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Predicting Success in an Online Course using Expectancies, Values, and Typical Mode of Instruction

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Abstract: Expectancies of success and values were used to predict success in an online undergraduate-level introductory statistics course. Students who identified as primarily face-to-face learners were compared to students who identified as primarily online learners. Expectancy-value theory served as a model. Expectancies of success were operationalized as self-efficacy for learning online and self-efficacy for learning statistics. Values were separated into the worth of learning statistics and the value of grades in the course. The purpose of this study was to determine if there are differences in the variables that may be used to predict final exam scores and successful course completion in typically face-to-face and typically online students, because there are differences in the populations of students who tend to take courses in these two different formats (i.e., traditional and adult learners). In predicting final exam grades there were no interactions with typical mode of instruction, though worth of statistics was a significant covariate and there was a main effect for typical mode of instruction. In predicting successful course completion, there were interactions between typical mode of instruction and one of the online learning self-efficacy subscales as well as the worth of statistics scale. These results are discussed in relation to the application of mainstream motivational models in the populations of traditional and adult learners.

Keywords: online education; statistics education; online learning self-efficacy; self-efficacy for learning statistics.

Résumé : Les attentes de succès et valeurs ont été utilisées pour prédire la réussite dans un cours en ligne d'introduction aux statistiques de niveau licence. Des étudiants identifiés comme apprenant principalement en face-à-face ont été comparés à d'autres apprenant principalement en ligne. La théorie de l'attente-valeur a servi de modèle. Les attentes de réussite ont été opérationnalisées en prenant en considération l'auto-efficacité dans l'apprentissage en ligne et l'auto-efficacité dans l'apprentissage des statistiques. Les valeurs ont été prises en considération en distinguant la pertinence d'apprendre les statistiques et la valeur des niveaux dans le cours. L'objectif de cette étude était de déterminer s'il y avait des différences dans les variables, qui pourraient être utilisées pour prédire les scores finaux d'examen et l'achèvement réussi des cours des étudiants typiquement en face-à-face et typiquement en ligne, sachant qu'il y a des différences dans les populations des étudiants qui tendent à suivre des cours dans ces deux différents formats (c'est-à-dire, les étudiants traditionnels *vs* les apprenants adultes). Il a été constaté que la prédiction des résultats finaux des examens n'avait pas de lien avec le mode d'instruction typique, même si la valeur des statistiques est une covariante significative et que l'effet du mode d'instruction typique est notable. La prédiction de l'achèvement des cours implique, quant à elle, une mise en lien du mode typique d'instruction et d'une des sous-échelles d'auto-efficacité de l'apprentissage en ligne de même que de la valeur de l'échelle statistique. Ces résultats sont discutés à la lumière de l'application des principaux courants motivationnels des populations d'apprenants traditionnels et d'apprenants adultes.

Mots-clés : éducation en ligne ; enseignement des statistiques ; auto-efficacité dans l'apprentissage en ligne ; auto-efficacité dans l'apprentissage des statistiques

Introduction

Many undergraduate programs require their students to complete an introductory statistics course. This is a requirement that many students struggle with or even attempt to avoid for a long as possible (Gordon, 2004; Onwuegbuzie & Wilson, 2003). Anecdotally, instructors of one online undergraduate-level introductory statistics course have noted that some students enter their course with low expectations in terms of their performance. For example, some students indicated they are satisfied to earn the minimum grade necessary to meet their degree requirements. These comments suggest that students have low perceptions of the value of the course and low performance expectations. This, along with the often-held belief that statistics is difficult, may lead to poor course performance.

According to the basic tenets of expectancy-value theory, "individuals' choice, persistence, and performance can be explained by their beliefs about how well they will do on the activity and the extent to which they value the activity (Atkinson, 1957; Eccles et al., 1983; Wigfield, 1994; Wigfield & Eccles, 1992)" (Wigfield & Eccles, 2000, p. 68). Students who do not believe that they can be successful in a course and those who do not value doing well in the course, either for the grade or personal development, are predicted to put forth less effort than those who believe that they have the ability to do well and value doing well in the course. That effort is then seen in students' grades and in whether or not they complete the course.

Expectations of success may be operationalized as self-efficacy beliefs. Eccles and Wigfield (2002) note that the expectations beliefs in their model "are measured in a manner analogous to measures of Bandura's (1977) personal efficacy expectations" (p. 119). Self-efficacy is an individual's perceptions of what he or she is capable of performing at a certain level of success (Bandura, 1977, 1982, 1997). This is similar to, though more specific than, the construct of self-concept. In a previous study of the same course, self-concept was found to be positively related to final exam scores and successful course completion (Zimmerman, Shumway, & Johnson, 2016).

Context and Purpose

The course featured in the present study is an undergraduate-level introductory statistics course taught completely online. Data were collecting during a summer session, which is unique because half of the students enrolled in the summers are typically face-to-face learners, not full-time online students. It is unknown if the expectancy-value model will have differential effects for typically face-to-face and typically online students given the differences between the two populations. Students who typically enroll in face-to-face courses at this institution tend to be traditional students while the full-time online students are often adult learners. Research in adult education, such as Knowles' (1984)

theory of andragogy, suggests that traditional and adult learners may differ in terms of their motivations to learn. For instance, adult learners tend to be more intrinsically motivated and motivated to learn what they believe they will have a use for in their own lives (Knowles, 1984). Within the expectancy-value theory of motivation, these aspects would fall into the category of values. While expectancy-value theory has been applied primarily in K-12 settings and with traditional students, Gorges (2015) argues that the theory should also be considered for use with adult learners. It is not yet known if differences between traditional and adult learners will impact how the expectancy-value model will perform. We do not know if the relations between expectancies, values, and success in the course will differ for these two groups of students.

In a traditional higher education environment, expectancy-value theory has been applied in the context of a statistics course. Hood, Creed, and Neumann (2012) observed statistically significant relations between students' overall course grades and their perceptions of value ($r = .23$, $p < .05$) and between students' overall course grades and their expectancy beliefs ($r = .28$, $p < .05$). Using path analysis methods, their model, which included past performance, cognitive competence (similar to self-concept), perceptions of difficulty of statistics, affect, effort, value, and expectancies, was able to explain 40% of the variation in achievement measured as overall course grades.

The purpose of this study is to examine differences in the application of the expectancy-value theory of motivation between individuals who are typically face-to-face students and individuals who are typically online students. The context is specifically that of an online introductory statistics course. All participating students were enrolled in online sections of the course with similar structures and identical final exams. This allowed for the unique opportunity to make direct comparisons between typically online and typically face-to-face students and to determine if the predictive ability of the model varies for the two groups.

Review of Literature

Relevant literature related to self-efficacy and perceived value was reviewed. Given that the course in question was an online statistics course, research concerning self-efficacy for both learning statistics and learning in the online environment was reviewed. In terms of value, literature concerning the value of learning statistics was reviewed as well as literature concerning the value of earning a good grade in the course. In relation to each of these constructs, differences between traditional and adult learners are discussed.

Self-Efficacy

Self-efficacy beliefs are one's perceptions of one's abilities to successfully complete a specific task (Bandura, 1977, 1982, 1997). This task-specificity is what distinguishes self-efficacy from self-concept

or self-esteem, which are discipline-specific but more holistic constructs. Research in a variety of domains has found positive relationships between self-efficacy and performance (Bandura, 1997). Individuals with higher levels of self-efficacy in a given area are more likely to engage in related behaviors (Pajares, 1996) and to persist when challenged (e.g., Lent, Brown, & Larkin, 1984; Schunk, 1981).

Self-efficacy is often cited as being influenced by four sources: personal experiences, vicarious experiences, psycho-physical state, and feedback from others (Schunk, 2012). Adult learners may bring with them more experiences than traditional students, which may make their self-efficacy beliefs stronger due to more reinforcement over time. The effect that this has on motivation may be dependent on whether those experiences have been positive or negative.

Research has found differences in the self-efficacy ratings given by traditional and adult learners, though those results have not been consistent in terms of one group having higher efficacy than the other. Malhotra (2015), for example, found that adult learners in a finance course had higher levels of self-efficacy than their traditionally-aged counterparts. The opposite was observed by Jameson and Fusco (2014) in terms of mathematics self-efficacy; they found that adult students scored lower on their measure of mathematics self-efficacy. These conflicting results suggest that the differences between traditional and adult learners may vary for different content matter.

Self-Efficacy for Learning Statistics. Self-efficacy in the domain of statistics can be approached in a number of ways. Students' confidence in their current abilities has been examined both in terms of an overall introductory statistics course [e.g., Current Statistics Self-Efficacy (CSSE) scale, Finney & Schraw, 2003] and in terms of a specific topic (e.g., chi-square test of independence, Zimmerman & Goins, 2015). Students' self-efficacy for learning statistics in the future has also been studied [e.g., Self-Efficacy to Learn Statistics (SELS), Finney & Schraw, 2003]; this emphasizes students' perceptions of their abilities to master statistical concepts at a later time, for example, in an upcoming statistics course.

In the context of a face-to-face undergraduate-level introductory statistics course, Finney and Schraw (2003) developed the SELS scale, which consists of 14 tasks related to learning objectives covered in most introductory statistics courses. When given this scale, students rate their level of confidence in their ability to learn to complete each of the 14 tasks on a scale of 1 to 6, where a rating of 1 signifies "no confidence at all" and 6 signifies "complete confidence." In their original study, a positive relationship was observed between students' SELS ratings at the beginning of a course and their end-of-course grades ($r = .340$, $p < .01$). That is, students who were more confident in their ability to learn the materials at the beginning of the course tended to have higher grades at the end of the course.

Given the results of Finney and Schraw's (2003) study, and research on self-efficacy theory in general, a positive relationship is expected between self-efficacy for learning statistics at the beginning of a course and course outcomes. Finney and Schraw related self-efficacy to course grades, but positive relations are also hypothesized with final exam grades and successful course completion. No research was identified that compared self-efficacy for learning statistics for traditional and adult learners.

Online Learning Self-Efficacy. In addition to self-efficacy for learning the content, self-efficacy for learning in the online context is also important to consider in the context of an online statistics course. Without regular synchronous meetings, online courses may require that students have advanced time management skills and self-discipline compared to face-to-face courses (Ko & Rossen, 2010). Compared to face-to-face courses, online courses often require more use of technology. Much of the previous research on self-efficacy in online learning contexts has focused on technology use (for a review, see Alqurashi, 2016). Here, research that has looked beyond self-efficacy for using technology, to address other areas of online learning, will be reviewed.

Online learning self-efficacy is a multidimensional construct. Shen, et al. (2013), for example, identified five factors: self-efficacy to complete an online course, self-efficacy to interact socially with classmates, self-efficacy to handle tools in a course management system, self-efficacy to interact with instructors in an online course, and self-efficacy to interact with classmates for academic purposes. With the exception of the self-efficacy to interact socially with classmates subscale, there were statistically significant positive relations between the number of online courses completed and self-efficacy ratings. Students with more personal experiences with online learning tended to have higher levels of self-efficacy.

A dimensional approach to operationalizing online learning self-efficacy was also taken by Zimmerman and Kulikowich (2016) with their Online Learning Self-Efficacy Scale (OLSES), which consists of three subscales: self-efficacy for learning online, self-efficacy for time management, and self-efficacy for using technology. They compared the factor structures of scores from students with and without online learning experience and found that the structure of the subscales was similar for students with and without online learning experience. This provides evidence for using the OLSES with students with and without online learning experiences. While there were no underlying structural differences, on each subscale students with online learning experience gave higher ratings than students without online learning experience. They also found that all three self-efficacy subscales were positively correlated with age, the number of online courses a student has completed, perceptions of one's own technology skills, one's general opinion of online education, and one's likelihood to enroll in an online course in the future.

Differences between traditional and adult learners, in terms of their self-efficacy for learning online, may be confounded by their prior online learning experiences. Research directly comparing the two groups may find that adult learners tend to have higher online learning self-efficacy because they tend to have more experience taking online courses compared to traditional students. That is, age or adult learner status is not the reason for higher efficacy but, rather, more personal experiences are the cause. It is also important to take into account that students self-select whether or not to take face-to-face or online courses. Students with low self-efficacy for learning online may be less likely to enroll in online courses if face-to-face options are available.

Value

In addition to having the confidence in one's abilities to be successful, the perceived value of the task also influences behavior. In an academic setting this includes the value of mastering the content and the value of the grade in the course. First, research concerning the value of learning statistics is reviewed. This is followed by a discussion of students' perceptions of the value of grades.

Value of Learning Statistics. According to Schau et al. (1995), value is an aspect of students' attitudes toward statistics. They define this aspect as "attitudes about the usefulness, relevance, and worth of statistics in personal and professional life" (pp. 869-870). Cruise et al. (1985) refer to this construct as "worth of statistics."

Cruise et al.'s (1985) Statistical Anxiety Rating Scale (STARS) includes a worth of statistics subscale that has been widely used, along with five other subscales: test and class anxiety; interpretation anxiety; fear of asking for help; fear of statistics teachers (sometimes referred to as "attitudes towards statistics teachers"); and computation self-concept. Researchers who have administered the STARS have frequently reported relations between students' perceptions of the worth of statistics and the other five subscales. Papousek et al. (2012), for example, found positive relations between students' perceptions of the worth of statistics and different types of anxiety including anxiety related to taking a statistics course and taking a statistics exam ("test and class anxiety," $r = .50$); anxiety for interpreting statistics in different contexts, for example in a journal article or through output from a computer ("interpretation anxiety," $r = .73$); and fear of asking for help in a statistics course ($r = .49$). They also found positive relations between perceptions of the worth of statistics and fear of statistics teachers ($r = .69$) and with self-concept in the area of statistics ($r = .61$). Students with more positive views concerning the value of statistics had lower levels of anxiety, more positive attitudes towards teachers, and more positive self-concepts.

Hanna, Shevlin, & Dempster (2008) also found statistically significant correlations between students' ratings of the STARS' worth of statistics subscale and the anxiety subscales (test and class anxiety, $r = -.54$; interpretation anxiety, $r = -.54$; fear of asking for help, $r = -.34$), the attitudes towards statistics

teachers subscale (r = .66), and the self-concept subscale (r = .76). Note that the direction of scoring was different between the Hanna et al. study and the Papousek et al. (2012) study and that the relations were actually in the same direction for both studies. More positive views concerning the worth of statistics were related to lower anxiety levels, more positive attitudes towards statistics teachers, and more positive self-concepts.

Neither of the reviewed studies compared traditional and adult learners or face-to-face and online learners. However, it is reasonable to believe that traditional and adult learners may differ in terms of their perceptions of the value of statistics. According to Moore (1986, p. 7), "adults are especially interested in learning that arises from the roles they play as they pass through the stages of human development (i.e., parent, consumer, employee, citizen)." With more life experiences, older students may see more value in understanding statistical concepts, whereas, traditional students may have more difficulty looking beyond the course to see how they could use what they learn in real life.

Value of Grades. In addition to seeing the value in learning statistics, for either personal or professional benefit, introductory statistics students may be motivated by grades. This may also be for personal or professional reasons. Students may take great pride in being able to earn a high grade in the course. Or, they may be concerned with how the grade in the course will impact their overall grade point average.

Traditional students and adult learners may differ in terms of their perceptions of the value of grades. According to Knowles (1984), for adults "the most potent motivators are internal pressures (the desire for increased job satisfaction, self-esteem, quality of life, and the like)" (p. 61). Traditional-aged college students, on the other hand, may be more motivated by external factors such as grades (Knowles, Swanson, & Holton, 2005).

Summary of Present Study

There are four predictor variables of interest, which were determined by key aspects of expectancy-value theory: self-efficacy for learning statistics, self-efficacy for learning in the online environment, value of statistics, and value of grades. There are two outcome variables of interest: successful course completion and final exam scores. The purpose of this study is to compare the relations between these predictor and outcome variables for typically face-to-face learners and typically online learners who are all enrolled in the same online introductory statistics course.

Methods

Students were enrolled in a completely online undergraduate-level introductory statistics course during a 12½ week summer semester. All required components of the course were asynchronous. There were optional synchronous group tutoring sessions led by trained undergraduate peer-tutors.

At the end of the first week of the course, 521 students were enrolled across 15 sections of the course. Of those, 407 (78.1%) completed the survey during the first week, were at least 18 years old, and gave permission for their data to be used for research purposes. Of the 407 individuals who consented to participate in the study, 192 (47.2%) identified as being primarily online students and 215 (52.8%) identified as being primarily face-to-face students.

During the first week of class students were asked to complete a survey consisting of demographic questions, a modified version of the Online Learning Self-Efficacy Scale (OLSES, see Appendix A; Zimmerman & Kulikowich, 2016), the full Self-Efficacy to Learn Statistics (SELS; Finney & Schraw, 2003) scale, an abbreviated form of the worth of statistics scale from the Statistical Anxiety Rating Scale (STARS, see Appendix B; Cruise, Cash, & Bolton, 1985), and a newly developed value of grades scale (see Appendix C).

The modified version of the OLSES consisted of 19 items taken from the original 22-item scale. Three tasks on the original OLSES that were not required in the online introductory statistics course that participants were enrolled in were excluded. For example, the item "Use the library's online resources efficiently" was excluded because this course does not require students to complete this task. The original scale was validated for use with face-to-face and online students at institution from which data were collected (Zimmerman & Kulikowich, 2016). The three-factor structure of the 19-item OLSES was examined for the typically face-to-face and typically online students in the present study using measurement invariance techniques. Unconstrained and fully constrained models were compared and were not statistically or practically significantly different [χ^2 (19) = 30.132, p = .0501]. It was concluded that the structure was similar for the modified version of the OLSES in the two groups and that the two groups could be compared in terms of the OLSES scores.

Cronbach's alpha was used as a measure of internal consistency for all six scales included in the study. These results are presented with the descriptive statistics in Table 1. All alpha coefficients were strong.

Table 1: Descriptive Statistics

Scale	Number of Items	N	Mean	SD	Cronbach's Alpha
OLSES Learning	7	407	5.136	0.710	.835
OLSES Time Management	5	406	5.012	0.764	.846
OLSES Technology	7	403	5.473	0.564	.794
SELS	14	391	4.066	1.222	.969
Worth of Statistics	6	406	3.530	0.957	.931
Value of Grades	6	405	4.682	0.562	.858

At the end of the semester, final exam grades and successful course completions were recorded. The same final exam was administered across all online sections of the course. This exam included 50 multiple-choice questions, with each question being drawn from a question bank of approximately

five questions each. The exam was completed online and was proctored. Successful course completion was defined as completing the course with a grade of D or higher, because this was the lowest possible grade for which students could earn credit for the course, however, some academic programs did have higher grade requirements (e.g., some majors required a C).

Results

Descriptive statistics are presented in Table 1 for each of the six scales that were administered to participants at the beginning of the course. All of the OLSES and SELS items were rated on a scale of 1 to 6 where 1 signified low self-efficacy and 6 signified high self-efficacy. The worth of statistics and value of grades scales were measured on a scale of 1 to 5 where higher scores represented greater perceptions of value.

The mean ratings on each of the six scales were compared by typical instructional mode, using a series of independent t-tests presented in Table 2. Effect size was measured as Cohen's *d* computed as the mean for the typically online group, minus the mean for the typically face-to-face students, divided by the pooled standard deviation. With a Bonferroni correction, there were statistically significant differences between the two groups on the OLSES learning and OLSES technology scales. For both scales, students who identified as typically being online students gave higher ratings with medium effect sizes.

Table 2: Mean Scale Comparisons by Typical Instructional Mode

	Typically Online			Typically Face-to-Face					
Scale	N	Mean	SD	N	Mean	SD	t	p*	d
OLSES Learning	192	5.331	0.585	215	4.961	0.766	5.430	< .001	0.539
OLSES Time Management	191	5.114	0.701	215	4.922	0.807	2.548	.011	0.253
OLSES Technology	192	5.600	0.459	211	5.357	0.623	4.420	< .001	0.441
SELS	185	4.053	1.226	206	4.077	1.221	-0.200	.841	-0.020
Worth of Statistics	191	3.612	1.021	215	3.458	0.892	1.618	.107	0.161
Value of Grades	190	4.661	0.556	215	4.700	0.567	-0.705	.481	-0.069

* *p* values on this table are not adjusted to account for multiple tests

The final exam was completed by 345 students. Out of a possible 100 points the mean score was 76.846 points with a standard deviation of 13.614 points. The median was 78 points. The relations between final exam scores and the six self-efficacy and value scale scores were calculated using Pearson's *r* and are presented in Table 3 for the typically face-to-face and typically online students separately.

Table 3: Scale and Final Exam Score Correlations by Typical Mode of Instruction

		1	2	3	4	5	6	7
1 OLSES Learning	*r*		.507**	.743**	.389**	.131	.052	.020
	N		191	192	185	191	190	156
2 OLSES Time Management	*r*	.589**		.440**	.328**	.123	-.044	-.032
	N	215		191	184	190	189	155
3 OLSES Technology	*r*	.828**	.622**		.290**	.015	.073	-.108
	N	211	211		185	191	190	156
4 SELS	*r*	.320**	.351**	.276**		.180*	.126	.134
	N	206	206	202		184	184	152
5 Worth of Statistics	*r*	.255**	.125	.165*	.298**		-.014	.250**
	N	215	215	211	206		189	155
6 Value of Grades	*r*	.185**	.175*	.287	.096	.043		.043
	N	215	215	211	206	215		155
7 Final Exam	*r*	-.058	-.008	-.089	.104	.121	-.040	
	N	189	189	185	182	189	189	

Correlations for typically online students are above the diagonal. Correlations for typically face-to-face students are below the diagonal.

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Final Exam Results

Final exam scores were compared by typical instructional mode using an analysis of covariance (ANCOVA) model. The six scale scores and all scales by typical instructional mode interaction terms served as the covariates. This overall model was statistically significant [$F (13, 314) = 3.493$, $p < .001$, $\eta_p^2 = .126$]. There were no statistically significant interactions between students' typical mode of instruction and any of the scale scores in predicting final exam scores. Given the lack of significant interaction terms, a second ANCOVA model was run without interaction effects. This second model was statistically significant [$F (7, 320) = 6.025$, $p < .001$, $\eta_p^2 = .116$]. An F-ratio was computed to compare the two models. Given that the two models were not statistically different [$F^* (6, 314) = 0.592$, $p = .737$], the second model was selected because it is more parsimonious.

The results of the selected ANCOVA model are presented in Table 4. There were significant main effects for typical mode of instruction and worth of statistics. There was a direct relationship between students' ratings on the worth of statistics scale and their final exam scores. And, final exam scores were higher for students who typically took face-to-face courses.

Table 4: Final Exam Scores Compared by Typical Instructional Mode Controlling for Scale Main Effects

Effect	Type III SS	df	MS	F	p
Typical Mode	2580.439	1	2580.439	15.489	< .001
OLSES Learning	13.126	1	13.126	0.079	.779
OLSES Time Management	30.222	1	30.222	0.181	.670
OLSES Technology	374.755	1	374.755	2.249	.135
SELS	216.227	1	216.227	1.298	.255
Worth of Statistics	2000.736	1	2000.736	12.009	.001
Value of Grades	174.505	1	174.505	1.047	.307
Error	53311.826	320	166.599		
Total	60338.622	327			

Course Completion Results

Of the students who gave permission for their data to be used for research purposes, the overall completion rate was 83.3%. For the students who typically took online courses, 154 out of 192 (80.2%) successfully completed the course. For the students who typically took face-to-face courses, 185 out of 215 (86.0%) successfully completed the course. The difference between the completion rates of the two groups was not significantly different ($z = 1.58$, $p = .115$).

Logistic regression was used to predict successful course completion. Complete data were available for 323 who did successfully complete the course and 61 who did not successfully complete the course. Typical instructional mode, the six scale scores, and all typical instructional mode by scale score interaction terms were entered into a model and removed using backward stepwise techniques (Wald) to identify the model that best predicts successful course completion. The resulting model included OLSES learning, OLSES time management, worth of statistics, the interaction between OLSES learning and typical instructional mode, and the interaction between worth of statistics and typical instructional mode. These results are presented in Table 5. This model was statistically significant [$\chi^2(5) = 22.367$, $p < .001$] and was able to correctly classify 84.4% of students. It was able to correctly classify all of the students who successfully completed the course; however, it was only able to correctly classify 1 of the 61 (1.6%) students who did not successfully complete the course. Thus, its sensitivity was perfect but its specificity was very poor.

Table 5: Logistic Regression Model Predicting Successful Course Completion

Variable	b	SE_b	Wald	df	p	Exp(b)
OLSES Learning	-1.190	0.336	12.566	1	< .001	0.304
OLSES Time Management	0.563	0.225	6.274	1	.012	1.756
Worth of Statistics	0.840	0.252	11.093	1	.001	2.316
OLSES Learning x Typical Mode	0.597	0.208	8.188	1	.004	1.816
Worth of Statistics x Typical Mode	-0.984	0.316	9.696	1	.002	0.374
Constant	2.346	1.363	2.966	1	.085	10.449

Typical mode is coded as 0 = face-to-face, 1=online

Course completion is coded as 0 = did not successfully complete, 1 = successfully completed

Discussion

Participants in the present study were enrolled in an online undergraduate-level introductory statistics course that was required for most of their degrees. Data were collected during a summer semester in which about half of the students enrolled in the online course were students who would typically take classes at a physical campus during the fall and spring semesters. This allowed for the unique opportunity to compare students who were primarily online learners to those who were primarily face-to-face learners taking an online course. The primary purpose of this study was to compare the relations between variables for these two groups; of particular interest were the abilities of self-efficacy and values to predict end-of-course outcomes.

Main Effects

Student who primarily enroll in online courses were first compared to those who primarily enroll in face-to-face courses in terms of their self-efficacy and value subscales ratings. Primarily online students gave significantly higher ratings on scales concerning self-efficacy for learning online and self-efficacy for using technology in an online course with moderate to large effect sizes (d = 0.539 and 0.441, respectively). One of the primary sources of self-efficacy is prior personal experiences (Schunk, 2012). Students who typically take online courses likely have experienced more personal success with learning in an online environment and using online learning technologies compared to students who typically take face-to-face courses. Such experience could account for their higher ratings on these self-efficacy subscales. Additionally, students with higher online learning self-efficacy may be more likely to choose to enroll as full-time online students.

There was no difference between the two groups on the time management subscale of the OLSES. This may be because all courses, regardless of mode of instruction, require some time management

skills. Given that this was an introductory course, all students, regardless of typical mode of instruction, had minimal prior experiences with statistics, which may explain the lack of significant differences on the SELS and worth of statistics subscale.

Relations between Variables by Typical Mode of Instruction

Correlations between the self-efficacy scales, values scales, and final exam scores were examined for the typically online and typically face-to-face learners. For both groups, the correlations between the three OLSES scores were moderately strong. These relations were consistently stronger for the typically face-to-face students. While the results of the measurement invariance analysis were not statistically significant (the p-value was just over 0.05), future research should further examine typically face-to-face students' perceptions of online learning. It is possible that the different aspects of online learning could blur together more so for students with limited experience with online learning. With a larger sample size these differences may be detected.

Relations with final exam scores for the two groups were examined using an ANCOVA. There were no statistically significant interactions between scale scores and typical mode of instruction (i.e., online versus face-to-face students) suggesting that the best model for predicting final exam scores using self-efficacy and values does not differ for the two groups. Given the lack of significant interaction terms, these results do not provide evidence that the expectancy-value model of motivation should be applied differently for typically face-to-face and typically online students when predicting final exam scores. Note that when using null hypothesis testing methods, "failing to reject the null hypothesis" is not equivalent to accepting the null hypothesis. We cannot yet conclude that there is no difference between the two groups in terms of how the selected scales relate to final exam scores; we can only say that there isn't sufficient evidence to state that there are any interactions. Future research may approach this research question using different statistical methods (e.g., Bayesian inference) in order to better understand the relations, or lack thereof, between these variables.

After removing the interaction terms from the ANCOVA model, the only statistically significant covariate was ratings on the worth of statistics scale. Within this model students who gave higher ratings on the worth of statistics scale tended to have higher final exam scores. The items on the worth of statistics scale address the value of learning statistics for personal or professional purposes. While the worth of statistics scale was a significant covariate when examining final exam scores, value of grades was not. When comparing the correlations with final exam scores, the worth of statistics scale was more strongly correlated with final exam scores compared to the value of grades scale in both groups but the correlation was only statistically significant in the typically online students. This positive relation between worth of statistics and course outcomes was expected in the sample of

students who typically take online courses because they tend to be adult learners. This further supports the notion that adult learners tend to be more motivated to learn when they perceive value compared to traditional students (Knowles, 1984).

With the six subscale scores serving as covariates in the ANCOVA model, there was a statistically significant main effect for typical mode of instruction. The students who typically take face-to-face courses had higher final exam scores than those who typically take online courses. This finding was initially surprising as the face-to-face learners had a reputation among the instructors for not doing as well in this online course. Although, many of the typically face-to-face students are individuals who study full-time in the fall and spring semesters. They may take fewer courses in the summers while working summer jobs. The majority of these students are between the ages of 18 and 25 and do not have other responsibilities. In contrast, many of the students who always take online courses work full-time and have the added responsibilities of caring for children or other relatives. Additionally, the typically online students tend to be enrolled in more credits; many of those students enroll full-time, year-round while the typically face-to-face students are more likely to take a reduced course load during the summers. Thus, the primarily face-to-face students may have more time to devote to the course. They also tend to have fewer unexpected emergency situations to deal with throughout the course.

Predicting Successful Course Completion

Logistic regression techniques were used to predict successful course completion. Successful course completion was operationalized as completing the course with a grade of D or higher. While a statistically significant model was obtained, and it was able to correctly identify all students who successfully completed the course, the specificity of the model was poor in that it only identified one of the 61 students who did not successfully complete the course. What is useful about this model are the variables that were identified as being related to successful course completion. There were statistically significant interactions between the self-efficacy for learning online subscale and typical mode of instruction, as well as between the worth of statistics subscale and typical mode of instruction. When applying the dummy codes for typical mode of instruction, the self-efficacy for learning online subscale has a negative coefficient for both the online and face-to-face groups. The absolute value of that coefficient was larger for the face-to-face group, suggesting a stronger negative relation between self-efficacy for learning online and successful course completion for typically face-to-face students compared to typically online students in this model. The negative relation between self-efficacy for learning online and successful course completion was unexpected. These results may be due to some students' over-confidence or poor self-efficacy calibration. Self-efficacy calibration is "the correlation between ratings of confidence in comprehension and actual performance on an

objective test of comprehension" (Glenberg, et al., 1987, pp. 119-120). In this sample, students who perceived themselves as being capable of successfully learning in an online course may not have been the most capable in reality. This finding may be of interest to individuals working to determine students' readiness for online learning. Confidence for learning online may not be directly related to actual abilities. In fact, these results suggest a negative relationship in the population of students who are typically face-to-face learners.

There was a statistically significant interaction between the worth of statistics scale and typical mode of instruction in predicting successful course completion. When applying the dummy code for typical mode of instruction, the coefficient was positive for the face-to-face group but negative and near zero for the online group suggesting that worth of statistics may be a predictor of successful completion in typically face-to-face students but not in typically online students. Both of the statistically significant interaction effects are in line with the findings of Zimmerman, Shumway, and Johnson (2016) in that the relations were stronger for typically face-to-face learners compared to typically online learners suggesting that mainstream motivational theories may have better predictive abilities with traditional students compared to online learners. However, the finding that worth of statistics is positively related to successful course completion only in the typically face-to-face learner group was unexpected and contradicts the findings of the analyses involving final exam scores, where the relation between worth of statistics and final exam scores was stronger, and only statistically significant, for the typically online group. This discrepancy may be due to differences in the samples available. In the analyses involving final exam scores the sample was limited to students who were still enrolled in the course at the end of the semester and who completed the final exam. Students who dropped the course earlier in the semester were not included in those analyses. Students who dropped the course were included in the analyses predicting successful course completion. The populations to which these results may generalize differ: students who take the final exam versus students enrolled in the course after the first week when the survey data were collected. To gain a better understanding of the relation between worth of statistics and outcomes in the population of all online students, future research may examine outcomes earlier in the semester, such as quiz scores in early weeks or midterm exam scores, to limit the attrition of participants.

Limitations

This was an observational study with limited demographic information available. While we may learn about differences in these existing groups, causal conclusion may not be drawn. The observational nature of this may be necessary as it is not possible to randomly assign students to be typically face-to-face or typically online learners. In real educational settings students enroll in

courses and bring with them their histories which educators and researchers have little or no control over.

Without demographic information, such as students' ages, conclusions concerning the aspects of typically face-to-face versus online learners that relate to the observed differences can only be hypothesized. In the future, data concerning age will be collected. And, participants will be asked to self-identify as traditional or adult learners, as these classifications are not necessarily analogous to the face-to-face and online learner variable that was used in the present study.

Another limitation of this study was that only students who completed the survey during the first week of class and gave permission for their data to be used for research purposes could be included in the disseminated results. The available sample size of 407 students represented 78.1% of the students enrolled in the course. The sample size was smaller for analyses involving final exam scores because students who had dropped the course prior to the end of the semester did not complete the final exam. Thus, analyses involving final exam scores could only include students who were still participating in the course at the end of the semester. Many students who were performing poorly dropped the course before the end of the semester or did not take the final exam.

Conclusion

The results of this study do not provide evidence that the expectancy-value model of motivation has vastly differential effects for typically online and typically face-to-face students, though there were some interesting interactions when predicting successful course completion. Future research may compare these two groups, or students classified as adult and traditional students, using structural equation modeling (SEM) techniques, or Bayesian methods, to better examine how the expectancy-value model can be applied in the two groups. This is a timely research topic, given that about 14% of student enrolled in institutions of higher education take some, but not all, of their courses at a distance. The number of students in the United States who take some of their courses online is slightly higher than the number of students who take all of their courses online (2.97 million compared to 2.85 million; Allen & Seaman, 2016). A better understanding of typically face-to-face students' motivations and attitudes toward learning online may improve the services provided to that population as well as the approaches taken by online faculty who may be challenged by simultaneously teaching full-time online students and students who are primarily face-to-face learners. In the context of this online introductory statistics course, only a few variables were statistically significant when predicting final exam scores and successful course completion. Those were the worth of statistics scale, the OLSES learning subscale, and the OLSES technology subscale. The value of grades subscale, OLSES time management scale, and SELS were not statistically significant in any of the models examined.

Future research should continue to examine the application of mainstream motivational theories, such as the expectancy-value model, in online learning environments. Theories that have been developed and tested with traditional students may not be the most effective for predicting success with the online learning population. Adult learning theories (e.g., andragogy, Knowles, 1984) should also be applied when studying performance and course completion in online learning settings with both traditional-aged college students and adult learners. An ideal model for predicting success in an online course will likely require the marriage of a traditional motivational theory and adult learning theory.

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Appendix A

Modified Online Learning Self-Efficacy Scale

Rate your confidence in your **current ability to perform** the following tasks related to **learning online** successfully.

A rating of 1 is the lowest; give a rating of 1 to any tasks that you have no confidence that you could complete successfully.

A rating of 6 is the highest; give a rating of 6 to any tasks that you have complete confidence that you could complete successfully.

Original OLSES Item Number	Scale	Item
1	Technology	Navigate online course materials
2	Technology	Find the course syllabus online
3	Technology	Communicate effectively with my instructor via email
4	Learning	Communicate effectively with technical support via email, telephone, or live online chat
5	Technology	Submit assignments to an online dropbox
6	Learning	Overcome technical difficulties on my own
7	Technology	Navigate the online grade book
8	Time management	Manage time effectively
9	Time management	Complete all assignments on time
10	Learning	Learn to use a new type of technology efficiently
11	Learning	Learn without being in the same room as the instructor
12	Learning	Learn without being in the same room as other students
13	Technology	Search the Internet to find the answer to a course-related question
14	Technology	Search the online course materials
15	Learning	Communicate using asynchronous technologies (discussion boards, email, etc.)
16	Time management	Meet deadlines with very few reminders
19	Time management	Focus on schoolwork when faced with distractions
20	Time management	Develop and follow a plan for completing all required work on time
22	Learning	When a problem arises, promptly ask questions in the appropriate forum (email, discussion board, etc.)

Appendix B

Abbreviated STARS Worth of Statistics Scale

Rate your level of agreement with the following statements.

1 = Strongly agree

5 = Strongly disagree

1. I wonder why I have to do all these things in statistics when in actual life I'll never use them?
2. Statistics takes more time than it's worth.
3. I feel statistics is a waste.

4. I wish the statistics requirement would be removed from my academic program.
5. I don't understand why someone in my field needs statistics.
6. I'm never going to use statistics so why should I have to take it?

Appendix C

Value of Grades Scale

Rate your level of agreement with the following statements.

1 = Strongly disagree

5 = Strongly agree

1. It is very important that I pass this class this semester.
2. If I dropped or failed this course I would be very upset.
3. Grades are a strong motivator for me to do well in this course.
4. If I do not receive a passing grade in this course there will be consequences that I must pay.
5. I will be very proud of myself if I can earn an A in this course.
6. My grade in this course is very important to me.