Psychometric Properties of Health & Self-Care

Linda S. Gottfredson
University of Delaware
Rosalind Arden
Kings College, London

International Society for Intelligence Research
Amsterdam
December 13, 2007
Calculus of Inconspicuous Effects: Essential for Theory Testing

- Small but consistent influences add & compound

**Examples**

- Individual level (across time, situations)
  - additive—GPA, high blood sugar
  - multiplicative—their sequelae for work & health “careers”

- Population level (across time, people)
  - additive—evol of g, accident rates by race/class

**Physiological too?**

- Essential for Fitness and System-Integrity theories of g & health (#2 above), where g signals overall physiological fitness
Vietnam-Era Veterans Data

- Study mandated by US Congress: Did defoliants affect health of Vietnam veterans?
  - Born ~1950
  - Inducted ~1970 (N ~18,000)
  - Telephone interview ~1985 (N ~14,000)
  - Physical/mental exam ~1985 (N ~4,500)
  - Mortality follow-up 2000, age ~50
  - Can replicate by race (~3,500 white, ~450 black)
% of Whites and Blacks by $g$ Level

Ns = 3,417 (whites), 467 (blacks)
## Typical Reliabilities for Measures

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Conditions</th>
<th>$r$ (intraclass)</th>
<th>Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab assays</td>
<td>Hematology, Immunology, Serological</td>
<td>.9+</td>
<td>.9+</td>
</tr>
<tr>
<td>Hearing, sight</td>
<td></td>
<td>.8 - .9</td>
<td></td>
</tr>
<tr>
<td>Lung function</td>
<td></td>
<td>.6-.9+</td>
<td></td>
</tr>
<tr>
<td>Abnormal chest X-ray</td>
<td></td>
<td>.6</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical exams</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• dermatology</td>
<td>Birthmarks, warts, acne, Alopecia, folliculitis, drug tracks</td>
<td>.2-.5</td>
<td></td>
</tr>
<tr>
<td>• general exam</td>
<td>Height, Weight, pulse, Blood pressure (arm), (ankle)</td>
<td>.99 .7 .5-.6 .1-.7</td>
<td>.4 .2 .2 .05</td>
</tr>
<tr>
<td>• skin hypersensitivity</td>
<td></td>
<td>.3-.6</td>
<td></td>
</tr>
<tr>
<td>• reflex</td>
<td>Knee, plantar</td>
<td>.1-.3</td>
<td></td>
</tr>
</tbody>
</table>
To be explained:
Mortality 1985-2000, by $g$ Level and Race (% and Odds Ratios)
Ns=3,417 (whites), 467 (blacks)
Potential confound:
Mortality 1985-2000, by Income Level and Race (% and Odds Ratios)

Ns=3,417 (whites), 467 (blacks)
Test Case: Peripheral Nerve Conduction Studies
(N ~ 4,500)

- **3 sensory amplitude (µV)**
  - Median (arm); ulnar (arm); sural (leg)

- **4 sensory velocity (m/sec)**
  - Median-distal,(arm); median proximal (arm), ulnar (arm), sural (leg)

- **2 motor amplitude (µV)**
  - Median (arm), peroneal (leg)

- **2 motor velocity (m/sec)**
  - Median (arm), peroneal (leg)

Added z scores to create SENSORY-7 scale

Added z scores to create MOTOR-4 scale
Same Results for Whites & Blacks

Zero-Order Correlations (concurrent)

<table>
<thead>
<tr>
<th>Blacks&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Sensory-7</th>
<th>Motor-4</th>
<th>g</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory-7</td>
<td></td>
<td></td>
<td>.16</td>
<td>.10</td>
</tr>
<tr>
<td>Motor-4</td>
<td>.47</td>
<td></td>
<td></td>
<td>.08</td>
</tr>
<tr>
<td>g</td>
<td>.16</td>
<td>.06</td>
<td></td>
<td>.35</td>
</tr>
<tr>
<td>Income</td>
<td>.11</td>
<td>.03</td>
<td>.34</td>
<td></td>
</tr>
</tbody>
</table>
### Regressions (concurrent)

#### Predicting $g^a$

<table>
<thead>
<tr>
<th></th>
<th>Sensory-7 ($\beta$)</th>
<th>Motor-4 ($\beta$)</th>
<th>Multiple R</th>
<th>(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whites</td>
<td>.16</td>
<td>-.02</td>
<td>.15</td>
<td>(3,417)</td>
</tr>
<tr>
<td>Blacks</td>
<td>.14</td>
<td>-.01</td>
<td>.14</td>
<td>(457)</td>
</tr>
<tr>
<td>Total</td>
<td>.21</td>
<td>-.07</td>
<td>.19</td>
<td>(3,874)</td>
</tr>
</tbody>
</table>

Prediction carried by Sensory; Motor acts like a slight suppressor

#### Predicting Sensory-7

<table>
<thead>
<tr>
<th></th>
<th>$g$ ($\beta$)</th>
<th>Income ($\beta$)</th>
<th>Multiple R</th>
<th>(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whites</td>
<td>.157</td>
<td></td>
<td>.16</td>
<td>(3347)</td>
</tr>
<tr>
<td>Blacks</td>
<td>.159</td>
<td>.045</td>
<td>.16</td>
<td>(457)</td>
</tr>
</tbody>
</table>

Prediction carried by $g$; Income adds virtually nothing

---

$^a$Results same for $g$ (General Technical) score at induction.
Sensory Nerve Conduction, by $g$ Level: Mean Standardized Velocity and Amplitude (7 tests)

Ns = 3,417 (whites)
Sensory and Motor Nerve Conduction, by $g$ Level: Mean Standardized Velocity and Amplitude (7 & 4 tests)

$Ns = 3,417$ (whites)
Sensory Nerve Conduction, by Race and $g$ Level:
Mean Standardized Velocity and Amplitude (7 tests)

Ns = 3,417 (whites), 467 (blacks)
Sensory and Motor Nerve Conduction, by Race and $g$ Level: Mean Standardized Velocity and Amplitude (7 & 4 tests)

$N_s = 3,417$ (whites), 467 (blacks)
## Different Means for Whites & Blacks

### Zero-Order Correlations (concurrent)

<table>
<thead>
<tr>
<th>Blacks&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Sensory-7</th>
<th>Motor-4</th>
<th>$g$</th>
<th>Income</th>
<th>W-B ($z$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory-7</td>
<td></td>
<td></td>
<td>.46</td>
<td>.16</td>
<td>.10</td>
</tr>
<tr>
<td>Motor-4</td>
<td>.47</td>
<td></td>
<td></td>
<td>.06</td>
<td>.08</td>
</tr>
<tr>
<td>$g$</td>
<td>.16</td>
<td>.06</td>
<td></td>
<td></td>
<td>.35</td>
</tr>
<tr>
<td>Income</td>
<td>.11</td>
<td>.03</td>
<td></td>
<td></td>
<td>.34</td>
</tr>
</tbody>
</table>

<sup>b</sup> Sensory-7 & Motor-4 are standardized scores.
% of Whites and Blacks by Income Level

Ns = 3,348 (whites), 458 (blacks)
Sensory Nerve Conduction, by Race & Income: Mean Standardized Velocity and Amplitude (7 tests)

Ns = 3,417 (whites), 467 (blacks)
Sensory and Motor Nerve Conduction, by Race & Income: Mean Standardized Velocity and Amplitude (7 & 4 tests)

Ns = 3,417 (whites), 467 (blacks)
Sensory and Motor Nerve Conduction, by Race and $g$ Level: Mean Standardized Velocity and Amplitude (7 & 4 tests)

Recall: Steeper for $g$
Effect Sizes for 3 Sensory Nerve Amplitudes

- Median-distal (arm): Amplitude µV = -.09
- Sural (leg): Amplitude µV = .16
- Ulnar (arm): Amplitude µV = .62

Legend:
- Blue: White
- Red: Black
Effect Sizes for 2 Motor Nerve Amplitudes

- Median (arm): Amplitude µV = -0.30
- Peroneal (leg): Amplitude µV = -0.44

Legend:
- Blue: White
- Red: Black
Effect Sizes for Ulnar Sensory Nerve Velocity

- All g levels: 0.61
- $z$ is -1 to 0: 0.34
Tentative Conclusions: Overall “Fitness”

• Peripheral nerve conduction correlated with $g$ (~.20)
  – Body is vast information processing system
• $g$ relates mostly to sensory, not motor conduction
  – Bodily input, not output
• Races differ in sensory-motor profiles
  – Whites higher in sensory, lower in motor (at all $g$ levels)
  – Same known for reaction time: decision vs. movement time
  – Major race difference here was in ulnar conduction (wrist-hand)
• Evolutionary tradeoff between sensory and motor?
  – More consistent with Genetic-Fitness than System-Integrity theory of $g$ as signal of physiological fitness
Thank you.