Miller Analogies Test Meta-Analysis

Nathan R. Kuncel
Sarah A. Hezlett
Deniz S. Ones

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Academic versus Practical Intelligence

- Fundamental argument is that different types of intelligence are needed in academic versus real world contexts
- It is argued that academic contexts require an “academic intelligence” or book smarts
- It is my belief that these arguments are based (in part) on an overly narrow conceptualization of the tasks that comprise academic performance
## Academic versus Practical Tasks

<table>
<thead>
<tr>
<th>Academic</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Formulated by others</td>
<td>• Requires problem recognition and formulation</td>
</tr>
<tr>
<td>• Well-defined</td>
<td>• Ill-defined</td>
</tr>
<tr>
<td>• Presents complete information</td>
<td>• Requires information seeking</td>
</tr>
<tr>
<td>• Single method for obtaining answer</td>
<td>• Multiple acceptable solutions</td>
</tr>
<tr>
<td>• Not embedded in ordinary experience</td>
<td>• Multiple paths to solution</td>
</tr>
<tr>
<td>• Little or no intrinsic interest</td>
<td>• Embedded in ordinary experience</td>
</tr>
<tr>
<td></td>
<td>• Requires motivation and personal involvement</td>
</tr>
</tbody>
</table>
Problems with the Task Distinction

- To be fair, the distinction between academic and practical tasks does a reasonable job characterizing the task of taking a test when this task is isolated from the broader academic context.
- However, it is a poor representation of other academic tasks like writing a term paper that are often ill-defined tasks.
- More importantly, it completely fails to consider the LARGE amount of behavior a student engages in weeks before taking the test.
Things Students Do Before Taking a Test

- Determine study objectives and methods
- Manage goal conflicts
- Coordinate work with other classmates
- Seek additional information or materials
- Handle school related finances
- Negotiate with peers and faculty
- Avoid counterproductive school behaviors
- Structure effective communications
A More Complete Picture of Academic Tasks

• Arriving at the test with a brain full of knowledge requires a student to engage in a large number of complex, ill-defined tasks with multiple paths to an acceptable solution
• These tasks share common elements with many job performance tasks
• Therefore, it should not be a surprise if the same individual difference variables predicted performance in both contexts
• There is a need for a taxonomy of the major dimensions of performance in college and graduate school
A Model of Undergraduate Student Performance Dimensions

- Traditional Classroom Success
- Written and Oral Communication
- Personal Discipline
- Resolving Goal Conflicts
- Studying and Learning Proficiency
- Sustained Goal Directed Effort
- Interactive Learning and Team Performance
- Administration
- Interpersonal Proficiency
- Non-Classroom Performance
- Development of Life Goals and Values

Kuncel (2002); Kuncel, Campbell, Hezlett, & Ones (2001)
A Model of Graduate Student Performance Dimensions

- Independent Research Accomplishment
- Using Discipline Specific Knowledge Expertly
- Expert Use of Research and Data Analytic Methods
- Effective Oral/Written Communication
- Exhibiting Sustained Goal Directed Effort
- Interpersonal Proficiency
- Professional/Networking Proficiency
- Being an Effective Team Member
- Leadership and Management
- Teaching Proficiency

Kuncel (2002); Kuncel, Campbell, & Oswald (1998)
Summary

• Although academic performance places a greater emphasis on demonstrating recently acquired knowledge, both contexts require the acquisition of knowledge and skill.

• There is considerable overlap in “Job” tasks across both contexts.

• Failure to consider academic performance as complex and multi-dimensional clusters of behaviors can lead to poor decisions about the relevance of different predictors.
Some Additional Counter Evidence

- Educational admissions tests predict more academic criteria than 1st Year GPA
  - Kuncel, Hezlett, & Ones (2001); Hezlett, Kuncel, Vey, Ahart, Ones, Campbell, & Camara (2001)

- GPA itself is related to job performance and salary
  - Roth, BeVier, Switzer, & Schippman (1996); Roth & Clarke (1998)

- Ability tests measure a common set of abilities
  - Carrol (1993); Vernon (1961)

- Ability tests are related to work performance
  - Hunter, (1986); Hunter, (1983); Schmidt, Ones, & Hunter, (1992)
Cross-Situational Validity: A Direct Test

• However, we still lack a direct test:
  – Examine the validity of a single test developed for academic settings but used in both academic and work settings
  – Ideally we would also establish the relationship between this test and other cognitive ability measures

• Unfortunately, a single ability measure is rarely used for both personnel selection and educational admissions decisions

• With one notable exception….
Current Study

- Miller Analogies Test (MAT)
  - Developed by W.S. Miller at the U of MN
  - First used in 1926
  - 50 minute test with 100 analogy items
  - Used for both:
    - Graduate school admissions decisions
    - Personnel selection for moderate to high complexity jobs
Objectives – MAT Meta-Analysis

- Examine validity of the MAT for multiple criteria in *both* academic and work settings
- Summarize large volume of research on validity of MAT
- Determine impact of statistical artifacts on validity of MAT
- Examine the correlations between the MAT and other cognitive ability tests
Hypotheses

• The MAT will be a valid predictor of academic and work criteria
• The validity of the MAT will not be equal for all criteria:
  – Motivationally determined criteria will be weakly predicted by the MAT tests.
• The MAT will have large correlations with other ability tests, particularly verbal ability tests and General Mental Ability Tests.
Academic Criteria

- 1st Year Graduate Grade Point Average
- Graduate Grade Point Average (GGPA)
- Comprehensive Examination Scores
- Faculty Ratings
- Degree Attainment
- Time to Complete Degree
- Research Productivity
- Internship/Practicum Ratings
- Student Teaching Performance Ratings
- Number of Courses/Credits Completed
- Ratings of Creativity
Work Criteria

• Counseling Work Sample Performance
• Ratings of Potential
  – Ratings of Potential for Counseling Work
• Job Performance
  – Counseling Performance
• Educational Administration Performance
• Membership in a Professional Organization
Correlations with Other Ability Tests

- GRE-Verbal
- GRE-Quantitative
- Verbal Ability Tests
  - e.g., Cooperative Reading – Total, MCAT–Verbal
- Math Ability Tests
  - e.g., Doppelt Math Reasoning Test, MCAT–Quant.
- General Mental Ability Tests
  - e.g., Ravens, Wechsler-Bellevue, Army Alpha
## Results: Academic Criteria 1

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>k</th>
<th>$r_{obs}$</th>
<th>$\rho$</th>
<th>90% lower</th>
<th>SD $\rho$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate GPA</td>
<td>11,049</td>
<td>67</td>
<td>.27</td>
<td>.36</td>
<td>.21</td>
<td>.09</td>
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<tr>
<td>1st Year GGPA</td>
<td>2,999</td>
<td>34</td>
<td>.29</td>
<td>.38</td>
<td>.15</td>
<td>.14</td>
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<tr>
<td>Faculty Ratings</td>
<td>1,909</td>
<td>25</td>
<td>.25</td>
<td>.37</td>
<td>.37</td>
<td>.00</td>
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<tr>
<td>Comp Exams</td>
<td>837</td>
<td>9</td>
<td>.48</td>
<td>.55</td>
<td>.48</td>
<td>.04</td>
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<tr>
<td>Degree Attain</td>
<td>3,726</td>
<td>18</td>
<td>.12</td>
<td>.15</td>
<td>-.11</td>
<td>.16</td>
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<tr>
<td>Time to Finish</td>
<td>1,700</td>
<td>5</td>
<td>.25</td>
<td>.30</td>
<td>.12</td>
<td>.11</td>
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## Results: Academic Criteria 2

<table>
<thead>
<tr>
<th>Criteria</th>
<th>N</th>
<th>k</th>
<th>$r_{obs}$</th>
<th>$\rho$</th>
<th>lower 90%</th>
<th>SD$_\rho$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Prod.</td>
<td>314</td>
<td>4</td>
<td>.13</td>
<td>.16</td>
<td>.16</td>
<td>.00</td>
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<tr>
<td>Internship Ratings</td>
<td>283</td>
<td>3</td>
<td>.14</td>
<td>.19</td>
<td>.19</td>
<td>.00</td>
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<tr>
<td>Student Teaching</td>
<td>444</td>
<td>5</td>
<td>-.02</td>
<td>-.04</td>
<td>-.04</td>
<td>.00</td>
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<tr>
<td># Courses Comp.</td>
<td>179</td>
<td>3</td>
<td>-.05</td>
<td>-.06</td>
<td>-.06</td>
<td>.00</td>
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<tr>
<td>Creativity Ratings</td>
<td>1,074</td>
<td>5</td>
<td>.25</td>
<td>.32</td>
<td>.32</td>
<td>.00</td>
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<tr>
<td>Coun. Work Samp.</td>
<td>114</td>
<td>5</td>
<td>.18</td>
<td>.22</td>
<td>.00</td>
<td>.00</td>
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</table>
## Results: Work Criteria

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>k</th>
<th>$r_{obs}$</th>
<th>$\rho$</th>
<th>90% lower</th>
<th>SD$\rho$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Performance</td>
<td>598</td>
<td>7</td>
<td>.26</td>
<td>.38</td>
<td>.18</td>
<td>.12</td>
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<tr>
<td>Counseling Perf.</td>
<td>92</td>
<td>2</td>
<td>.33</td>
<td>.45</td>
<td>.45</td>
<td>.00</td>
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<tr>
<td>Edu. Admin. Perf.</td>
<td>225</td>
<td>10</td>
<td>.15</td>
<td>.23</td>
<td>-.02</td>
<td>.15</td>
</tr>
<tr>
<td>Member Pro. Org.</td>
<td>278</td>
<td>3</td>
<td>.19</td>
<td>.23</td>
<td>.23</td>
<td>.00</td>
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<tr>
<td>Potential Ratings</td>
<td>494</td>
<td>11</td>
<td>.24</td>
<td>.34</td>
<td>.34</td>
<td>.00</td>
</tr>
<tr>
<td>Coun. Pot. Ratings</td>
<td>192</td>
<td>6</td>
<td>.32</td>
<td>.45</td>
<td>.45</td>
<td>.00</td>
</tr>
</tbody>
</table>
Summary

- These results demonstrate that a so called academic intelligence measure also has important relationships with real world outcomes like job performance and evaluations of creativity and potential.

- These findings contradict arguments that intelligence as measured by the MAT is restricted to academic domains.
## Results: Cognitive Ability Correlates

<table>
<thead>
<tr>
<th>Measure</th>
<th>N</th>
<th>k</th>
<th>$r_{obs}$</th>
<th>$\rho$</th>
<th>lower 90%</th>
<th>SD$_\rho$</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRE – Verbal</td>
<td>8,328</td>
<td>15</td>
<td>.70</td>
<td>.88</td>
<td>.78</td>
<td>.06</td>
</tr>
<tr>
<td>GRE – Quant.</td>
<td>7,055</td>
<td>15</td>
<td>.42</td>
<td>.57</td>
<td>.41</td>
<td>.10</td>
</tr>
<tr>
<td>Verbal Measures</td>
<td>3,614</td>
<td>23</td>
<td>.67</td>
<td>.88</td>
<td>.75</td>
<td>.08</td>
</tr>
<tr>
<td>Math Measures</td>
<td>2,874</td>
<td>18</td>
<td>.50</td>
<td>.68</td>
<td>.60</td>
<td>.05</td>
</tr>
<tr>
<td>GMA Measures</td>
<td>1,753</td>
<td>15</td>
<td>.56</td>
<td>.75</td>
<td>.50</td>
<td>.15</td>
</tr>
</tbody>
</table>
Summary: Cognitive Ability Correlates

- A possible argument against the validity results is that the MAT is unusual and unrelated to other ability measures.
- These analyses demonstrate that the MAT is not sitting in isolation and is very strongly related to other ability measures.
- These analyses extend the findings in the MAT study across dozens of different measures and make the findings more generalizable.
Why Should I Care About a Small Correlation?

• After all, we want a “difference that makes a difference” – D. G. Patterson

• In personnel selection contexts use of a predictor with a small validity can greatly increase the performance of the selected group.

• But first, we have to have some confidence that the small correlation is real. Meta-analytic or large sample estimates can provide this confidence.
Quantifying the Difference

• The most basic approach is to consider the % of correct decisions. (Taylor & Russell, 1939)
• More elaborate expectancy tables can be constructed (Tiffin & McCormick, 1965)
• Can also consider the increase in mean performance (Blum & Naylor, 1968)
• Or can even consider dollar value increase in work performance (Cronbach & Gleser, 1965)
Taylor and Russell Example

- Although more complex models exist, increase in number of correct decisions is good for illustration
- Assumptions for going from $r$ to percent correct decisions
  - Homoscedastic
  - Linear
- $r$ (MAT, degree attainment) = .15
- Assume that 30% of applicant group would be acceptable performers (base rate)
- Assume that we are a highly selective school with a selection ratio of .10 (10% percent accepted)
Results

- Our rate of correct decisions would rise from 30% to 40%
- With the “trivial” correlation an additional 10% of our workers or grad students will be acceptable
- Take the same situation with $r = .55$ (quals)
- Correct decisions = 69%
- We go from 1 in 3 acceptable workers to 7 in 10
- Not too shabby for 50 minutes of testing with a 77 year old test!
Some Other Correlations

- Correlation between taking aspirin and having versus not having a heart attack
  \( r = .034 \)
- Correlation between taking AZT versus a placebo and death from AIDS
  \( r = .23 \)
- Correlation between psychotherapy and more positive outcomes
  \( r = .32 \)
- Correlation between GRE and faculty ratings
  \( r = .36 \)
Summary

• A test developed for prediction of academic performance is a valid predictor of:
  – Academic performance criteria
  – Work performance criteria
  – Evaluations of creativity
  – Evaluations of potential

• Although academic performance and job performance differ, they have many tasks and predictors in common
Note: The relationships between IQ or SES and academic attainment seen here is when the other is held constant.