Graduate Record Exam (GRE)

I. Description
II. Psychometric Properties
III. Predictive Validity
IV. Demographic Differences and Bias
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I. Description

Sections:

- Verbal (computer adaptive testing)
- Quantitative (computer adaptive testing)
- Analytic Writing (two essays, graded by at least two trained readers)
  - 0-6 scoring
- Psychology (and other) Subject Test

I. Description

Verbal

- 7 Text Completion questions
- 6 Sentence Equivalence questions
- 14 Reading Comprehension questions
- 27 questions total

I. Description

Quantitative

10 Quantitative comparison questions

13 Problem solving questions

4 Data interpretations questions

27 questions total

I. Description

Analytic Writing

"Assesses your critical thinking and analytical writing skills by assessing your ability to:

- articulate and support complex ideas
- construct arguments
- sustain a focused and coherent discussion"

"It doesn't assess specific content knowledge."

Analyze an issue task (see more detail here)

Topic pool link

https://www.ets.org/gre/test-takers/general-test/prepare/content/analytical-writing.html

I. Description

Psychology subject test

144 multiple choice questions

- Biological (30
- questions), Cognitive (29 questions), Social (19
- questions), Developmental (18 questions),
- Clinical
- (23 questions), and Measurement/
- Methodology/ Other (25 questions)

ETS testing site: “A question may require recalling factual information, analyzing relationships, applying principles, drawing conclusions from data and/or evaluating a research design.”

More on test content:

https://www.ets.org/pdfs/gre/fact-sheet-psychology.pdf

I. Description

Table 1A: Performance Statistics on the GRE General Test

(Based on the performance of all individuals who tested between July 1, 2020, and June 30, 2023)

Test	Number of Test Takers	Mean	Standard Deviation
Verbal Reasoning Measure	1,039,310	151.29	8.27
Quantitative Reasoning Measure	1,041,330	156.93	9.89
Analytical Writing Measure	1,037,639	3.49	0.88

Note: A total of 50 percent of test takers indicated they were female, 50 percent indicated they were male, and less than 1 percent indicated they were either non-binary, preferred to self-describe, or preferred n to answer.

II. Psychometric Properties

Table 4A: Reliability Estimates and Standard Errors of Measurement (SEM)[a] for Individual Scores and Score Differences for the GRE General Test

Score	Reliability Estimate	SEM of Individual Scores	SEM of Score Differences
Verbal Reasoning	0.87	3.2	4.5
Quantitative Reasoning	0.93	2.6	3.7
Analytical Writing	0.76	0.43	0.61

[a] The reliability estimates and SEMs for the Verbal Reasoning and Quantitative Reasoning measures of the General Test are based on item response theory (IRT). The reported values are an average of all the estimates obtained for all the multi-stage tests delivered between September 2023 and May 2024 to reflect the reliability of the shortened GRE. The reliability estimates and SEMs for the Analytical Writing measure are computed based on test-retest analyses using the performance on the Issue task only of all repeaters who tested between July 1, 2020, and June 30, 2023.

II. Psychometric Properties

Reliability

Test-retest reliability (Lee & Wai, 2023)

GRE-Q = 0.91

GRE-V = 0.82

GRE-AW = 0.78 for Analytical Writing

Average increase if retaking

GRE-Q = 1.43

GRE-V = 1.49

II. Psychometric Properties

Remember the standard error of measurement is the average size of error scores

Standard deviation of observed scores times the square root of 1 minus the reliability

$$se_m = s_o\sqrt{1 - R_{xx}}$$

II. Psychometric Properties

Conditional standard error of measurement (CSEM) is IRT concept of the standard error given certain ability value, θ_s

Tends to be the largest in the middle range of ability and smallest for the lowest and highest ranges of ability

II. Psychometric Properties

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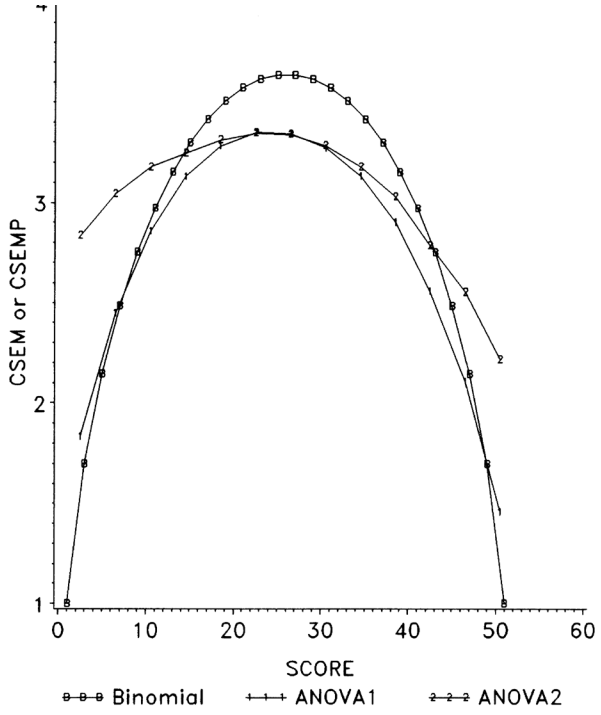


FIGURE 1. *Plot of estimated conditional standard errors of measurement for the Natural Sciences test*

Woodruff, D. (1990). Conditional standard error of measurement in prediction. *Journal of Educational Measurement*, *27*(3), 191-208.

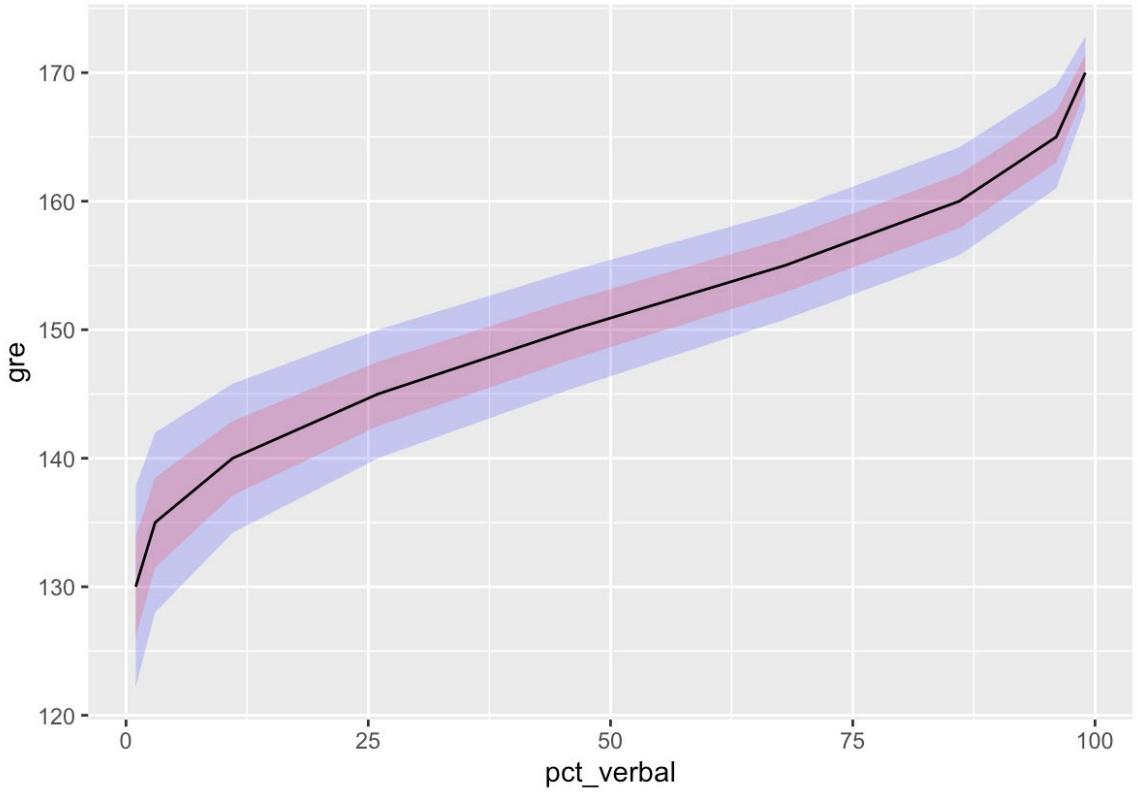
II. Psychometric Properties

Description

MARCH 5, 2020 BY TONY

Visualizing Conditional Standard Error in the GRE

https://thetaminusb.com/2020/03/05/visualizing-conditional-standard-error-in-the-gre/



III. Predictive Validity[1]

	GRE-V		GRE-Q		GRE-Subject	
	Validity Coefficients	**Corrected[1]**	**Validity Coefficients**	**Corrected[2]**	**Validity Coefficients**	**Corrected[2]**
Grad GPA	.23	.34	.21	.32	.31	.41
1st Yr Grad GPA	.24	.34	.24	.38	.34	.45
Comprehensive Exam Score	.34	.44	.19	.26	.43	.51
Fac Rated Performance	.23	.42	.25	.47	.30	.50

Combined GRE-V and GRE-Q predicting combined Grad GPA and Performance: .46
Combined GRE-V, GRE-Q, and GRE-S predicting combined Grad GPA and Performance: .52

[1]Kuncel, N. R., Hezlett, S. A., & Ones, D. S. (2001). A comprehensive meta-analysis of the predictive validity of the Graduate Record Examinations: Implications for graduate student selection and performance. *Psychological Bulletin*, *127*(1), 162–181. https://doi.org/10.1037/0033- 2909.127.1.162

[2]Corrections for restriction of range and measurement error

Note that some other studies are less positive about the magnitude of GRE's predictive validity (e.g., Feldon et al., 2024; Peterson et al., 2018; see also Appendix B review in Woo et al., 2023)

IV. Demographic Differences and Bias

Test and item bias of GRE

Nice review of graduate admissions bias issues by

Woo, S. E., LeBreton, J. M., Keith, M. G., & Tay, L. (2023). Bias, fairness, and validity in graduate-school admissions: A psychometric perspective. Perspectives on Psychological Science, 18(1), 3-31.

IV. Demographic Differences and Bias

Average Scores Compared with White students:[1]

GRE-V
Black students: -.92 SD
Hispanic students: -.58 to -.67 SD

GRE-Q
Black students: -.72 SD
Hispanic students: -.84 to -.97 SD

Compared to male students:[2]

GRE-Q
Female students: -.5 SD

[1]Educational Testing Service. (2019). A snapshot of the individuals who took the GRE General test July 2014-June 2019. https://www.ets.org/s/gre/pdf/snapshot_test_taker_data_2019.pdf
[2]Bleske-Rechek, A., & Browne, K. (2014). Trends in GRE scores and graduate enrollments by gender and ethnicity. Intelligence, 46, 25–34. https://doi.org/10.1016/j .intell.2014.05.005

IV. Demographic Differences and Bias

Some disparities in differential item functioning

Black students less likely to get easy items correct, but more likely to get difficult items correct, when compared with White students (Santelices & Wilson, 2012; Scherbaum & Goldstein, 2008)

Woo et al., 2023 “In summary, there is very limited evidence for psychometric bias (i.e., differential item functioning in the GRE items)” …. “a bigger issue of fairness”... “subgroup differences in test scores strongly signal the presence of systemic inequalities” p. 16

Differential prediction of outcomes

No differences for age, sex, or race (Braun & Jones, 1984; Kuncel & Hazlett, 2007)

[1]Educational Testing Service. (2019). A snapshot of the individuals who took the GRE General test July 2014-June 2019. https://www.ets.org/s/gre/pdf/snapshot_test_taker_data_2019.pdf

[2]Bleske-Rechek, A., & Browne, K. (2014). Trends in GRE scores and graduate enrollments by gender and ethnicity. Intelligence, 46, 25–34. https://doi.org/10.1016/j .intell.2014.05.005

IV. Demographic Differences and Bias

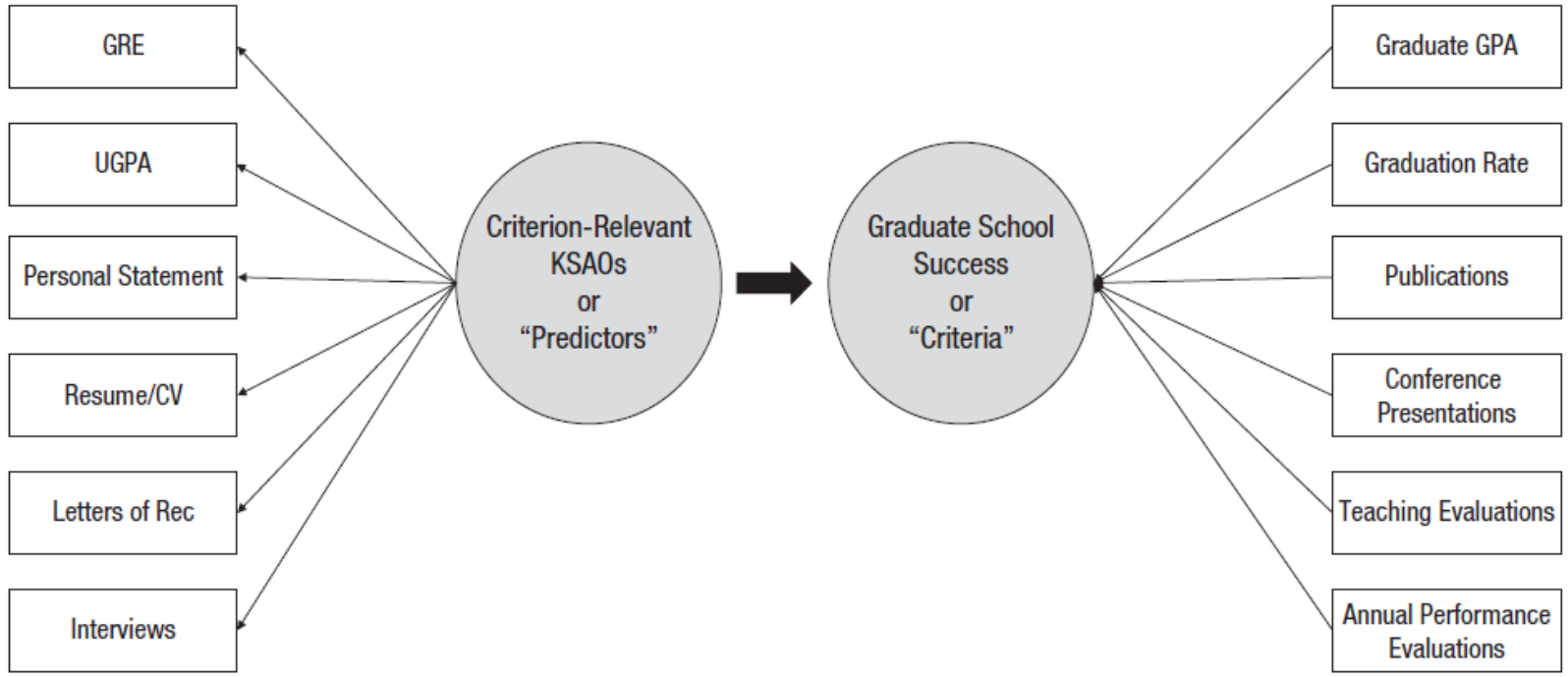


Fig. 1. Measures of graduate-school predictors and criteria. KSAOs = knowledge, skills, abilities, and other characteristics. Measures are in boxes, and constructs are in circles.

Woo, S. E., LeBreton, J. M., Keith, M. G., & Tay, L. (2023). Bias, fairness, and validity in graduate-school admissions: A psychometric perspective. *Perspectives on Psychological Science*, *18*(1), 3-31.

IV. Demographic Differences and Bias

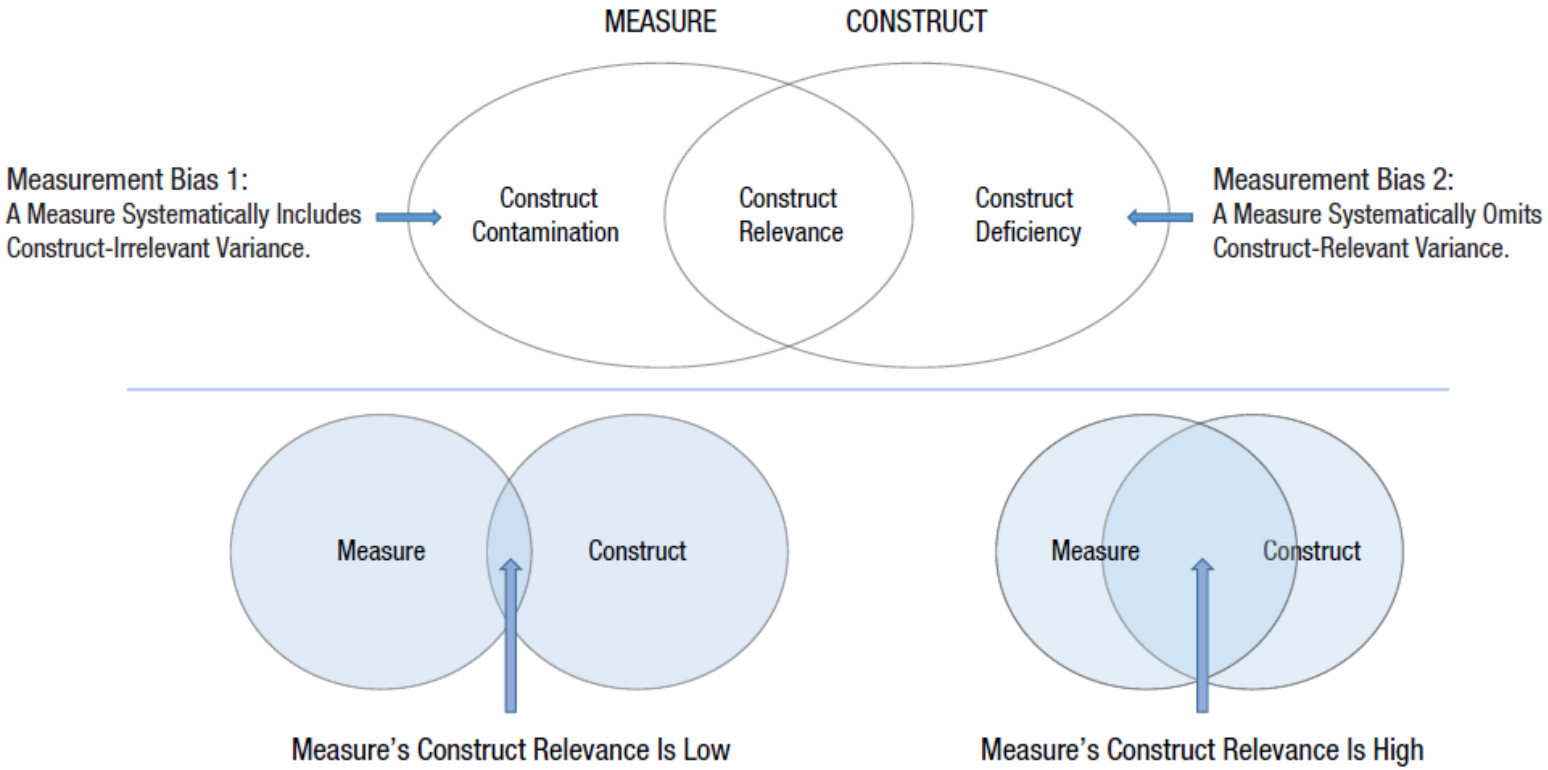


Fig. 2. An illustration of measurement biases and construct relevance, contamination, and deficiency.

Woo, S. E., LeBreton, J. M., Keith, M. G., & Tay, L. (2023). Bias, fairness, and validity in graduate-school admissions: A psychometric perspective. *Perspectives on Psychological Science*, *18*(1), 3-31.

Table 1. Potential Sources of Variance in Tests Used in Graduate-School Admissions Decisions

Source of variance	GRE	UGPA	PS	CVs	LOR	Interview
			Random variance			
Error scores	X	X	X	X	X	X
			Systematic variance			
True scores	X	X	X	X	X	X
Content biases						
Construct deficiency	X	X	X	X	X	X
Construct contamination	X	X	X	X	X	X
Sociocognitive biases						
Mere exposure bias		X			X	X
Confirmation bias		X	X	X	X	X
Truth bias		X	X	X	X	X
Similar-to-me bias		X	X	X	X	X
Attractiveness bias		X		X	X	X
Racial bias		X	X	X	X	X
Gender bias		X	X	X	X	X
Age bias		X	X	X	X	X
Representativeness bias		X	X	X	X	X
Anchoring bias		X	X	X	X	X
Rater biases						
Halo bias		X	X	X	X	X
Central tendency bias		X	X	X	X	X
Leniency bias		X	X	X	X	X
Severity bias		X	X	X	X	X

Note: GRE = Graduate Record Examination; UGPA = undergraduate grade point average; PS = personal statement; CV = curriculum vita; LOR = letters of recommendation.

Woo, S. E., LeBreton, J. M., Keith, M. G., & Tay, L. (2023). Bias, fairness, and validity in graduate-school admissions: A psychometric perspective. *Perspectives on Psychological Science*, *18*(1), 3-31.

V. GRE Test Preparation

Suggestions from the ETS site for preparation:

- Take a practice test (purchase or free online,
  e.g., https://www.ets.org/content/ets-org/language-master/en/home/gre/test-takers/general-test/prepare/powerprep.html)
- Familiarize yourself with the test content and format
- Set milestones (ETS site: “most test takers prepare for 1 to 3 months”)
- Download official prep materials
- Take advantage of online resources

From the ETS site: https://www.ets.org/gre/test-takers/admissions-resources/advice/its-better-when-you-have-a-study-plan.html

VI. Some Suggested Readings

Bridgeman, B., & Cline, F. (2022). Can the GRE predict valued outcomes? Dropout and writing skill. Plos one, 17(6), e0268738.

Lee, M. H., & Wai, J. (2023). Initial vs. retest GRE performance: A study of one million Graduate Record Examination test-retest observations. *Personality and Individual Differences*, *207*, 112180.

Leonhardt, D. (Jan, 2024). *The Misguided War on the SAT.* The New York Times.

Newman, D. A., Tang, C., Song, Q. C., & Wee, S. (2022). Dropping the GRE, keeping the GRE, or GRE-optional admissions? Considering tradeoffs and fairness. International Journal of Testing, 22(1), 43-71.

Petersen, S. L., Erenrich, E. S., Levine, D. L., Vigoreaux, J., & Gile, K. (2018). Multi-institutional study of GRE scores as predictors of STEM PhD degree completion: GRE gets a low mark. PloS one, 13(10), e0206570.

Westrick, P.A. (2017) Reliability Estimates for Undergraduate Grade Point Average, Educational Assessment, 22:4, 231-252, DOI: 10.1080/10627197.2017.1381554

Woo, S. E., LeBreton, J. M., Keith, M. G., & Tay, L. (2023). Bias, fairness, and validity in graduate-school admissions: A psychometric perspective. Perspectives on Psychological Science, 18(1), 3-31.

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