# The Surprising Impact of Seat Location on Student Performance

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Every physics instructor knows that the most engaged and successful students tend to sit at the front of the class and the weakest students tend to sit at the back. However, it is normally assumed that this is merely an indication of the respective seat location preferences of weaker and stronger students. Here we present evidence suggesting that in fact this may be mixing up the cause and effect. It may be that the seat selection itself contributes to whether the student does well or poorly, rather than the other way around. While a number of studies have looked at the effect of seat location on students, the results are often inconclusive, and few, if any, have studied the effects in college classrooms with randomly assigned seats.[1] In this paper, we report on our observations of a large introductory physics course in which we *randomly* assigned students to particular seat locations at the beginning of the semester. Seat location during the first half of the semester had a noticeable impact on student success in the course, particularly in the top and bottom parts of the grade distribution. Students sitting in the back of the room for the first half of the term were nearly six times as likely to receive an F as students who started in the front of the room. A corresponding but less dramatic reversal was evident in the fractions of students receiving As. These effects were in spite of many unusual efforts to engage students at the back of the class and a front-to-back reversal of seat location halfway through the term. These results suggest there may be inherent detrimental effects of large physics lecture halls that need to be further explored.

## The Course

This study was done in the "Physics of Everyday Life" course we taught at the University of Colorado in Boulder. This is an algebra-based introductory physics course for nonscience, nonengineering majors and uses the textbook by L. Bloomfield with a similar name.[2] Our 201 students were a diverse mix of majors and ages, with 43% being first-term freshmen. The class included two 75-minute lectures per week, regular pre-class reading assignments, extensive weekly homework assignments, three evening hourly exams, and a comprehensive final.

## The Lecture

The lectures were designed to be highly interactive and engaging for the students via a number of methods. Peer instruction techniques[3] and a personal electronic response system (PERS)[4] were used extensively during every class to stimulate student discussion and to provide feedback to both the instructor and the student. During a typical class, students were asked to consider numerous questions (7 to 10). These questions were designed to, for example, elicit/reveal students' misconceptions, test for conceptual understanding, predict or reflect on demonstration outcomes, or draw on intuition from everyday life.

We emphasized student-student discussions that focused on sense-making and reasoning. In order to ensure all students were part of a well-defined and stable discussion group, students were randomly assigned to a seat location and a group at the start of the term, where each group was composed of three or four students seated adjacent to each other. We had the students debate many of the in-class questions with their group members and then click in their answer using their PERS device. To improve both the quality and amount of student discussion within the group, many of the questions required "group consensus answers."[5] Halfway through the term, seat locations were reversed front to back in the lecture hall, with some reorganization of groups where necessary.

A significant effort was made to keep all students engaged in the course. Two undergraduate teaching assistants and often a second faculty member moved throughout the classroom encouraging engagement and discussion with an explicit goal of getting students in the back involved. Although the lecture hall is relatively large with the projection screen and demonstration table about 2 meters from the nearest students and 13 meters from the most distant, the hall is sloped so that all seats have a clear view of the front.[6] To ensure good visibility from the back, we used PowerPoint slides projected on a large screen with a good LCD projector. All slides used large figures and fonts. A video camera was used to project a large image of any smaller demonstrations.

**Table I. Students grouped by *initial* seating assignment.**

| Seating group | Initial seat distance from front of class | # of students | Average GPA (not including this course) |
|---|---|---|---|
| Group 1 | 0–4 meters | 48 | 2.86 ± 0.11 |
| Group 2 | 4–6.5 meters | 48 | 2.95 ± 0.09 |
| Group 3 | 6.5–9 meters | 48 | 2.90 ± 0.08 |
| Group 4 | 9–12 meters | 57 | 2.89 ± 0.09 |

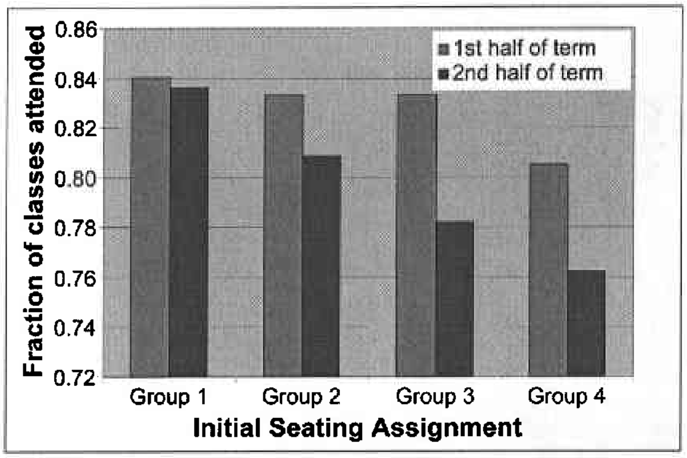


**Fig. 1. Initial seating location vs attendance. The average attendance is plotted for the first (blue) and second (red) half of the term for students grouped by the distance of their initial assigned seat from the front of the classroom.**

## The Grading

Students earned points for reading quizzes, class participation, homework, and exams. Typically, two points per class (in total accounting for ~12% of the possible points) were given for responding to the in-class questions (almost always regardless of whether or not the answer was correct). This grading structure encouraged attendance and involvement in the questions and in-class discussion. The attendance averaged 82.7% over the first half of the term with 1% of students virtually never attending. Over the second half of the term, the attendance averaged 79.6% with 5.4% of students virtually never attending.

## The Impact of Seat Location

Halfway through the semester when we switched the seating location of the groups to bring those in the back to the front and move the ones in front to the back, we found ourselves in a strange situation. Students sitting in the back of the room were attending more regularly and asking significantly more questions than those sitting in the front. Struck by this behavior, we carried out a more detailed analysis of the impact of the student's seating location.

We analyzed the course data by grouping the students based on their original seating location as listed in Table I. When the seat locations were reassigned at the midpoint of the term, the group locations were generally reversed (e.g., group #1 students were now near the back). We found the average of the GPAs for each group (not including this course) to be identical (see Table I), suggesting that the student populations were similar.

In our analysis, we looked for correlations between group number and a variety of other variables, and found some striking differences in the four groups.

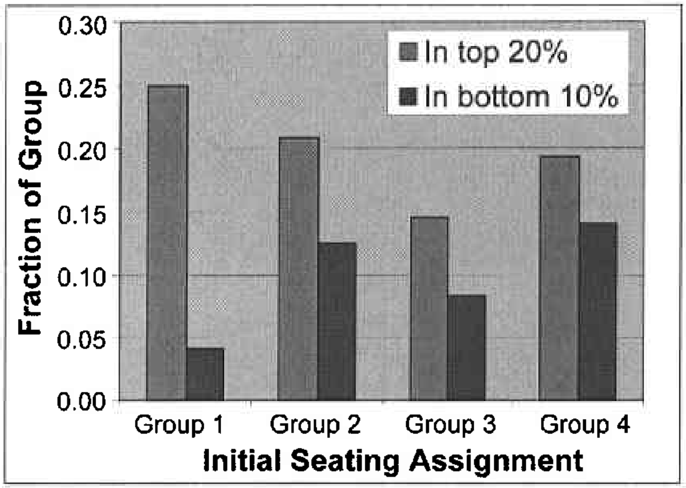


**Fig. 2. Initial seating location vs course performance (not including attendance). This plot shows the fraction of students within each group who were in the top 20% and in the bottom 10% of the class for total points earned excluding attendance points. The effect is even more pronounced when looking at final grades, where attendance points are included.**

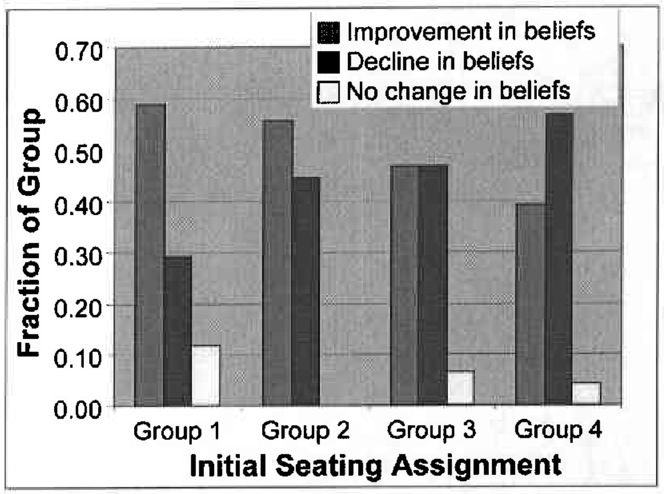


**Fig. 3. Initial seating location vs students' beliefs. The fraction of students within each group whose beliefs about physics improve over the term is correlated with the distance of their initial assigned seat from the front of the classroom.**

Figure 1 shows each group's average attendance for the first and second half of the term. Two trends are evident: the further the original seating location is from the front of the classroom, then 1) the lower the average attendance and 2) the larger the drop-off in attendance between the first and second half of the term. The trend in the drop-off in attendance is particularly notable because during the second half of the semester, students in group #1 were sitting *far* from the front while students in group #4 were sitting *close* to the front. Even though the students in group #1 were now sitting far from the front and skiing season had begun, their average attendance declined by less than 1%!

We also looked at the relationship between seating location and grade. We found a difference in average grade for the four groups that is at the edge of statistical significance; however, the effects on the top and bottom of the grade distribution are quite pronounced. The fraction of A's decreased steadily as the group's *original* seat location was further from the front (27% in group #1 received A's compared to 18% in group #4), while the fraction of F's increased (2% in group #1 to 12% in group #4). Student performance did not change significantly between the first and second halves of the semester; the students who started in front and doing well continued to do so when they moved to the back. As shown in Fig. 2, even when the attendance contribution to the grade is removed, there is still a clear effect.

Finally, we looked at the students' beliefs about physics and learning physics for the different groups. These were probed using the Colorado Learning Attitudes about Science Survey (CLASS),[7] where students are asked to consider statements about physics and respond on a five-point, strongly-agree-to-strongly-disagree scale (e.g., "Knowledge in physics consists of many disconnected topics" or "I think about the physics I experience in everyday life"). About half of the students in each group were given the CLASS both at the beginning and end of the course to measure these beliefs. In Fig. 3, we show the fraction of students within each group whose beliefs improved (moving from more novice-like to more expert-like beliefs) or deteriorated. While there is considerable uncertainty because of the limited statistics, we find that a larger fraction of students who started the semester in front showed improved beliefs compared to those who started the semester in back. It should be noted that it is typical for the beliefs of students to decline in introductory physics courses that use mostly traditional teaching practices.[8]

In summary, we have seen that the assigned seat location in a large lecture hall has a significant effect on students' attendance, grades, and beliefs about physics. This is in spite of many activities that were designed to engage all students in the class and some activities specifically aimed at students at the rear of the room. It would be interesting to see how such seat location effects might vary with different instructional styles and student populations.


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