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Peter KIRIAKIDIS, Natalie THORNTON JOHNSON

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The Effects of Non-traditional Teaching Styles on College Mathematics between Face-to-face and Online Students

Peter Kiriakidis^{1 2}

Natalie THORNTON JOHNSON³

Abstract

Limited research exists on the effects of teaching styles on college mathematics between face-to-face and online students. The purpose of this experimental quantitative research was to examine the effects of teaching styles on college mathematics between face-to-face and online students. The research question was "What are the effects of teaching styles on college mathematics between face-to-face and online students?" The participants were college students who took math classes either face-to-face or online. The participants were taught by the same professors the same math curricula. The findings of this research may shed further light on the effects of teaching styles on college mathematics between face-to-face and online students

Keywords:

college math, face-to-face classes, online classes, instructional practices of math college professors, math classes, college education, college professors and administrators

¹ Peter KIRIAKIDIS – PhD, Founder and CEO of Higher Education Research and Consulting Company, Peter Kiriakidis, PhD has expertise in higher education educational leadership: (a) chairing comprehensive examinations and dissertation committees; (b) developing curriculum and academic programs; and (c) teaching graduate courses in research, educational leadership in higher education, educational and information technology, online technology, e-commerce, software development, and information systems. Peter is a reviewer of many academic journals. Peter has presented a plethora of research studies nationally and internationally. Email: KiriakidisPeter@yahoo.com

² Research Paper Pertains to community college and mathematics

³ Natalie THORNTON JOHNSON - PhD, College Math Professor, Email: drnatjohnson@yahoo.com

Introduction

The traditional teaching styles refer to educators illustrating via examples to students how to solve a certain type of a math problem where students complete problems in class and as homework. According to Harris (2007:34), “Traditional teaching styles include lectures, textbooks, and notes”; however, Reardon and Derner (2004:345) noted, “The typical structured classroom often fails to engage students”.

In the non-traditional style of teaching mathematics, the focus is on problem solving, mathematical reasoning, justifying ideas, making sense of complex situations and independently learning new ideas. Math students must be able to use drawings and real-world applications and participate logical arguments” (Johnson, Onwuegbuzie, 2004:18). Saliva stated, “Cooperative group promotes self-esteem, motivation, and success in mathematics” (1999:3). A cooperative group is a non-traditional teaching style (Dossey, 1999:234) where students are encouraged to apply the use of mathematics in the real world” (Adeeb, Bosnick, 2004:1). McManus, Dunn, and Denig found that math students who learned using hands-on manipulative activities had higher math achievement and math attitude scores than students who learned using traditional lecture (2003:97).

The need for various teaching styles at the higher education level has been well documented. According to McNaught “Educators might use a variety of different resources in very different styles (2004:44). Pajak asserted that educators should explore different ways of teaching” (2003:130). Researchers of mathematics education have reported the importance of teaching with learning styles in mind” (Gylmn, Koballa, Thomas, 2005:77). Teaching a mathematics course means that educators teach concepts and problem-solving skills (Daro, 2006:35).

Statement of the Problem

The research site was a community college located in the Southeastern United States of America. Stakeholders at the research site needed empirical evidence that non-traditional teaching styles have had an effect on college mathematics students’ final grades who took face-to-

face or online math courses. No research has been conducted at the research site to examine the effects of non-traditional teaching styles on college mathematics between face-to-face and online students.

Purpose of Study

The purpose of the study was to provide education stakeholders with empirical evidence that non-traditional teaching styles have had an effect on college mathematics students' final grades who took either face-to-face or online math courses. The findings may help these stakeholders with policy development on teaching styles for both face-to-face and online math courses. The findings may encourage faculty members teaching math courses to utilize non-traditional teaching styles in both course modalities (i.e., face-to-face and online). Policy makers may use the findings for professional development workshops for math college professors to improve their instructional practices.

Definition of Terms

Traditional Teaching Styles: According to Harris, "Traditional teaching styles include lectures, textbooks, and notes" (2007:34); however, Reardon and Derner noted, "The typical structured classroom often fails to engage students" (2004:345).

Non-traditional Teaching Styles: Saliva stated, "Cooperative group promotes self-esteem, motivation, and success in mathematics" (1999:3). A cooperative group is a non-traditional teaching style (Dossey, 1999: 234) where students are encouraged to apply the use of mathematics in the real world" (Adeeb, Bosnick, 2004:1).

Research Question

What are the effects of non-traditional teaching styles on college mathematics students' final grades who took either face-to-face or online math courses?

Null Hypothesis: Non-traditional teaching styles have had no effect on college mathematics students' final grades who took either face-to-face or online math courses.

Alternative Hypothesis: Non-traditional teaching styles have had an effect on college mathematics students' final grades who took either face-to-face or online math courses.

Literature Review

According to Sabean and Bavaria (2005), a list of the most significant principles related to mathematics non-traditional teaching and learning should include the expectation that instructors know what students need to learn based on what they know by focusing on developing conceptual understanding. According to Verhovsek, non-traditional teaching methods should be used to encourage collaboration and the development of higher-level critical thinking skills on part of the learner (2003:381). Scholars have reported that presenting mathematics via problem-based learning is a better way to promote a higher learning of problem solving skills (Verhovsek) and diverse approaches to instruction are needed (The Mathematical Association of America's Curriculum, 2004:1). According to Alexander, approaches to instruction should include exchange of words to development of ideas (2006:235). Udovic, Morris, Dickman, and Postlethwait (2002) asserted that non-traditional strategies such as active, cooperative, collaborative and problem based learning should be utilized in the classroom.

Johnson and Dasgupta asserted that students in cooperative environments develop more positive attitudes towards mathematics because cooperative learning has a positive effect on motivation, classroom socialization, and the student's confidence in learning and attitude toward the subject being learned (2005:125). According to Miller, students in algebra courses need a different kind of teaching (2005:55). As a result, more attention from faculty and experiential methods facilitate student success (Lichtensteuin, 2005:341). Students prefer teaching strategies that help them to be successful in their courses by having creative professors who use interactive teaching methods that yield high student achievement (Ray, 2004:345).

According to McBay, the learning environment should be supportive, relaxed, and friendly (2003:2). Torok, McMorris, and Lin reported that humor fostered a relaxed, playful, and engaged classroom environment (2004:235). For example, laughter is likely to be greater

with larger classes in crowded classrooms than with smaller classes in a larger setting (Berk, 2002:123) and humor might be used in the classroom (Haladyna, Downing, Rodriguez, 2002:320) to reduce anxiety (Saroglou, Scariot, 2002:53).

According to Kumar and Lighter, the use of non-traditional interventions, such as games, simulations, multimedia instruction, and interactive activities are valuable teaching methods (2007:53). Kumar and Lighter suggested to faculty to increase the classroom time spent on interactive pedagogy in order to prepare students for the type of learning that they will encounter later in their professional lives (2007:59).

Differing Methodologies

Lichtenstein examined instructors who created a classroom ambience in which students developed strong relationships with their peers and the faculty member (2005:341). Johnson and Dasgupta examined nontraditional teaching at the college level and found that there were positive outcomes of students success in statistics courses (2005:122). Lee (2002) examined socioeconomic, family conditions, and practices as factors accounting for some of the achievement gap for a particular racial and ethnic group. Slaughter (2004) reported that minority students are taking higher level math courses in college. Irvin reported that multicultural education serves as a tool in confronting social issues that relates to race, ethnicity, and gender (2003:452).

Assumptions, Limitations, Delimitations, and Scope

For the purpose of this study, the researchers assumed that non-traditional teaching styles have had an effect on college mathematics students' final grades who took either face-to-face or online math courses. The researchers also assumed that better prepared freshmen students at the research site performed better academically in college math classes.

The weakness of the study was that the researchers relied on the administrator responsible for research at the research site to randomly select college math grades from freshmen students. The study was limited to college freshmen students from one college. Thus, the study

was bounded by one college and the findings may apply to the research site.

The scope of this study was specific to college students at the research site who were the focus of the study. The small sample size may limit the opportunity to generalize the findings to the larger and like college student populations in other counties or states. The researchers had no authoritative position over the participants and therefore they were not concerned with the possibility of coercion. The math scores were randomly selected by the administrator responsible for research at the research site.

Delimitation to the study was the sample size compared to the total population of the college being studied and the possible inability for replication or generalization to the broader post secondary education community.

Population

The research site was a community college located in the Southeastern United States of America. The students' failure rate in math, according to the administrator responsible for Institutional Research, was more than 40%. The college offers a variety of courses to approximately 4,500 students. The majority of the students are European Americans.

Sample and Data Collection

For the purpose of this study, freshmen math scores were collected randomly by the administrator responsible for Institutional Research at the research site. The administrator selected math courses taught by the same professors in face-to-face or online classes who used the same math curriculum and non-traditional instructional practices.

The administrator provided the researchers with 203 scores from face-to-face classrooms and 203 scores from online classrooms giving a sample of $n = 406$ math scores from freshmen college math classes. The administrator did not provide to the researchers the names of the students or faculty, course codes, gender, or any other information about the students and faculty.

The collected math scores were for the academic year of 2010-2011. The administrator responsible for Institutional Research at the research site provided the researchers with one Excel document containing two columns of numeric data. Each datum was a number between zero and 100. The first column contained freshmen math scores from face-to-face classrooms. The second column contained freshmen math scores from online classrooms.

Ethical Procedures

Ethical consideration for research involving humans was addressed. All participants in the study were adults who had completed a freshmen college math course and were over 18 years old. Institutional Review Board approval was obtained from the administrator at the research site responsible for research.

Research Methodology

A quantitative research design was used for this study. Data collection procedures included quantitative measures to examine the differences in the grades of college students who took math courses either face-to-face or online. SPSS was used to compute a *t* test used to examine the effects of non-traditional teaching styles on college mathematics students' final grades who took either face-to-face or online math courses.

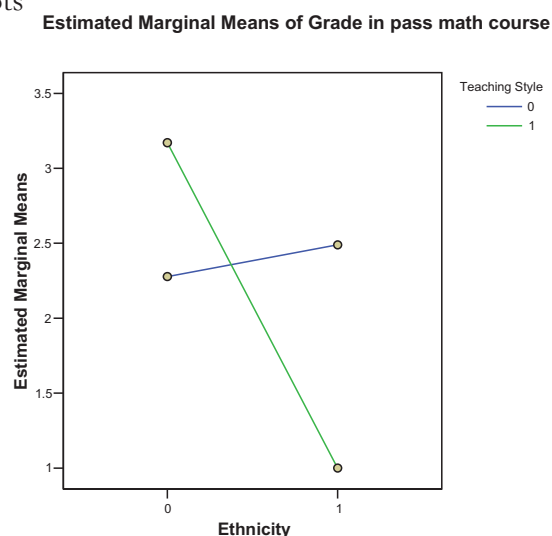
Data Analysis

A *t* test was conducted to examine the hypothesis with 203 math scores from face-to-face classrooms and 203 math scores from online classrooms. With $n = 406$ math scores from freshmen college math classes the *p* value was $p = .08$ which is less than .05 and as a result the null hypothesis was rejected. The mean of online math scores was 79.04. The mean of face-to-face math scores was 87.81. The mean difference between online math scores and face-to-face math scores was -8.77. The *t* value was -16.1 and the *r* value was .69 indicating a strong relationship between online and face-to-face math scores. Cohen's *d* value was -1.13.

Conclusion

The study indicated that there was a small difference in the mean of results derived from nontraditional lecture and traditional lecture teaching styles. The teaching styles have no significant impact on the passage rate in math course. However, there was a significant difference in the pass rates among ethnicities. The descriptive means showed that Anglos had more passing math grades when taught by traditional lecture. However, the students of color passage rates increase when nontraditional teaching styles are used. The role play by ethnicity in student success was significant as documented by a p -value of .000. An univariate analysis of variance was conducted to test this hypothesis (Appendix B Table 4). With p -value of .000, which is less than .05, the null hypothesis was rejected indicating that there was a relationship between ethnicity and teaching styles. This interaction profile was plotted below. The profile shows that teaching styles and ethnicity did intercept with each other, which means there is an interaction.

Profile Plots



Research Hypothesis 5: There was a difference in math scores that relates to gender. There was a large difference in the mean of female and male passage rate in math. A t -test was conducted to test this hypothesis (Appendix B Table 5). With p -value of .000, which is less

than .05, the null hypothesis was rejected indicating that (3.05) have a higher pass rate in math than males (1.43).

Conclusions and Recommendations

This chapter explored the results and conclusions of the statistical analysis. Additionally, recommendations for further research studies on the subject matter were offered.

Results

The purpose of this study was to gain insight into the effectiveness of the use of nontraditional teaching styles on students of color. More specifically, this study was designed to measure the effects of nontraditional teaching on the success of these students in mathematics based on their math scores. This research project was intended to enrich the literature and attract the interest of other researchers in continuing investigations as to how the success of students of color in mathematics were enhanced through the use of nontraditional teaching styles.

This study sought to answer five research questions. The first question students of color was whether these students were more successful in mathematics than their peers, and it was shown that there is little difference in the mean pass rate of students of color in mathematics when taught by using nontraditional teaching styles. .

The null hypothesis was retained, and finding showed that Anglos earn more passing grades than do students of color.

The second question is whether there was a difference in math scores when teachers use traditional lecture and nontraditional lecture methods with both students of color and white students. There was insufficient evidence to recommend one method over the other as the results derived from the different teaching styles were not significantly different. While Verhovsek suggested that “instructional strategies and delivery formats should be designed to respond to different learning and teaching styles” (2003:382) and suggested that different delivery formats should help to address the different learning and teaching styles.

The third question related to the relationship between the perception of the classroom environment and student success in math. There was sufficient evidence to reject the null hypothesis, as the students' perception of the classroom environment correlated directly with success in mathematics. "The learning environment of a classroom can be described as the overall climate, culture ambience, or atmosphere in which learning takes place" (Briggs, 2003:86). Briggs states that "the intangible aspects of a classroom that give it a particular feel or tone" (2003:88). The test show that the perception of classroom environment did affected math scores in the past.

The fourth question was whether there was a relationship between interaction between ethnicity and the kind of teaching styles that were effective in teaching mathematics. Testing hypothesis 4 indicated that there were such relationship. The null hypothesis was rejected, and findings showed that the intercept p -value is .000, which indicates that different teaching styles were more effective in different ethnic communities. Teaching styles did not appear to affect success in the population as a whole, but when the population was divided by ethnicity, there was a significant difference in student success.

The fifth question was whether there was a difference between the success rates of men and women students in mathematics. The means showed a large difference between the pass rates of females and males passed that was significant with a p -value is less than .05.

Reflecting on the results of this study, it was found that students of color have more success in mathematics when their teachers employ nontraditional teaching styles courses. The findings of the fourth hypotheses support approve the statement of Adeeb and Bosnick (2004) that students of color taught by nontraditional have more success in mathematics. Adeeb and Bosnick stated that "traditionally mathematics was a discipline where success was limited among students of colors" (2004:1). The results from the aforementioned hypotheses clearly indicate that students of color can have success in mathematics if their needs are designed to a format that they are able to understand mathematics. Could there be other conditions that could have helped ensure students of color success in mathematics? Was the assessment used to classify whether students of color are successful accurate? While

these questions cannot be answered by this study, they certainly deserve for further investigation.

Limitations of the Study

The limitation in this study was the inability of the researcher to gain direct access to the students' grades. Having direct access to grade would have been helpful to measure the overall affect of students' GPA. Through it was discovered that gender, classroom environment, and the interaction of ethnicity and teaching did had a significant affect on grades in past students' math courses. This study supports the idea that nontraditional teaching was a major factor but it was ultimately unknown whether this, can improve overall grades.

Conclusions

The literature provided an overview of researchers' concerns about successfully teaching mathematics to students of color. John Ogbu addressed the variables that limited African Americans success in learning mathematics. He argued that those cultural and social factors with African American students affect them being successful academically. This study expands to all students of colors and look at major factors inside the classroom. These factors relate to the type of teaching styles used, the perception of the classroom environment, gender, ethnicity, and the interaction of ethnicity and teaching styles all of which were tested to determine how they affected the success of students of color in mathematics.

The effects of nontraditional teaching styles gave students of color an opportunity to be successful in their mathematics courses. This study helped address the high failure rate of students in the mathematics department. These results provided the math instructors alternative in teaching students of color or all students. Since the deans, chairperson, and campus president was not in the math classroom, implementing nontraditional teaching would be the responsibility of the instructors. This teaching style simply was applied when every instructor takes on the challenge of adding nontraditional teaching to their classroom. It should begin with instructors who initiate these methods and consistently make

an effort to communicate with and teach students of color or all students in the most effective way. The researcher has observed that success will come to students of color or to all students if the instructors are willingly to try other teaching styles that can have been shown to help all students.

Based upon the finding of this study, it appears that all students are more successful in mathematics when nontraditional teaching styles are employed. This leads one to wonder why teaching that was more nontraditional styles has not been encouraged more in either mathematics education or even in education in general. There were data to reflect that specific factors did not affect the success of students of color in mathematics, for example; classroom environment and teaching styles. Perhaps instructors could place more emphasis on helping students of color or all students to develop more consistent practices of communicating on their (instructors) format in delivery information on mathematics.

Recommendation for Future Research

As indicated earlier, there is no current research on how nontraditional teaching style affects the success of students of color in mathematics. It would be interesting to see similar research conducted in the area of students of color on the lower grade school and high school levels. It is important to assist all students especially those students who have limited success in the academic arena.

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Appendix A Questionnaire

Mathematics Survey

Please help determine which teaching styles affect student success in mathematics by completing this voluntary survey. Thanks!

Please circle (or fill in the blank) your response.

1. Gender: Male or Female
2. Ethnicity: Black Hispanic Anglo Asian Amer. Indian
Other _____
3. Classification as a student:
 - a. Graduated from High School within the past year/ is a freshman in college
 - b. Returning student
 - c. Sophomore
 - d. Taking course for continuing education
 - e. Adult starting first year
 - f. Other _____
4. Last math course completed (9th grade to now).

5. Grade in last math course.
A B C D F
6. Typical grade made on math test:
90-100 80-89 70-79 60-69 below-59
7. Previous Math experience:
Excellent Very good Good Poor Very poor
8. Best learning style for you:
Visual Active Lecture Auditory
9. Does classroom environment affect your success in a math course?
Yes No
10. Do you prefer *lecture only* style in a math course?
Yes No

11. Does your instructor allow you to ask questions in class?
 Yes No
12. Does your instructor allow you to work in groups?
 Yes No

Instructor: Please return all surveys in the envelope provided.

Appendix B Statistical Testing for Hypotheses

Table B1
 T-Test – Ethnicity

Group Statistics

	Ethnicity	N	Mean	Std. Deviation	Std. Error Mean
Grade in 0 pass math 1 course		95	2.66	1.277	.131
		105	2.36	.900	.088

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig.	Mean Difference	Std. Error Difference

95%
 Confiden
 ce
 Interval
 of the
 Differenc

								e		
								Lo wer	Up per	
Grade in pass math cours e	Equal varian ces assum ed	21. 566	.00 0	1.9 43	198	.053	.301	.155	-. .00 5	.60 7
	Equal varian ces not assum ed			1.9 10	167 .01 7	.058	.301	.158	-. .01 0	.61 3

Table B2
T-Test – Teaching Styles

Group Statistics

		Teaching Style	N	Mean	Std. Deviation	Std. Error Mean
Grade in pass math course	1		50	2.78	1.694	.240
	0		150	2.41	.804	.066

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	t	df	Sig.	Mea n Diff	Std. Err or	

95%
Confiden
ce

							Differ ence	Differ ence	Interval of the Differenc e	
									Lo wer	Up per
Grade in pass math cours e	Equal varian ces assum ed	190 .92 3	.00 0	2.0 53	198	.041	.367	.179	.01 4	.71 9
	Equal varian ces not assum ed			1.4 76	56. 536	.145	.367	.248	-. 13 1	.86 4

Table B3
 T-Test – Classroom Environment
 Group Statistics

	Classroom Environment	N	Mean	Std. Deviation	Std. Error Mean
Grade in pass	0	27	3.00	.000	.000
math course	1	134	1.92	.694	.060

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig.	Mea n	Std. Err

95%
Confiden

							Diff erence	or Diff erence	ce Interval of the Differenc e	
									Lo wer	Up per
Grade in pass math cours e	Equal varian ces assum ed	34. 861	.00 0	8.0 79	159	.000	1.08 2	.134	.81 8	1.3 47
	Equal varian ces not assum ed			18. 044	133 .00 0	.000	1.08 2	.060	.96 3	1.2 01

Table B4
Univariate Analysis of Variance - Interaction of Ethnicity and
Teaching Styles

Between-Subjects Factors

		N
Ethnicity	0	95
	1	105
Teaching Style	0	150
	1	50

Descriptive Statistics

Dependent Variable: Grade in pass math course

Ethnicity	Teaching Style	Mean	Std. Deviation	N
0	0	2.28	.738	54

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	1	3.17	1.626	41
	Total	2.66	1.277	95
1	0	2.49	.833	96
	1	1.00	.000	9
	Total	2.36	.900	105
Total	0	2.41	.804	150
	1	2.78	1.694	50
	Total	2.50	1.103	200

Levene's Test of Equality of Error Variances(a)

Dependent Variable: Grade in pass math course

F	df1	df2	Sig.
40.163	3	196	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept+Ethnic+Teachstyle+Ethnic * Teachstyle

Tests of Between-Subjects Effects

Dependent Variable: Grade in pass math course

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	41.367(a)	3	13.789	13.471	.000
Intercept	485.838	1	485.838	474.631	.000
Ethnic	23.337	1	23.337	22.798	.000
Teachstyle	2.165	1	2.165	2.115	.147
Ethnic * Teachstyle	34.521	1	34.521	33.725	.000
Error	200.628	196	1.024		
Total	1497.000	200			
Corrected Total	241.995	199			

a. R Squared = .171 (Adjusted R Squared = .158)

Estimated Marginal Means

1. Ethnicity

Dependent Variable: Grade in pass math course

Ethnicity	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
0	2.724	.105	2.518	2.931
1	1.745	.176	1.397	2.093

2. Teaching Style

Dependent Variable: Grade in pass math course

Teaching Style	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
0	2.384	.086	2.214	2.553
1	2.085	.186	1.718	2.453

Profile Plots

Estimated Marginal Means of Grade in pass math course

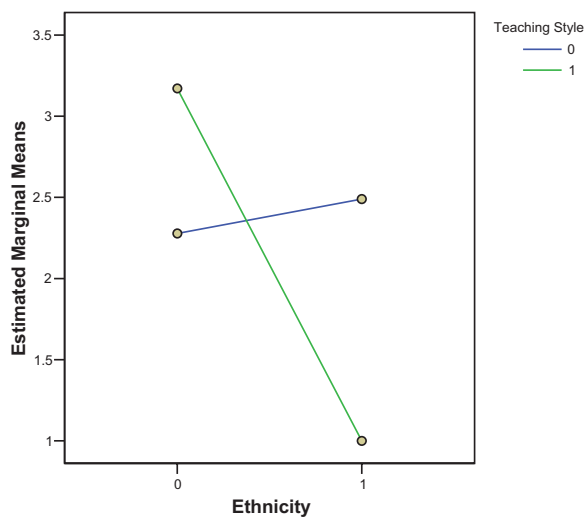


Table B5
 T-Test – Gender
 Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Grade in 1 pass math 0 course		133	3.05	.912	.079
		67	1.43	.499	.061

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig.	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Grade in pass math course	Equal variances assumed	5.509	.020	13.481	198	.000	1.612	.120	1.376	1.848
	Equal variances not assumed			16.147	196.602	.000	1.612	.100	1.415	1.809