and problem-solving skills. There also appears to be evidence that essay exams produce smaller gender differences than multiple-choice exams (Murphy 1982; Bolger and Kellaghan 1990). Some studies suggest that short-answer testing results in equal or greater retention of knowledge than multiple-choice testing (Gay 1980). At the same time, these types of free-response tests have been criticized for the difficulty associated with objective scoring on the part of the instructor. For instance, certain studies indicate that factors other than the content of essay answers may determine a student's score, such as spelling and grammatical errors (Scannell and Marshall 1966; Marshall 1967), the first name of the student (Harari and McDavid 1973), and even the quality of handwriting (Chase 1968; Marshall and Powers 1969).

Given this variety of assessment options and the associated advantages and disadvantages, it is interesting to note that few of these articles call for a variety of testing methods. In fact, the more recent trend appears to have been toward the adoption of more standardized assessment strategies, such as multiple-choice exams (Swain 2004; Butler and Roediger 2008; Nichols and Berliner 2008; Johannesen and Habib, 2010). This seems to do a disservice to diversity among our students.

Even though scholars have discovered a great deal about the way students perform on certain types of exams, and know even more about students' learning styles, there is a significant gap in the literature that connects the two. This article is not another study that seeks to dismiss the merit of multiple-choice exams or any other format but rather argues that the appropriate assessment method depends on the student's individual learning style. Instead of adopting an across-the-board recommendation in favor of a particular format, as virtually all of the articles in the literature do, this author argues for a variety of assessment strategies in a single course, and maybe even a single exam.[1]

There is some evidence from studies conducted outside the field of liberal arts that suggests that students' learning styles do indeed impact their performance on certain exam types. For instance, Brenenstuhl and Catalanello (1976) experimentally tested the relationship between learning styles and students' performances in discussion groups, experiential labs, and simulation labs in business courses. The authors found that "converging learners" (Kolb 1976)—who prefer abstract conceptualization and active experimentation—outperformed others in experiential labs but did rather badly in discussion groups. "Accommodating learners"—who prefer concrete and active experience—consistently outperformed their peers in simulations. Similarly, Holley and Jenkins (1993) found that accounting students significantly differed in their performance on four different exam types: multiple-choice theory, multiple-choice quantitative, open-ended theory, and open-ended quantitative.

While these findings are certainly useful, it seems reasonable to assume that political science students—or Liberal Arts majors in general—might differ in their learning styles from business and accounting students, and that our discipline could benefit tremendously from further research on the relationship between learning styles and "testing styles." Therefore, the working hypothesis adopted for this study is: Political science students' learning styles—minus the effects of gender and GPA—significantly contribute to the explanation of performance on different exam formats.

## Findings from the Student Survey

In order to gain a better understanding of assessment techniques and performance from a students' perspective, the author constructed an 84-item questionnaire that was designed to test the following: (1) reveal students stated preferences for written and verbal testing, and (2) reveal students' approaches to studying. The purpose of the survey was to develop a basic understanding of the variance of testing styles among political science students, their individual attitudes toward certain testing formats, and various other related questions.

The survey was conducted between December 2, 2007, and January 9, 2008, at the author's university. In all, 158 students—most of them political science majors (88.6%) and the rest other liberal arts students—filled out the survey on a voluntary basis. Table 1 summarizes a few of the descriptive statistics of the respondents.

Part I of the survey consisted of 21 questions that asked students about various issues concerning their test-taking experiences at the college level. For instance, the survey included a few questions about testing anxiety, perceptions of whether (and how much) professors are aware of students' testing difficulties and learning styles, and perceived fairness of college exams.

**Table 1.** Descriptive statistics of survey respondents ($N = 158$)

| | Descriptive statistics | | | |
|---|---|---|---|---|
| Year | Freshman 35.9% | Sophomore 21.8% | Junior 24.4% | Senior 17.9% |
| Gender | Male (41.8%) | Female (58.2%) | | |
| Major | Political Science (88.6%) | Nonpolitical Science (11.4%) | | |

In Part II, the survey asked students 30 questions about their preferred exam formats, how well they felt they perform in different exam types, and how they would like to be tested in a number of areas (exams, participation, readings, etc.), if they had any influence over the testing in their classes.

The majority of students can be classified as either visual learners or as verbal learners. The percentage of "hands-on" learners is relatively low. Considering the emphasis on theory and abstract reasoning in a discipline such as political science, these results are not terribly surprising. Interestingly, however, students have a tendency to grossly misjudge their own learning styles. In a previous study, the author discovered that the majority of students (59%) tested assumed their learning style was different from what it was. The fact that many students misjudge their own learning styles might indicate that they do not utilize the most appropriate study techniques for their individual strengths. In addition, this lack of knowledge among the students also poses a problem for the proposition by the author that students could benefit from being given choices on their exams: If they do not know their strengths, how can they choose the most effective testing format for themselves? The answer to this question is that it might be beneficial for teachers to administer a learning-style inventory to their students and to discuss the findings with them or to encourage them to explore the nature of their learning style on their own.

Another finding from the survey reveals what many professors probably already know: Students dread essay exams more than any other format and—if given the choice—prefer multiple-choice exams and/or a combination of multiple-choice and short-answer exams, because they feel they perform better on the latter. Ironically, the findings from the author's own experiment indicate that this is another gross misperception on the part of the students. Perhaps students perceive multiple-choice exams as simpler due to the fact that the answers are listed in front of them, when in reality the nature of multiple-choice questions makes them often more difficult than other formats, at least for certain learning styles. Table 2 summarizes the results concerning students' perceptions on this matter. The questions were: "I feel most anxious when I know I have to take . . . ," "In my experience, I tend to perform better in . . . ," and "If given a choice, I prefer to take. . . ."

Overall, there seems to be some indication that the exam format students dread the least is the short-answer exam. Interestingly, this lack of dread does not cause students to prefer this format or to believe that they perform better in it; this might be explained by the deceptive appearance of multiple-choice exams and/or students' dislike for exams in which they are required to write a lot. Nonetheless, short-answer exams score the second highest with students.

**Table 2.** Student perceptions of exam formats and performance ($N = 158$)

| | Multiple choice | Essay exam | Short answer | Combination | True false | Other | Total |
|---|---|---|---|---|---|---|---|
| "Anxious" | 13.9% | 43% | 5.1% | 16.5% | 10.1% | 3.8% | 92.4%* |
| "Prefer" | 30.4% | 13.9% | 22.8% | 18.4% | 4.4% | 7.6% | 97.5%* |
| "Perform" | 31.6% | 15.2% | 21.5% | 16.4% | 2.6% | 3.8% | 91.1%* |

*Some students chose to not answer this question.

While students may not necessarily understand their own learning styles, the majority of them do not believe that "college exams allow students with different learning styles to perform well" (Question III-1). They do believe that "the format of an exam influences how well [they] do on it" (Question III-2) and that "certain exam formats do not allow [them] to show their knowledge of the material" (Question III-3). These findings are summarized in Table 3.

In addition, the survey asked students whether or not they believe that most or some of their professor/instructors are aware of their concerns about test taking. Of the 158 students who responded, 44.8% disagreed or strongly disagreed that *most* of their professors are aware, 33.3% felt neutral about the question, and only 21.8% agreed that their professors were aware. Not a single student agreed strongly. When asked if *some* of their professors are aware, 45.6% agreed, 27.8% felt indifferent, and 26.6% disagreed or strongly disagreed. This is not to say that professors truly are not aware of the problems many students face when taking their exams, but it certainly does indicate that if they do care, they are not all that successful in communicating this concern.

Finally, 42.3% of students disagreed or strongly disagreed with the statement that on average, their college professors take into consideration different student learning styles when they write their exams. Only 27.9% agreed, while the rest felt indifferent about the question. These findings further illustrate the author's belief that more research on the connection between learning styles and testing styles is needed.

## Findings from the Experiment

After asking students about their personal beliefs and experiences, the next logical step seemed to be to test these findings, as well as the working hypothesis about the relationship between learning styles and performance on various test formats. To that end, the author designed an experiment that will hopefully shed light on the research question at hand.

Participants were students in the author's 100-level introductory political science/research methods course. Students are randomly block-scheduled into two sections of the class, which should eliminate any selection bias. The two sections were comparable in terms of their makeup as well, as Table 4 illustrates.

**Table 3.** Student beliefs about learning styles, exam formats, and performance ($N = 158$)

| Question | Strongly agree | Agree | Neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| "College exams allow students with different learning styles to perform well" | 1.3% | 27.8% | 25.3% | 37.8% | 11.4% |
| "The format of an exam influences how well (I) do on it" | 26.6% | 60.7% | 6.3% | 6.3% | 0% |
| "Certain exam formats do not allow (me) to show (my) knowledge of the material" | 31.6% | 50.6% | 7.6% | 10.1% | 0% |

**Table 4.** Descriptive statistics of experimental and control group

| | Section 01 (Control) | Section 02 (Experimental) |
|---|---|---|
| *Total number of students* | 45 | 45 |
| Freshmen | 17 | 15 |
| Sophomores | 12 | 13 |
| Juniors | 4 | 7 |
| Seniors | 12 | 10 |
| *Gender* | | |
| Male | 16 | 18 |
| Female | 29 | 27 |
| *Major* | | |
| Pols | 43 | 40 |
| Non-Pols | 2 | 5 |
| *Average GPA** | 3.08 | 3.05 |

*For Freshmen, I included the GPA from their applications to our institution since they had not yet taken courses here.

With the exception of the time of day, the two sections were identical in their schedules, course content, and assessment components. As a result, this course provided the perfect context for testing the impact of giving students choices on their final exams on their performance. Section 02 was designated as the experimental group, receiving an option of choosing two of four formats on the final exam: (1) 35 multiple-choice questions, (2) five out of six short-answer questions and one out of two essay questions, (3) two visual charts, or (4) one out of two applied case studies. Students in this section received $1\frac{1}{2}$ hours to complete the exam. Section 01 was designated as the control group and received no choice of format; instead, all students were required to complete an exam that consisted of 35 multiple-choice questions, five out of six short-answer questions, one out of two essay questions, two visual charts, and one out of two applied case studies. Both exams took place on the same day during finals week.

For the sake of fairness, students in the control group were told after the exam was over that they could choose to have only two of the sections they completed count toward their final course grade. The exams were graded by the author on the basis of previously determined categories derived from learning outcomes stated clearly on the syllabus.[2] The author also asked a colleague in the same discipline to grade the exams to see whether the grading was objective. Intercoder reliability was 93%.

Ten weeks prior to the exam, students completed the Solomon and Felder Learning Style Index,[3] a questionnaire consisting of 44 discreet-choice questions that calculated their learning style on four continua (Felder and Solomon, 2000). A student's learning style is determined by a 23-point scale, ranging from −11 to +11. The four continua measured are:

1. **Active/reflective**: Shows how students process information. Active learners tend to learn best by doing something with the information, that is, applying or explaining it to others. Reflective learners prefer to think about information quietly.

2. **Sensing/intuitive**: Shows what type of information students prefer to perceive. Sensing learners tend to like learning facts, while intuitive learners like to discover relationships and possibilities.
3. **Visual/verbal**: Shows how information is most effectively perceived. Visual learners remember best what they see, that is, pictures, diagrams, flow charts, etc. Verbal learners remember best what they read and/or hear, for example, lectures, lecture notes, textbook readings, etc.
4. **Sequential/global**: Shows how students progress toward learning. Sequential learners gain understanding in linear steps, one following logically from the previous one. Global learners progress in steps and are better at grasping the "bigger picture" and solving complex problems.[4]

The results of the pretest questionnaire were recorded for each student. The categories that were ultimately tested in the experiment were the Visual-Verbal continuum (LS Vi/Ve), the Active-Reflective continuum (LS A/R), and the Sensing-Intuitive continuum (LS S/I). In order to maximize the effectiveness of giving students in Section 02 a choice on the exam, all students were made aware of their scores and advised of strategies for learning and test-taking based on their exhibited strengths and weaknesses. Table 5 indicates the distribution of learning styles among students in the control and experimental groups.

The hypothesized effects of the learning styles on test performance are summarized in Table 6.

These expectations were derived deductively. One might expect students with a greater preference for the verbal dimension to perform better on narrative-oriented tests, such as essay or short-answer exams. Possibly, such students would also do well in case study applications, although the requirement to actively apply knowledge in such a format might better suit students who also score highly on the active and sensing continuum. A multiple-choice exam might appeal more to students who like to learn facts, are detail-oriented and are good at memorizing, as the sensing and active learners tend to be. Conversely, students who are more reflective and intuitive learners and who are better at grasping the "bigger picture" might have trouble with such a format. Finally, a format that requires students to fill in charts and timelines with facts and explanations might appeal more to the visual learners.

**Table 5.** Learning styles of control and experimental groups

| | Section 01 (Control) (N = 45) | | Section 02 (Experimental) (N = 45) | |
|---|---|---|---|---|
| Average GPA | 3.08 | | 3.05 | |
| Learning Style (LS) | | | | |
| | **Visual** | **Verbal** | **Visual** | **Verbal** |
| | 17 | 28 | 22 | 23 |
| | **Active** | **Reflective** | **Active** | **Reflective** |
| | 22 | 23 | 15 | 30 |
| | **Sensing** | **Intuitive** | **Sensing** | **Intuitive** |
| | 16 | 29 | 18 | 27 |
| LS Matches Exam Choice? | | | **YES** | **NO** |
| | | | 23 | 22 |

**Table 6.** Hypothesized relationships between learning styles and exam performance

| | Dominant learning style | | | | | |
|---|---|---|---|---|---|---|
| | Visual | Verbal | Active | Reflective | Sensing | Intuitive |
| Multiple-Choice | ? | ? | Pos. | Neg. | Pos. | Neg. |
| Short Answer/Essay | Neg. | Pos. | Pos. | Pos. | Neg. | Pos. |
| Case Application | ? | ? | Pos. | Neg. | Pos. | Pos. |
| Charts | Pos. | Neg. | Neg. | ? | ? | ? |

The comparative results of the control and the experimental groups are summarized in Table 7.

The findings from the experiment are preliminary and—due to the relatively low *N*—not necessarily representative. Nonetheless, there appear to be a few recognizable trends. Firstly, students overall performed worse on the multiple-choice portion of the exam than on any other part, contradicting the level of confidence in the multiple-choice exam illustrated by students' responses on the survey. When breaking down the results by learning style (see discussion below), it is revealed that some learning styles perform much better in this format, but even those perform worse than on other portions of the exam.

Interestingly, the experimental group's performance was better on the exam in general (by 5.51%), as well as on every portion of the exam, most notably the multiple-choice portion (by 5.51%) and the visual charts (by 5.28%). A $t$ test of the results reveals that the difference of means of the two groups is statistically significant at the $p < .005$ level.

When comparing the exam scores of students based on the fit between their choices of format, the results indicate an even stronger relationship between learning styles and "testing styles." Overall, students in the experimental group did fairly well when choosing their two exam formats. Of the 45 participants, 23 chose two formats that suited their learning styles (based on deductive logic). Nineteen participants chose one format that suited their learning styles, and 3 participants chose two formats that did not match their learning styles. Table 8 summarizes students' exam scores based on their choices.

The difference between those individuals who chose two suited exam formats and the control group was 7.5%, which clearly exceeds the averages between

**Table 7.** Comparative exam results

| | Section 01: Control ($n = 45$) | Section 02: Experimental | Difference between sections |
|---|---|---|---|
| Exam Score Total | 82.63 | 87.1 ($n = 45$) | 4.47 |
| Multiple-Choice | 76.91 | 82.42 ($n = 21$) | 5.51 |
| Short Answer/Essay | 84.22 | 87.31 ($n = 26$) | 3.09 |
| Case Application | 85.2 | 89 ($n = 21$) | 3.8 |
| Charts | 84.2 | 89.48 ($n = 23$) | 5.28 |

**Table 8.** Average of results by exam choice (experimental group)

| | |
|---|---|
| Exam Score Total | 87.1 ($n = 45$) |
| Exam Score Total (Control Group) | 82.63 ($n = 45$) |
| Learning Style Matches Exam Choice | 90.13 ($n = 23$) |
| Learning Style Does Not Match One Exam Choice | 85.21 ($n = 19$) |
| Learning Style Does Not Match Two Exam Choices | 75.83 ($n = 3$) |

groups. If this result is typical, it means that students could score almost an entire letter grade higher on exams, if only they were given the option of being tested in a format that suits them. Students who chose one exam format that suited them still outperformed the control group by an average of 2.58%. Interestingly, the three students who chose two ill-fitting formats actually performed worse on the exam than the control group (by 6.8%). Of course, the low $N$ of only 3 makes it impossible to draw any conclusions from this subsection of the experimental group. However, it is interesting to note that the GPAs of these three individuals were 3.1, 3.0, and 2.0, and hence not those of students one might expect to receive a C-average on an exam.

In order to truly test the causal argument made in this article, Table 9 summarizes the exam scores by format and learning style.

The results largely confirm the hypothesized expectations. The most notable impact of learning style on testing style occurs along active/reflective and the visual/verbal continua. Even in the control group, students who are more active learners perform best on the applied case studies section of the exam and perform worst on the multiple-choice component. Compared to their peers, they outperform every other learning style on the applied case studies section with the exception of sensing learners. As sensing learners are also expected to enjoy the factual nature of applied knowledge, this finding is consistent with the author's expectations.

In both groups, visual learners performed very well on the charts section of the exam. Students in the control group scored the second-highest number of points in this category, while students in the experimental group scored by far the highest, outperforming the control group by 7.53%. In contrast, visual learners performed the worst in the multiple-choice and the short-answer/essay sections of the exam.

The more verbal learners clearly took to the short answer/essay component of the exam. In the control group, the verbal learners outperformed all but the sensing learners. In the experimental group, both the verbal and the reflective learners scored the highest points in this category. The average difference between the control and experimental groups was 2.49, which is somewhat lower than anticipated. This suggests that even though the essay exam is the most dreaded among students, a majority of them tend to perform better on it than they think.

Finally, active and sensing learners both perform better on the multiple-choice portion of the exam than their peers. The difference between groups is an astonishing 10.66% for active learners, and a somewhat puzzling −3.51% for sensing learners. A possible interpretation for the latter result could be that students in the control group felt more of a time constraint and thus had a lower tendency to overanalyze multiple-choice answers. The literature suggests that second-guessing and changing one's

**Table 9.** Results by learning style*

| | Visual ($n=17$) | Verbal ($n=28$) | Active ($n=22$) | Reflective ($n=23$) | Sensing ($n=15$) | Intuitive ($n=29$) |
|---|---|---|---|---|---|---|
| **Section 01 (Control Group)**** | | | | | | |
| Exam Score | 82.36 | 82.78 | 84.01 | 81.31 | 89.38 | 81.99 |
| Multiple-Choice | 76.52 | 77.14 | 78.05 | 81.32 | 89.2 | 73.21 |
| Short Answer/Essay | 79.88 | 86.86 | 84.41 | 83.96 | 88 | 85.17 |
| Case Application | 88.35 | 85.5 | 89.22 | 81.35 | 90.93 | 85.08 |
| Charts | 84.7 | 81.68 | 84.36 | 84.04 | 89.4 | 84.41 |
| **Section 02 (Experimental Group)***** | | | | | | |
| Exam Score | 87.66 | 86.57 | 91.4 | 84.95 | 87.36 | 86.93 |
| | ($n=22$) | ($n=23$) | ($n=15$) | ($n=30$) | ($n=18$) | ($n=27$) |
| Multiple-Choice | 84.93 | 77.43 | 88.71 | 79.28 | 85.69 | 77.12 |
| | ($n=14$) | ($n=7$) | ($n=7$) | ($n=14$) | ($n=13$) | ($n=8$) |
| Short Answer/Essay | 80.5 | 89.35 | 89 | 86.9 | 84.29 | 88.42 |
| | ($n=6$) | ($n=20$) | ($n=5$) | ($n=21$) | ($n=7$) | ($n=19$) |
| Case Application | 87.5 | 89.64 | 92.45 | 84.77 | 94.33 | 88.06 |
| | ($n=6$) | ($n=14$) | ($n=11$) | ($n=9$) | ($n=3$) | ($n=17$) |
| Charts | 92.22 | 79.6 | 94.14 | 87.44 | 89.07 | 90 |
| | ($n=18$) | ($n=5$) | ($n=7$) | ($n=16$) | ($n=13$) | ($n=10$) |
| **Difference (Control vs. Experimental Group)** | | | | | | |
| Exam Score | 5.3 | 3.79 | 7.39 | 3.64 | −2.02 | 4.94 |
| Multiple-Choice | 8.41 | 0.29 | 10.66 | −2.04 | −3.51 | 3.91 |
| Short Answer/Essay | 0.62 | 2.49 | 4.59 | 2.94 | −3.71 | 3.25 |
| Case Application | −0.85 | 4.14 | 3.23 | 3.42 | 3.4 | 2.98 |
| Charts | 7.52 | −2.08 | 9.78 | 3.4 | −0.33 | 5.59 |

*Please note that individual students are included multiple times, once on the visual-verbal continuum, once on the active-reflective continuum, and once on the sensing-intuitive continuum.

**Based on four exam sections, completed in 3 hours.

***Based on a choice of two out of four exam sections, completed in 1.5 hours. Total *n* per category varies based on students' choices.

answer on multiple-choice questions tends to produce a worse outcome than going with one's instincts.

In addition to analyzing the percentages of the exam scores, the author conducted a few simply statistical analyses in order to highlight the correlation between learning styles and testing styles. Table 10 summarized the correlations coefficients for learning styles, GPA, gender, and the exam scores by section.

One of the more interesting findings is that whereas in the control group the students' GPAs are always significantly correlated to their exam scores, the relationship is only significant between GPA and overall exam score in the experimental group, but not in any of the individual portions of the exam. This suggests that learning styles might account for more of the variance among exam scores than overall GPA.

The other statistically significant correlations were—as expected—between the visual/verbal learning styles and students' performance on the short answer/essay

**Table 10.** Correlation coefficients for learning styles and exam results

| Learning style | Exam score | Multiple choice | SA/Essay | Case App. | Charts |
|---|---|---|---|---|---|
| | | (Section 01: Control Group) | | | |
| Visual/Verbal | .03350 | .03012 | .47645 | .05367 | −.45172 |
| | (.827) | (.8443) | (.0009)** | (.7262) | (.0018)* |
| Active/Reflective | −.22949 | −.11235 | −.03220 | −.54912 | −.02234 |
| | (.1294) | (.4625) | (.8337) | (<.0001)*** | (.8842) |
| Sensing/Intuitive | −.14346 | −.50303 | .19062 | −.00517 | .04017 |
| | (.3471) | (.4625) | (.2097) | (.9731) | (.7933) |
| GPA | .71305 | .81209 | .71606 | .764800 | .71823 |
| | (<.0001)*** | (<.0001)*** | (<.0001)*** | (<.0001)*** | (<.0001)*** |
| Gender | .04739 | .06853 | −.08694 | −.21876 | .05324 |
| | (.7572) | (.6546) | (.5701) | (.1488) | (.7288) |
| | | (Section 02: Experimental Group) | | | |
| Visual/Verbal | −.09656 | −.36655 | .64338 | .34614 | −.64670 |
| | (.528) | (.0133) | (<.0001)*** | (.0198) | (<.0001)*** |
| Active/Reflective | −.53697 | −.04989 | .33924 | −.45045 | .02831 |
| | (<.0001)*** | (.7448) | (.0226) | (.0019)* | (.8535) |
| Sensing/Intuitive | −.03765 | −.46008 | .33307 | .43890 | −.33787 |
| | (.806) | (.0015)* | (.0254) | (.0026)* | (.0232) |
| GPA | .63103 | .03702 | −.23276 | .12438 | .22632 |
| | (<.0001)*** | (.8092) | (.1239) | (.4156) | (.1349) |
| Gender | −.03364 | .03208 | .22309 | −.18415 | −.07145 |
| | (.8263) | (.8343) | (.1239) | (.2259) | (.6409) |

*$p = < 0.01$. **$p = < 0.001$. ***$p = < 0.0001$.

and the charts portions of the exam, and between the active/reflective learning styles and the applied case studies. This was true for both the control and the experimental group, but the latter exhibited greater statistical significance, suggesting that when students get to choose the exam format, their learning styles become more highly correlated with their performance.

A multiple linear regression model for both groups indicates that there is, indeed, a causal relationship that underlies these correlations. Table 11 illustrates the impacts.

In the control group, the visual/verbal learning style has a statistically significant impact on students' performance on the short/answer essay component and on the charts sections. This is consistent with the initial hypotheses, because it indicates that verbal learners perform better on exams that emphasize writing, and visual learners appear better at recalling information when asked to input it into a graph or chart. This learning style continuum is also statistically meaningful for the performance of the experimental group in the same categories. The impact is much larger than in the control group, however, which might suggest that students who get a choice perform better than those who do not.

The active/reflective learning styles have a significant impact on students' performance on the applied case studies in both groups, but slightly more so in

**Table 11.** Multiple linear regression models

| | Exam score (DV) | MC (DV) | SA/Essay (DV) | Applied (DV) | Charts (DV) |
|---|---|---|---|---|---|
| | | | Section 01: Control Group | | |
| LS Vi/Ve | −0.198 | 1.048 | 6.265 | −0.685 | −7.419 |
| | (.8672) | (.631) | (<.0001)*** | (.664) | (<.0001)*** |
| LS A/R | −1.026 | 1.494 | 1.483 | −6.938 | −0.146 |
| | (.388) | (.495) | (.253) | (<.0001)*** | (.922) |
| LS S/I | −4.313 | −14.223 | −0.947 | −0.604 | −1.476 |
| | (.0015)* | (<.0001)*** | (.494) | (.722) | (.359) |
| GPA | 13.878 | 16.660 | 14.419 | 10.619 | 13.814 |
| | (<.0001)*** | (<.0001)*** | (<.0001)*** | (<.0001)*** | (<.0001)*** |
| Gender | −0.851 | 1.0627 | −1.921 | −2.861 | 0.315 |
| | (.4759) | (.628) | (.142) | (.0778) | (.833) |
| $R^2$ (adj.) | .604 | .516 | .668 | −.518 | .571 |
| Model $p$ | (<.0001)*** | (<.0001)*** | (<.0001)*** | (<.0001)*** | (<.0001)*** |
| | | | Section 02: Experimental Group | | |
| LS Vi/Ve | 0.852 | −2.933 | 10.096 | 2.609 | −10.691 |
| | (.519) | (.375) | (<.0001)*** | (.071) | (<.0001)*** |
| LS A/R | −4.284 | −5.079 | 2.486 | −7.310 | −1.003 |
| | (.0049)** | (.118) | (.1101) | (<.0001)*** | (.453) |
| LS S/I | −1.022 | −6.131 | 4.038 | −2.635 | 0.033 |
| | (.442) | (.0496)* | (.0076)* | (.196) | (.975) |
| GPA | 10.210 | 11.715 | 6.564 | 6.238 | 7.874 |
| | (<.0001)*** | (.031)* | (.0094)* | (.053) | (.0004)** |
| Gender | −0.560 | −3.513 | 0.377 | 1.421 | −1.026 |
| | (.6842) | (.2383) | (.762) | (.280) | (.396) |
| $R^2$ (adj.) | .473 | .555 | .751 | .765 | .855 |
| Model $p$ | (<.0001)*** | (.0028)* | (<.0001)*** | (<.0001)*** | (<.0001)*** |

*$p < .01$. **$p < .001$. ***$p < .0001$. LS Vi/Ve = Learning Style Continuum Visual/Verbal; LS A/R = Learning Style Continuum Active/Reflective; LS S/I = Learning Style Continuum Sensing/Intuitive; GPA = Grade Point Average.

the experimental group. Again, this was expected, because the application of knowledge to concrete cases should favor those students who learn better when they can do something with the information.

The sensing/intuitive styles become significant in the control and experimental groups when it comes to the multiple-choice sections of the exam. Interestingly, the control group shows a more significant impact of this learning style than does the experimental group. This is likely explained by the fact that of those students in the experimental group who chose the multiple-choice option, over one third chose the wrong format for their learning style, biasing the relationship. This wrong choice might be the result of American students being so heavily exposed to the multiple-choice format and wrongly assuming that it is one of the easier exam types. The survey results presented earlier in this article support this assumption.

Finally, GPA is one of the most significant variables in explaining students' performances on the exam. This is to be expected, because even though an exam format that suits a student's particular learning style might help that student better express their knowledge, it certainly does not make up for nonexistent knowledge. It was very interesting to note, however, that the impact of a student's GPA on his or her performance becomes much less in the experimental group, indicating that other factors, such as exam format, might play a larger role than most educators might think.

## Conclusion and Recommendations

The findings summarized in the previous section clearly indicate that at least in this particular case, learning styles have a significant impact on students' performance on various exam formats. This author believes this suggests that so-called testing styles are correlated with learning styles. Admittedly, the limitations of size, class type, and possible institutional biases make it difficult to treat this as more than a pilot study at this point in time. However, the results are so robust that it stands to reason that with more research, the relationship proposed here could be further illuminated.

Even at this stage, the results lend themselves to some preliminary recommendations for professors and lecturers. First and foremost is the appeal to not automatically assume that a student's performance on an exam is necessarily a good indicator for how much that student knows about the subject matter. Academics would do well to more often consider the possibility that their exams are not only testing what students know but also how well they take certain types of exams. Inasmuch as most forms of assessment at the university level are somewhat arbitrary and removed from real-life demands, it would be worth considering an adjustment in assessment in order to truly test what students know. Since education is measured in terms of outcomes rather than inputs, knowing exactly how much students have learned is crucial for developing courses and teaching practices that truly communicate the material they present.

This is not to say that certain types of assignments or even exams are not important. For instance, this author strongly believes that university students should absolutely be tested on their ability to express themselves well in writing; this is not a recommendation to never force students to write an essay. However, given the time constraints during a typical in-house exam, it might make more sense to assign a research paper or a take-home exam, when writing is one of the categories assessed. Similarly, all students should learn to apply the knowledge they have acquired, not just the active learners who, in turn, could benefit from being forced to become more reflective on occasion. The overall message of this article is not to completely change assessment strategies or to always offer students choices. At the same time, some skills and learning outcomes might be better tested in a less stressful environment than an in-house, timed exam. In an exam, the primary goal is typically to assess how well students have acquired the materials presented to them. Even though constructing an exam that takes into consideration students varying learning styles can be somewhat time-consuming, the benefit of having an assessment tool that is reliable and valid seems to be worth the effort. Furthermore, most political science content lends itself to be tested in a variety of formats. The author included an example

of an exam question about causality in four different variations to illustrate this point (see Appendix A).

A secondary recommendation is to make students aware of their own strengths and weaknesses, perhaps by encouraging them to complete a learning-style inventory, and teaching them how to capitalize on the former and to improve on the latter. Most professors and lecturers likely feel they do not have enough time to worry about this aspect of their students' education in addition to covering the required course materials. However, if the acquisition of content can be made more effective by slightly changing teaching and assessment strategies, the outcome would benefit students and teachers alike. There are numerous resources available to instructors who wish to inform themselves about learning-style inventories, such as the Solomon-Felder Index, and the interpretation and application of their findings (see Appendix B). Instructors might find that these resources will benefit their own teaching and learning. After all, we are not just educators but lifelong learners ourselves.

## Notes

1. Although the question of examinee choices in testing has been addressed, articles in this strand of the literature generally examine the effects of allowing students to choose from a number of essay exams (e.g., Bridgeman et al. 1997) or to choose from a larger pool of multiple-choice questions. What the author proposes here is the choice between two completely different exam formats.
2. I attempted to make the different sections as equal as possible in terms of content and level of difficulty, but slight differences were unavoidable, thus affecting the validity of the findings. Nonetheless, I hope that a general trend might be discernible that could be used as the basis for future research.
3. Even though the author used a different learning style index for the survey, it became apparent that in order to measure learning-style impact on test performance a more nuanced index would be needed.
4. The descriptions of the different styles are adapted from Dr. Felder's Web site: http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/styles.htm

## References

Aiken, L. (1987). Sex differences in mathematical ability. A review of the literature. *Educational Research Quarterly*, 10, 25–35.

Becker, William E. and Michael Watts. 1996. "Chalk and Talk: A National Survey on Teaching Undergraduate Economics." *The American Economic Review* 86(2): 448–453.

Ben-Shakhar, G. and Y. Sinai. 1991. "Gender Differences in Multiple-Choice Tests: The Role of Differential Guessing Tendencies." *Journal of Educational Measurement* 28: 23–35.

Biggs, J. B. 1993. "What Do Inventories of Students' Learning Processes Really Measure? A Theoretical Review and Clarification." *Educational Psychology* 63: 3–19.

Bokhorst, F. D. 1986. "Confidence-Weighting and the Validity of Achievement Tests." *Psychological Reports* 59: 383–386.

Bolger, N. and T. Kellaghan. 1990. "Method of Measurement and Gender Differences in Scholastic Achievement." *Journal of Educational Measurement* 27: 165–174.

Brenenstuhl, D. C. and R. F. Catalanello. 1979. "The Impact of Three Pedagogue Techniques on Learning." *Journal of Experiential Learning and Simulation* I: 211–225.

Bridgeman, B., R. Morgan, and M. Wang. 1997. "Choice Among Essay Topics: Impact on Performance and Validity." *Journal of Educational Measurement* 34(3): 273–286.

Butler, Andrew C. and Henry L. Roediger, III. 2008. "Feedback Enhances the Positive Effects and Reduces the Negative Effects or Multiple-Choice Testing." *Memory & Cognition* 36(April): 604–623.

Chase, C. I. 1968. "The Impact of Some Obvious Variables on Essay-Test Scores." *Journal of Educational Measurement* 16: 39–42.

Collier, H. W. and W. A. Mehrens. 1985. "Using Multiple Choice Test Items to Improve Classroom Testing of Professional Accounting Students." *Journal of Accounting Education* Fall: 41–51.

Dunn, R. and K. Dunn. 1978. *Teaching Students through their Individual Learning Styles: A Practical Approach*, Reston, VA: Reston Publishing Division of Prentice Hall.

Ebel, R. L. 1972. *Essentials of Educational Measurement*, Englewood Cliffs, NJ: Prentice Hall.

Felder, R. M. and B. A. Solomon. 2000. *Learning Styles and Strategies*. North Carolina State University, Resources in Science and Engineering Education. http://www2.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/styles.htm (January 5, 2011).

Gay, L. R. 1980. "The Comparative Effects of Multiple-Choice Versus Short-Answer Tests on Retention." *Journal of Educational Measurement* 17(1): 45–50.

Geiger, M. A. 1990. "Correlates of Net Gain from Changing Multiple-Choice Answers: Replication and Extension." *Psychological Reports* 67: 719–722.

Gronlund, N. E. 1981. *Measurement and Evaluation in Teaching*, New York: Macmillan.

Harari, H. and J. W. McDavid. 1973. "Name Stereotypes and Teachers' Expectations." *Journal of Educational Psychology* 65: 222–225.

Hassmén, Peter and Darwin P. Hunt. 1994. "Human Self-Assessment in Multiple-Choice Testing." *Journal of Educational Measurement* 31(2): 149–160.

Holley, J. H. and E. K. Jenkins. 1993. "The Relationship between Student Learning Styles and Performance on Various Test Question Formats." *Journal of Education for Business* 68(5): 301–308.

Hunt, D. P. 1982. "Effects of Human Self-Assessment Responding in Learning." *Journal of Applied Psychology* 67: 75–82.

Johannesen, Monica and Laurence Habib (2010). The Role of Professional Identity in Patterns of Use of Multiple-Choice Assessment Tools. *Technology, Pedagogy and Education*, 19(1): 93–109.

Jonassen, D. H. and B. Grabowski. 1993. *Handbook of Individual Differences, Learning, and Instruction*, Hillsdale, NJ: Lawrence Erlbaum Associates.

Karns, G. 2006. "Learning Style Differences in the Perceived Effectiveness of Learning Activities." *Journal of Marketing Education* 28: 56–63.

Keefe, J. W., ed. 1979. *Student Learning Style: Diagnosing and Prescribing Programs*, Reston, VA: National Association of Secondary School Principals.

Kolb, D. 1976. *Learning Style Inventory*, Boston: McBer & Co.

Larsen, R. E. 1992. "Relationship of Learning Style to the Effectiveness and Acceptance of Interactive Video Instruction." *Journal of Computer-Based Instruction* 19: 17–21.

Maier, N. R. F. and G. G. Casselman. 1970. "The SAT as a Measure of Problem-Solving Ability in Males and Females." *Psychological Reports* 26: 927–939.

Marshall, J. C. 1967. "Composition Errors and Essay Examination Grades Re-Examined." *American Educational Research Journal* 4: 375–475.

Marshall, J. C. and J. M. Powers. 1969. "Writing Neatness, Composition Errors and Essay Grades." *Journal of Educational Measurement* 6: 97–101.

Messick, S., ed. 1976. *Individuality in Learning*, San Francisco: Jossey-Bass.

Morrison, M., A. Sweeney, and T. Heffernan. 2006. "Karn's Learning Styles and Learning Effectiveness: A Rejoinder." *Journal of Marketing Education* 28: 64–68.

Morrison, M., A. Sweeney, and T. Heffernan. 2003. "Learning Styles of On-Campus and Off-Campus Marketing Students: The Challenge for Marketing Educators." *Journal of Marketing Education* 25: 208–217.

Murphy, R. J. L. (1982). Sex Difference in Objective Test Performance. *British Journal of Educational Psychology*, 52, 213–219.
Myers, I. B. 1962. *Manual: The Myers-Briggs Type Indicator*, Princeton, NJ: Education Testing Service.
Nichols, Sharon L. and David C. Berliner. 2008. "Why Has High-Stakes Testing So Easily Slipped into Contemporary American Life?" *Education Digest* 74(1): 41–47.
Paivio, A. 1971. "Styles and Strategies of Learning." *British Journal of Educational Psychology* 46: 128–148.
Riding, R. and E. Sadler-Smith. 1992. "Type of Instructional Material, Cognitive Style, and Learning Performance." *Educational Studies* 18: 323–340.
Sax, G. and L. S. Collet. 1968. "An Empirical Comparison of the Effects of Recall and Multiple-Choice Tests on Student Achievement." *Journal of Educational Measurement* 5: 169–173.
Scannell, D. P. and J. C. Marshall. 1966. "The Effects of Selected Composition Errors on Grades Assigned to Essay Examinations." *American Educational Research Journal* 3: 125–130.
Schroder, H. M., M. J. Driver, and S. Struefert. 1967. *Human Information Processing*, New York: Holt, Rinehart & Winston.
Swain, Harriet. 2004. "It's as Easy as A, B or C." *Times Higher Education Supplement* 1648(July 9): 21–29.
Tatsuoka, K. K. 1991. *Item Construction and Psychometric Models Appropriate for Constructed-Responses*, Princeton, NJ: Educational Testing Service.
Vermunt, J. D. 1996. "Metacognitive, Cognitive and Affective Aspects of Learning Styles and Strategies." *Higher Education* 31: 25–50.

## Appendix A

***Sample Question in Different Exam Formats***

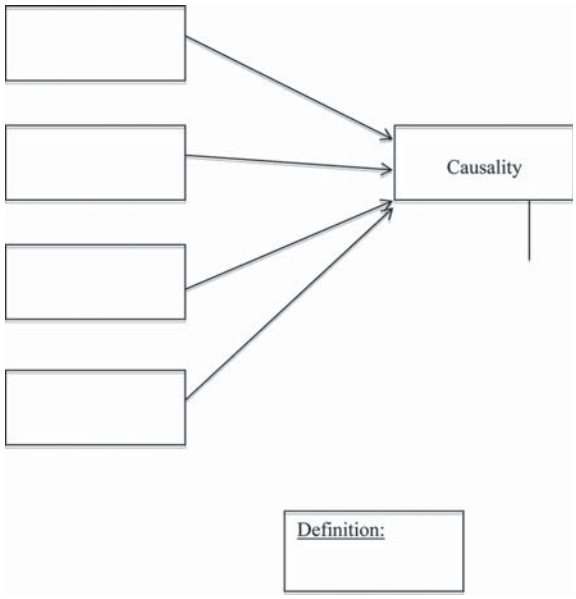
*Multiple-Choice Question*
Which of the following is NOT a condition for causality between variables?

A. The time-order has to be correct.
B. The two variables have to be correlated.
C. The relationship has to be nonspurious.
D. The relationship has to be positive.
E. All of the above are conditions of causality.

*Short-Answer Question*
Please explain the four conditions of causality and provide an example for each condition.

*Essay Question*
Please write a short essay about the study of "causality" in political science. Using an example of causal research from class or the textbook, be sure to address the conditions of causality as opposed to those of correlation.

*Fill-in-the-Blank Chart (Based on In-Class Handouts)*
Please fill in the missing information in the following chart:




*Application*
International relations scholars frequently debate the relationship between economic development and the existence of democratic institutions and values. Based on your readings and our in-class discussions of the topic, please identify the necessary conditions for a causal relationship between the two variables.

## Appendix B

Solomon-Felder Learning Styles and Strategies:
http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/styles.htm
Web-based Solomon-Felder Learning Style Inventory:
http://www.engr.ncsu.edu/learningstyles/ilsweb.html