



## Predicting PhD Attainment: The Efficacy of the GRE

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### Introduction

“The Graduate Record Examinations (GRE) are an outgrowth of a project funded by the Carnegie Foundation for the Advancement of Teaching in the early 1930s to study the outcomes of college education. However, widespread use of the GRE began after World War II when a much larger and more diverse student body began to pursue graduate degrees. The test was used by institutions as a common objective measure to evaluate the credentials of applicants from different and often not widely known undergraduate programs” (Educational Testing Service (ETS), 2008, p. 2).

Standardized tests, especially the GRE, have been heavily weighted sources of information in admissions decisions for many departments (Kuncel, Hezlett & Ones, 2001). In 1996, GRE scores were required by 93% of doctoral programs, and 81% of masters programs had minimum GRE scores (Norcross, Hanych and Terranova, 1996). In 2007, FairTest reported that the GRE was used by 60% of American graduate programs. In the 2013-14 academic year, ETS reported that over 570,000 people took the GRE (ETS, 2014).

Much of the GRE validity research has focused on first year or overall graduate grade point average (Bridgemen, Burton & Cline, 2008, Kuncel, et al., 2001). There has been some work tying GRE scores to PhD attainment. Kuncel et al. (2001) found validities for GRE prediction on degree attainment in the life sciences were neutral or slightly negative while in math and the physical sciences they were neutral or slightly positive. Burton and Wang (2005) found the GRE: Quantitative (GRE:Q) scores of Biology, Chemistry and Psychology students who received their PhDs were lower than that of those who withdrew from their PhD programs (676 vs 697) while their GRE: Verbal (GRE:V) scores were slightly lower (567 vs 578).

### The Study

To begin to explore the relationship between GRE scores and PhD completion, GRE scores and PhD completion status data were collected from 1,997<sup>2</sup> STEM graduate students from four flagship

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<sup>2</sup> One student did not have both GRE: Q and V scores.

state universities. These students entered a STEM PhD program between 2000 and 2005 and either received the PhD or left the program by 2015<sup>3</sup>. The sample was predominately White (73%) with 7% Under-Represented Minorities (URM). Forty-five percent of the sample were women. The number of subjects, who completed GRE Q and GRE V varied by institution. Institution A had 952 subjects, Institution B 706, Institution C 163 and Institution D 175.

The overall PhD completion rate was 63%. Women and men had approximately the same overall completion rates (62% vs 63.5%). Overall completion rates did not differ significantly by race/ethnicity (Asian American-61%, Black 60%, Hispanic 69%, White 63%)<sup>4</sup>. There were significant differences in completion rates by institution (Chi Square=9.7, p=.021). Institutional completion rates ranged from 57% to 72%. The mean of the mean completion rates by institution was 63.5%.

## The Results

### GRE: Quantitative

There were significant differences by institution ( $f=30.3$ ,  $p=.000$ ) and by gender ( $f=66.2$ ,  $p=.000$ ) in reported GRE: Q scores. There was also a significant interaction between student gender and PhD attainment ( $f=5.9$ ,  $p=.015$ ). Across institutions, women who left the PhD program had approximately the same GRE: Q scores as women who received the PhD. Men who received the PhD had lower scores than those who left their PhD program.

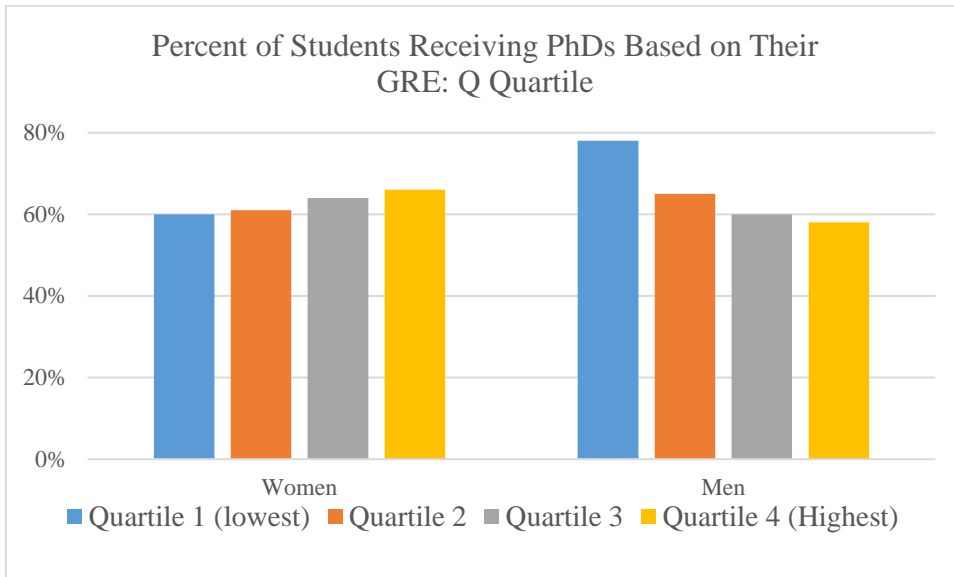
#### GRE: Q Scores of Those Receiving PhDs and Those Leaving the Program

		Received PhD	Left Without PhD	Difference
<b>Total</b>				
	Women	670	664	6
	Men	697	720	<b>-23</b>
	Total	685	694	<b>-9</b>
<b>Institution A (N=952)</b>				
	Women	692	673	19
	Men	712	735	<b>-23</b>
<b>Institution B (N=707)</b>				
	Women	654	666	<b>-12</b>
	Men	712	735	<b>-23</b>
<b>Institution C (N=163)</b>				
	Women	622	621	1
	Men	664	690	<b>-26</b>
<b>Institution D (N=175)</b>				
	Women	644	632	12

<sup>3</sup> A new version of the GRE was introduced in August 2011. These students took an earlier version.

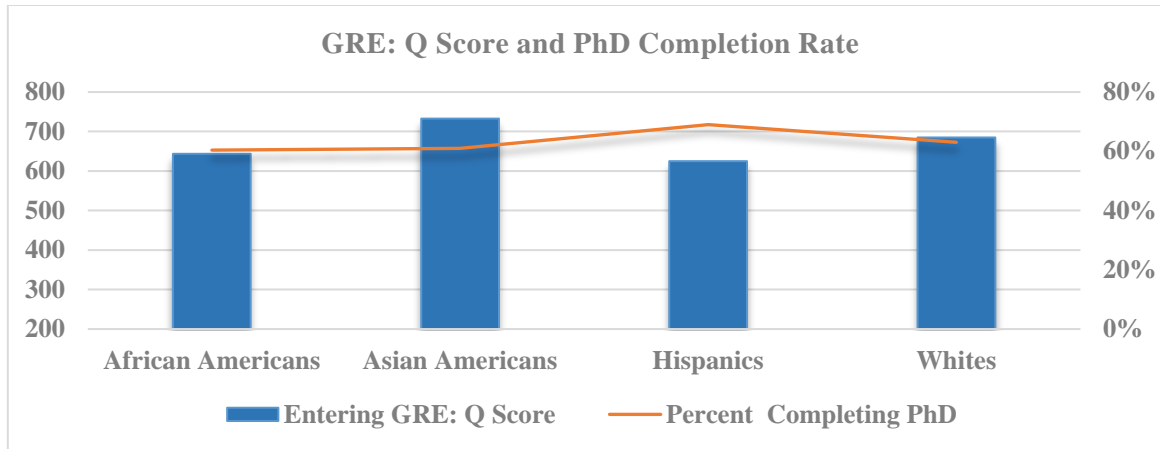
<sup>4</sup> Those in other and unknown categories were not included in the analysis by race/ethnicity.

GRE: Q scores were also broken into quartiles by institution. Approximately the same percentage of women in each GRE: Q quartile received their degrees or left without a degree while men in the GRE: Q lowest quartile were more likely to receive their PhD than those in the top two quartiles (Chi Square= 22.5, p=.000).



Forty-four students had GRE: Q scores of below 500, 69% of whom received their PhD.

The very small numbers of under-represented minority students in these institutions (53 Black students and 90 Hispanic students) made it inappropriate to break out the analysis by institution or even by race/ethnicity by gender. Significant differences in GRE: Q scores were found by race/ethnicity ( $f=23.9$ ,  $p=.000$ ), however no significant differences were found in the GRE: Q scores of those who dropped out and those who received their PhDs by race/ethnicity. As indicated below, the PhD completion rate for Asian American and Black students was essentially the same (61% vs 60%) even though the mean GRE:Q score for Asian Americans was 88 points higher than that for Black students. Hispanic students had an even lower GRE: Q and their completion rate was 69%. White students had a completion rate of 63%.



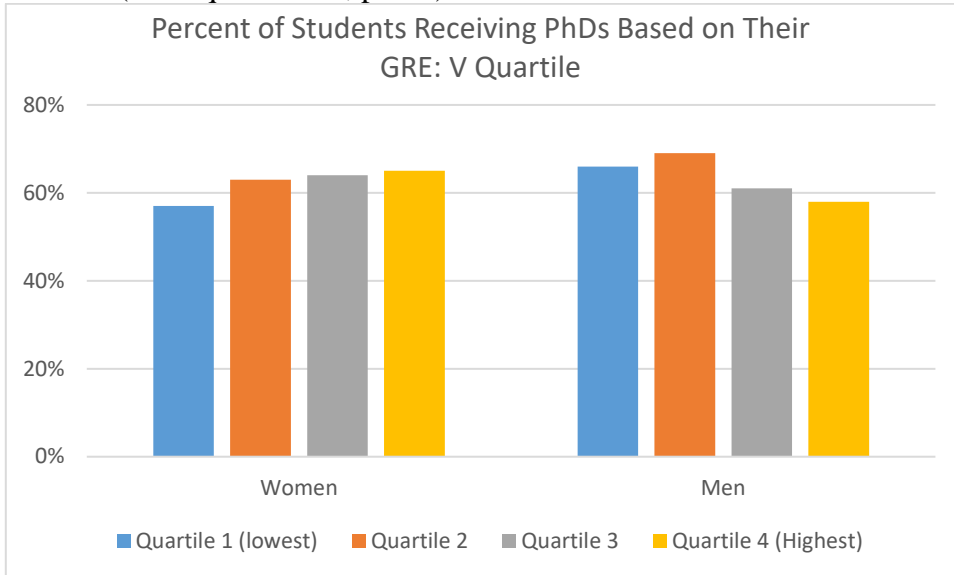
### GRE: Verbal

Overall students who left their PhD program had a mean GRE: V that was approximately the same as that of those who received their PhDs. Unlike the GRE: Q, there were no significant differences by gender. Neither was there a significant interaction in GRE: V scores by gender of those who left the PhD program and those who received their PhD. While there were significant differences in the GRE: V by institution ( $f= 4.4, p=.004$ ) there were not significant differences in the scores of those who received the PhD and those who left. There were somewhat different patterns by institution ( $f=3.8, p=.01$ ). In two institutions, students who received their PhDs had lower GRE: V scores than those who left their programs. In one institution those who left had a lower GRE: V than those who received their degree. In the final institution the scores were about the same.

#### GRE: V Scores of Those Receiving PhDs and Those Leaving the Program

		Received PhD	Left Without PhD	Difference
<b>Total</b>				
	Women	550	537	12
	Men	538	553	-15
	Total	543	546	-3
<b>Institution A (N=952)</b>				
	Women	553	526	27
	Men	537	537	0
<b>Institution B (N=706)</b>				
	Women	550	558	-8
	Men	537	537	0
<b>Institution C (N=163)</b>				
	Women	550	551	-1
	Men	530	569	-39
<b>Institution D (N=175)</b>				
	Women	524	522	2

GRE: V scores were also broken into quartiles by institution. When the GRE: V scores were broken out by whether students received their degree or not and by gender, about the same percentage of women in each quartile received their degrees or left without a degree. However, for men this was not the case. Men in the lower two quartiles of the GRE: V were more apt to receive the PhD (Chi Square=7.79, p=.05).



The patterns by race/ethnicity were not consistent. Asian American and Black students who received the PhD had higher GRE: V scores than did those who left (Asian American 552 vs 520; Black 492 vs 446) while Hispanic and White students who received the PhD had lower GRE: V scores than those who left (Hispanic 445 vs 476; White 551 vs 556).

### Explaining the Findings

GRE: V and GRE: Q scores did not predict PhD attainment for women while for men higher GRE: Q scores and to a lesser degree GRE: V scores were tied to lower PhD attainment. The difference in GRE scores of entering students, by race/ethnicity, was not reflected in their completion rates

One possible explanation of the results was that computer science and engineering (CS/E) students would be more apt to have higher GRE: Q scores and would be more apt to leave a PhD program because they could get lucrative jobs without a PhD. CS/E students had a higher mean GRE: Q than other students and were more likely to dropout. The GRE: Q scores of women CS/E students who received a PhD were about the same as CS/E women who left. CS/E men who left the program had higher scores than those who received the PhD (16 points). However, this difference was smaller than the difference between the GRE: Q scores of other male science students who left the program and those who received the PhD (31 points).

A second possible explanation, which was also not supported, was after the first two years of graduate school, STEM students rarely take courses; their time is spent in the lab or in the field. The skills and knowledge necessary to do well on the GRE and to be successful in classes, may not

be as good a match with the skills and knowledge needed to be a successful researcher. This may be the case, however, for this sample, students were more apt to leave during their first and second years of their PhD program.

Another possible explanation, which can't be tested with this data set, is that when people with lower GRE scores are admitted to a graduate program it is because there is something special that sets them apart so that decision-makers look beyond the applicants' GRE scores.

### **Collateral Damage**

As the results below, indicate, the use of the GRE as an admission criteria, may have some additional effects. Based on data from a different study, 23 URM college seniors who were planning to go to graduate school in bio-medical programs were interviewed about their educational and career plans. Even though no questions about the GRE were asked, almost 80% (18) mentioned the GRE, 15 of whom mentioned it in terms of its negative impact on their graduate school plans. Sample comments included:

*"I feel like I'm good at in my classes, like at like conferences when I'm presenting, like, I'm comfortable. I think the GRE is a big, huge -- for me it was a huge factor, it was like the factor that just put everything aside."* Pamela, African American woman

*The GRE has been my biggest obstacle...You know, I came from another country... I'm not a novel reader so the books I read are science books so you know you'll see those, you know, very strange adjectives and things like that, so that's' really tough.* Maria, Hispanic woman who took a year off to study for the GRE

*I mean, ah, XXX told me that I was a good candidate for a Masters, but not for the PhD. I'm sure the only reason was the GRE 'cause I had everything else. I think GREs could potentially be a barrier [to graduate school].* Nate, Hispanic man

The expectation that the GRE is a required step to apply to graduate school, may be having a negative impact of the pool of those who even apply.

### **In Conclusion**

With a smaller sample ETS researchers Burton and Wang (2005) found similar results similar. They concluded "Our efforts to define progress to degree did not provide a reasonable outcome measure for a prediction study. This is a regrettable result, since degree attainment is one of the first and most obvious measures of success in graduate school. The research literature, however, consistently shows that it is difficult to predict which students will attain a degree, undergraduate or graduate." (p. 40). It is indeed difficult, and the GRE does not appear to help in that prediction.

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