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Does Seat Location Matter? A Review of the Proximity Effect in Large and Small Classrooms

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The proximity effect—whether distance from an instructor correlates with grades—has been the topic of many articles dating back nearly 100 years. Despite this attention, a cleavage in the literature remains. Some authors argue that increased proximity to the instructor negatively relates with academic performance while others maintain no proximity correlation with grades. This paper posits that a consensus does exist: seat location influences grades in larger classrooms but not in smaller ones. To support that position, these authors offer a review of previous literature and add to that body by analyzing student performance in six relatively small community college economics classes. In that analysis, seat location bore no statistical correlation with student performance, supporting the conclusion that proximity affects grades less often in small classrooms than in large.

Today's college students face spiraling tuition costs upon entry to college and heightened job market competition upon graduation. Coincidentally, higher educational institutions are experiencing increased accountability for outcomes and greater pressure to prepare students for post-academic work. The confluence of these trends justifies any reasonable effort to enhance or augment student academic success. To that end, researchers often explore classroom ecology in an effort to understand student outcomes. Historically, of the many topics comprising classroom ecology research, seat location remains a favored topic.

Significant effort has been expended to tease out the factors that enhance or deter student performance as it relates to seat location in the higher edu-

cation classroom. In fact, research in this area dates back nearly a century (Griffith, 1921) where an initial but illusive question was considered: Is there a relationship between a student's proximity to the instructor and academic performance? Since then, reviews of performance outcomes as they relate to seat location continue to broaden with two general theories emerging: behavioral theory and ecological theory.

Under the umbrella of behavioral theory, analysts observing a correlation of seat location to student grades attempt to explain differences in performance through student personality characteristics. Behavioral theorists argue that if a correlation between proximity to an instructor and student performance exists, it is likely because more prepared or more interested students tend to select seats closer to the instructor. As proof, numerous studies have analyzed personality traits relative to student seat selection and performance. Some examples of determinant variables include self-esteem (Hillmann and Brooks, 1991), anxiety (Rebeta et al., 1993), and attitude about the subject (Becke, et al., 1973). In each of these cases, authors believe the underlying nature of the student, not the location of the seat, explains why differences in student performance may occur as a student's seat location becomes more distant from the instructor.

A different line of thinking within the behavioral theory concludes that distance from an instructor influences student behavior and that by extension can influence student performance. For example, proximity from instructor has been analyzed in conjunction with class participation and engagement (Becker et al., 1973; Koneya, 1976; Wulf, 1977; Levine et al., 1980; Richards, 2006; Fernandes et al., 2011; Parker et al., 2011), attendance (Buckalew et al., 1986; Brooks and Rebeta, 1991; Perkins and Wieman, 2005; Zomorodian et al., 2012), and teacher and student relationships (Becker et al., 1973). Here again, analysts espousing these views would argue that it is a behavioral factor that explains any inverse relationship between distance from an instructor and performance.

Alternatively, the ecological theory speculates that classroom ecology (i.e., the classroom's physical characteristics) serves as a key determinant of student performance. When examining an observed relationship between seat location and student outcomes, these analysts point to other determinants such as room configuration (Meeks et al., 2013), seating density (Holliman & Anderson, 1986) and lighting, noise or acoustical properties (Griffith, 1921; Horowitz and Otto, 1973; Black, 2007; Yang et al., 2013). In each of these cases, analysts argue that differences in student performance hinge on the classroom's physical attributes.

A broad sweep across the whole of this analysis illuminates some areas where little controversy exists: seat location plays a key role in attendance and in many cases, participation. However, there is an important area of research where a clear consensus cannot be found: the correlation between distance from the instructor and student grades (what is from here forward referred to as the "proximity effect"). This paper offers an explanation as to why numerous research efforts draw opposing conclusions when exploring this issue by asking: is the proximity effect observed in both large and small classrooms?

Beginning with an outline of the findings in the literature, giving particular attention to research that has focused on the existence of a proximity effect, these authors find that class size plays a key role in this debate. More specifically, the authors reveal that a negative relationship between grades and seat location is reported far more often in literature-examining classes that are relatively large and is not observed in similar but smaller research-analyzing classrooms. These authors then test this theory using the data that are available to them, by investigating the impact of seat location on student grades in six small economics classes offered at Tidewater Community College in Southeastern Virginia.

Related Research

In total, 16 articles were found that specifically address the existence of a proximity effect. Each is briefly described below with attention first given to large classrooms, then to smaller classrooms. For this work, a large classroom is defined as 45 or more students while a small classroom is limited to fewer than 45 students. While this figure was selected subjectively through pedagogical experience, modest movements in this threshold are not believed to be consequential to the broader findings herein.

Griffith's (1921) research on student outcomes and seat location entitled "A Comment Upon the Psychology of the Audience" pioneered the first of these large classroom analyses. This robust review of roughly 20,000 grades of students in randomly assigned seats revealed that the academic performance of students in the front central portion of the room exceeded the outlying seats, with a more marked difference reported for students in the back of the classroom. While this study did not specify the exact classroom sizes, it did describe classes as large with the ability to hold 70 to 100 students each. Becker et al. (1973) also analyzed large classrooms: 283 students in three sections. They reported that grades decreased significantly as students chose seats further from the front and center of the classrooms and found an interaction effect between

distance from instructor and areas toward the sides of the classroom as well. Brooks and Rebeta (1981) investigated 12 psychology classes with 47 to 54 students over a six-year period. While the primary focus of this analysis centered on attendance, these authors also reported that students fared significantly worse academically as seats drifted further from the instructor. Holliman and Anderson (1986) examined proximity to instructor in two large psychology classes (141 students) and reported an inverse relationship between distance to the instructor and course average. They also noted that students who chose to sit closer to the instructor were significantly more likely to receive A's. In another example of large classroom analysis (180 and 158 students per section), Benedict and Hoag (2004) found that students who chose to sit in the front of the classroom also performed significantly better. In addition, when students preferring back seats were forced to move forward, these authors reported that their grades improved. Perkins and Wieman (2005) studied a large physics classroom with 201 students who were randomly assigned seats for the first half of the semester then were required to switch (front to back) for the second half of the semester. They found a significant impact on grade distribution in the first half of the semester, with students in the back nearly six times more likely to receive an F than students in the front. Similarly, Zimorodian et al. (2012) studied a class of 106 students and found a statistically significant proximity effect as well.

In a mixed seating arrangement designed to explore different behavioral influences, Stires (1980) examined two sections of the same psychology class with 279 students—one where students selected their seats and another where seats were assigned alphabetically. The author discovered that students seated in the middle of the classroom achieved higher grades on tests than the students positioned in the side seats but a front-to-back correlation was not reported. Interestingly for this work, that paper reported that the room used in this analysis was far wider than deep. These authors contend that given this room configuration, any evidence of a proximity effect would be more pronounced from side to side than front to back—as was observed. Nearly coincidentally, Levine et al. (1980) explored the role that assigned seating may have on a proximity effect in a two-phase study of a classroom with 209 students. In phase 1, students selected their seats and remained in those seats for four weeks. In phase 2, students were required to move to randomly assigned seats for the duration of the course (four additional weeks). Once again, the negative proximity effect prevailed in the self-selection phase as grades worsened when distance from the instructor increased. Rennels and Chaudhari (1988) visited the same query in a large auditorium seating 180 or more

students. The authors divided seats into nine subsections: three on the left, three in the center, and three on the right side of the room. They reported that grades generally fell as distance to the instructor increased in the middle three sections regardless of seating method. Further evidence of a proximity effect in large classrooms can be found in the work of Armstrong and Chang (2007). These authors separated 20 large class sections containing between 236 and 322 students per section into three groups. In the first group (six sections), students selected their seats and received lecture-based instruction. In the second group (six sections), students selected their seats in a cooperative learning environment. In the final group (eight sections), instructors assigned seats and used a cooperative learning model. These authors reported that six of 20 sections (all self-selected seating) showed a significant and negative correlation between distance from the instructor and grades. Among those that did not, all were inconclusive with the exception of one assigned seating section (with cooperative learning) where grades positively correlated with distance.

In only one case did these authors find a clear lack of support for a proximity effect in a large classroom (Parker et al., 2011). In this study, instructors divided a class of 55 students in half and assigned students alternating seats (like a checkerboard). Half of the class (the "stay group") remained in their original seat while the other half (the "move group") continuously and randomly changed seats through the semester. The prime focus of the analysis was to determine if differences occurred in participation between groups. In closing and almost anecdotally however, they also noted that there was "no significant difference in final grade between the front and back stay group students" (p. 82). It is difficult to address these findings, which arguably stand alone against a broader pattern of a proximity effect in large classrooms, particularly since the authors offer little information related to room configuration. However, despite this result, a preponderance of evidence discussed here supports the idea that a proximity effect may exist in large classrooms. Within this selection of studies, only one case fully opposes the premise that a proximity effect exists in large classrooms and many offer extensive support for that idea.

Shifting to small classroom analyses, an examination of five studies follows. First among them, Wulf (1976) examined the existence of a correlation between seat location and grades, GPA and participation in two psychology courses. The two courses included 44 students in self-selected seats and 37 students in randomly assigned seats. The study produced

no evidence of a proximity effect in either group. Millard and Stimpson (1980) also examined the impact that seating location had on grades, as well as four "personal preference factors" including enjoyment, interest, motivation, and inclusion. In this case, instructors assigned 43 students seating in various zones. Zones were designed such that each was successively more distant from the instructor. Every two weeks, students took a test and moved to a newly assigned seat. While the authors reported correlations between seating location and each of the four personal preference factors, no correlation between test scores and seating zone occurred. Buckalew, Daly, and Coffield (1986) examined the potential existence of a proximity effect for 215 students over nine sections of psychology classrooms—roughly 25 students per section. Again, a statistically significant correlation between student seating location and performance remained absent. Kalinowski and Taper (2007) concurred with the idea that a proximity effect does not exist in small classrooms in their study of 43 students who were assigned seats, reporting grades were uncorrelated with seat location. Finally, Griffith's (1921) seminal work lends support here as well. While he did find evidence of a proximity effect in large classrooms, he also reported that in smaller classes and labs such a relationship diminished. He did not specify sizes of these classes but these authors present his anecdotal commentary here, given a relatively limited set of small class observations available in the current literature.

As summarized in Table 1, this review offers substantial evidence of a proximity effect in large classrooms while smaller classroom examinations uniformly lack an indication of such an effect.

Given an absence of a proximity effect in small classrooms, these authors assert small class sizes may benefit students as they mitigate a proximity effect. By extension, the existence of a proximity effect in large classrooms has the potential to act as an obstacle to students in seating locations distant from the instructor. In essence, classroom size can impact student performance.

Analysis

To further support the idea that a proximity effect does not exist in smaller classrooms, data was collected for six courses over a recent academic year. In each of these classes, students were allowed to select their own seats. Once seats were selected, students were asked to remain in the same seat during the semester. The rationale given for that request was that remaining in the same seat facilitated the learning of names. Students uniformly

Table 1. Distribution of Support For and Against a Proximity Effect in Small and Large Classrooms

	Large Classroom	Small Classroom
Proximity Effect Observed	Becker et al. (1973); Self-Selected Seating Benedict & Hoag (2004); Self-Selected Seating Brooks & Rebata (1981); Self-Selected Seating Griffith (1921); Assigned Seating Holliman & Anderson (1986); Self-Selected Seating Levine et al. (1980); Mixed Seating* Armstrong & Chang (2007); Mixed Seating* Perkins & Wieman (2005); Mixed Seating* Rennels & Chaudhari (1988); Mixed Seating* Stires (1980); Mixed Seating* Zimorodian el al. (2012); Self-Selected Seating	None
Proximity Effect NOT Observed	Parker et al. (2011), Mixed Seating*	Buckalew et al. (1986); Seating format unspecified Griffith (1921); Assigned Seating Kalinowski & Taper (2007); Assigned Seating Millard & Stimson (1980); Assigned Seating Wulf (1976); Mixed Seating*

* Mixed seating involves switching classes from front to back during the term, developing groups that move at some point during the semester, or designating different sections by seating format.

complied with that request. The sample courses included both 100- and 200-level economics classes with the same instructor for all classes.

Classes met in two separate rooms, each with capacity seating of 36 students. Both rooms contained four rows of seats, and had a podium and small worktable located at the front and center of the room. Each classroom is equipped with four monitors measuring 48 and 60 inches diagonally, the larger two of which are mounted high on the front wall while the smaller are suspended from the ceiling halfway to the back of

the room. At most, a seat is no further than 23 feet from a monitor in either classroom, a detail that may be important to ecological theory proponents that examine the impact that access to visual material may have on performance. The front of the room contained a large whiteboard, and the greatest distance from the whiteboard for any given seat was 32 feet. In general, all visual displays were considered to be easily observable by these authors regardless of seat location.

Classes comprised of lecture accompanied by visual presentation (in PowerPoint) of key concepts, historical data, and other pertinent material. Additionally, in order of decreasing frequency of use, students engaged in problem-solving exercises, in class discussion of current events as they relate to course concepts, group activities, and multimedia presentations (i.e., short videos lasting fewer than 10 minutes). The whiteboard was used occasionally to demonstrate the application of formulae, or to emphasize key terms.

Two of the sections took place in what might be described as a traditional classroom (a non-tiered classroom with linear rows of tables and chairs), while students in the remaining four sections received instruction in a tiered classroom. The non-tiered classroom was square and measured 36 by 36 feet and each row contained 10 seats with the exception of the last row (which had six seats). Chairs and desks were movable, though this room configuration did not change during the course of the semester. A single door was located in the back right corner (all descriptions given are from the presenter's perspective) and the leftward wall was floor-to-ceiling glass overlooking woods and a small lake. Student seating reached the wall on both sides of the room and was separated by a singular center aisle. Across the two sections held in this classroom, 33.3% of the students selected front row seating while fewer students selected seats further from the podium (27.1%, 18.8%, and 20.8% in the second, third, and fourth row, respectively).

The tiered classroom had fixed furniture that was arranged in a gentle horseshoe shape. The rows held (moving from front to back) 7, 8, 9, and 12 seats each. The room was rectangular being wider than it was deep and measured 46 by 36 feet. Access points include two doors, one in the middle of the left wall and one in the front of the right wall. The latter was an external door, routinely locked from the outside and rarely used for entry, though it was routinely used for egress. The back wall was largely glass and overlooked the building's lobby. Two aisles located on each side of the room allowed students to access seating. Seat selections in this classroom tended to favor the rear of the room as the distribution

of seating was 12.8%, 22.0%, 32.1%, and 33.0% in rows one through four, respectively. Across all six courses, class sizes ranged from 21 to 33 students. A summary of course and classroom characteristics is provided in Table 2.

Table 2. Summary of Course and Classroom Characteristics

	Course Number	Course Title	Typical year of student	Classroom	Class size/ Capacity
1	ECO 210	International Economics	2nd	Not tiered	22/36
2	ECO 120	Survey of Economics	1st	Not tiered	32/36
3	ECO 202	Principles of Microeconomics	2nd	Tiered	33/36
4	ECO 120	Survey of Economics	1st	Tiered	21/36
5	ECO 201	Principles of Macroeconomics	2nd	Tiered	29/36
6	ECO 201	Principles of Macroeconomics	2nd	Tiered	26/36

To explore the existence of a proximity effect (or lack thereof), six separate linear (univariate) regression models with significance levels of 5% ($\alpha = 0.05$) were developed for each course. In each model the final numerical course grade (GRADE) served as the dependent variable and the row in which the student sat (coded as ROW and taking the value of 1–4) was the sole independent variable.

The model that offered the most explanatory power among the six was for Course 6. In that course, slightly less than 5% of the variation in final grades was explained by the seating location. No other model offered explanatory power of more than 3% and in two cases (Course 1 and Course 4), the model offered virtually no explanatory power whatsoever. Further, coefficients for the independent variable ROW were near zero in each of the six courses and t-scores related to those coefficients took both no pattern in signage and no significance in magnitude. Based on this data, and in corroboration of previous literature examining small classrooms, support for the idea that a proximity effect exists in small classrooms cannot be reported. A summary of these statistical results is displayed in Table 3.

Table 3. Summary of Regression Results

		Intercept		Row		
	n	Coefficient	t-statistic	Coefficient	t-statistic	R^2
1	22	0.78	9.84	–0.01	–0.22	0.0025
2	32	0.76	15.66	0.02	0.91	0.0269
3	33	0.88	19.13	–0.01	–0.88	0.0244
4	21	0.83	10.21	0.00	0.00	0.0000
5	29	0.69	6.17	0.03	0.88	0.0279
6	26	0.88	9.50	–0.04	–1.12	0.0496

Discussion

Consistent with previous analyses of small college classrooms these authors did not find evidence of a proximity effect in any of the six courses examined. However, that finding is in contrast to numerous reports of a proximity effect in large classrooms, an inconsistency which suggests that a proximity effect may be exclusively a large class phenomenon. If true, then research to date allows one to conclude that larger classrooms may disadvantage some students, a finding which may prompt classroom design to be reexamined, particularly in a period where infrastructure investment may be accelerating.[1] Even more, large courses often serve students in their first or second year of college/university, when they are likely least prepared for such a radical change in classroom ecology.

The conclusion that a proximity effect might be a large classroom phenomenon should bring about new questions higher education institutions need to consider. For example, if large classrooms do disadvantage students seated far from the instructor, then what potential alternatives to these large classrooms might be available? Is online teaching a viable substitute? Can possible hurdles related to a proximity effect be mitigated through supplemental online content or in some other way? It is in the interest of both students and academic institutions to ponder these questions further.

These authors admit that many additional variables—both relating to students, classroom features, and beyond—can act as determinants to performance. They encourage future research to both compare the proximity effect in large and small classrooms, especially for analysts that have access to data for both classroom sizes. Additionally, these authors recom-

1 A review of data from "The 20th Annual College Construction Report" (Abramson, 2015) demonstrates that college construction activity rebounded strongly after the financial crisis, increasing 25% from 2012 to 2014.

mend further study of small classrooms in an effort to build the relatively smaller body of research about small classrooms and the proximity effect.

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