Swedish student perceptions of achievement practices: The role of intelligence

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Intelligence

- The ability to flourish and succeed within the environment
  - Not fixed, not unitary, not just inherited
- Multi-componental & multiple models
- Spearman
  - Performance across subjects is correlated $\rightarrow$ 'g' general intelligence
- Cattell
  - Sub-components depending on structure of process
    - Crystallised and structured capabilities $\rightarrow$ 'Gc' crystallised intelligence ability to use learned knowledge and experience
    - Fluid or dynamic capabilities $\rightarrow$ 'Gf' fluid intelligence: ability to solve new problems, use logic in new situations, and identify patterns
Intelligence is a product of genetic and environmental factors
- Not fixed!
- Intelligence appears to be growing (Flynn effect)

Raymond B. Cattell model

Is intelligence teachable?

- Intelligence is a product of genetic and environmental factors
  - Not fixed!
- Intelligence appears to be growing (Flynn effect)
Schooling contributes

› School attendance increases intelligence
› Curriculum processes contribute if students develop:
  ◦ Effortless recall of important data
  ◦ Ability to identify patterns, structure, relationships in data
  ◦ Broad cognitive skills taught and assessed: Analysis, synthesis, evaluation, creation, problem-solving, etc.
› Large burden on curriculum, teaching, and assessment

Achievement demands of school

› Tests, Homework, Questions in class, failing–success,
  ◦ Creates pressure on students from
    • Themselves
    • Teachers
    • Parents
› Coping with demands is important
  ◦ Self-regulation, self-efficacy contribute to greater success
› Parental concerns rub off on students
Positive views about assessment are associated with >test scores; Negative views about assessment <test scores

IQ contributes to >school achievement

Twin / triplet studies show that
  - IQ contributes to >coping, self-efficacy

Question
  - IQ lead to positive beliefs about achievement in normal populations of parents and students?

**Conceptual model**

- IQ as predictor of beliefs (Model 1)
- IQ as dependent on beliefs (Model 2)
Secondary Data:
Swedish Evaluation Through Follow-up (ETF)

- Large cohort-sequential longitudinal database,
  - 9 cohorts with individuals born between 1948 and 1998.
  - Each cohort about 9000 pupils, sampled to be nationally representative.
  - Cognitive tests and questionnaire with items about their experience of selected aspects of schooling.
  - Parents of each student completed a questionnaire.
  - Students sampled through a multi-stage sampling design
    - Municipalities, schools, classes
  - [http://ips.gu.se/english/research/research_projects/ETF](http://ips.gu.se/english/research/research_projects/ETF)

1998 birth cohort

- Cohort 9 in Grade 6 survey = 2011 testing
- N=9671 children, who were nominally 13 years old in early 2011 during the 2nd semester of their 6th year of schooling.
  - 96.5% born in calendar year 1998,
  - born in 1997 (n=84) and 1999 (n=81).
- Cases with >10% missing questionnaire responses deleted, those without matching parent data deleted
- Effective sample n=4749
- Sex: 51.8% boys, 48.2% girls
School clustering

- School was available only for \( n=2918 \) (61% of retained sample)
- Schools with \( \geq 20 \) students \( n=1056 \); just 11%
- Thus multilevel problematically non-generalizable?
  - ICCs ranged from 0.02 to 0.175 (\( M=0.05 \), \( SD=0.03 \))
  - only 1 value>0.10 (i.e., QS611–How often do you do tests?).
    - This item should show a significant school variance component since the frequency of testing is determined at the school level
    - The larger message is that the school contribution to variance in the model was relatively trivial
    - So a one-level model is defensible.

Modeling

- CFA for student, parent, and IQ item sets
- SEM for relationship of student–parent–IQ factors
  - Missing data with EM imputation
  - MLR estimation
  - Fit imputed not reject if: RMSEA < 0.08; SRMR \( \leq 0.06 \); CFI & gamma hat > 0.90; \( \chi^2/df \) ratio has \( p > .05 \)
  - MPlus used
- Models compared for selection
  - \( \Delta AIC > 10 \) smaller value preferred
A comment on missing values

- Rubin & Little 2002
  - Imputation valid if missing is small (<5%)
- Imputation techniques work if missing is large (<50%)
- EM and MI maximise the input values of M, SD, matrices (covariance/correlation)
- But meaningful in terms of the truth?
- We deleted 4251 because >10% missing but FIML with 8650 found results almost identical, so proof that imputation maximises start values... which should you use if they are the same?

Student result

- Fit
  - $\chi^2=312.24$; df=48; $\chi^2$/df=6.05, p=.01; CFI=0.97; gamma hat=0.99; RMSEA=0.03; SRMR=0.03
- Students
  - strongly endorsed I cope with demands
  - moderately agreed that parents enquired about performance
  - reasonably high frequency of testing and homework
- Overall, rejected being worried about tests, exams, and school happenings

<table>
<thead>
<tr>
<th>Scale &amp; items</th>
<th>Loading</th>
<th>Scale inter-correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. I Worry (M = 2.47, SD = 0.88)</td>
<td></td>
<td></td>
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<tr>
<td>I worry about tests on homework</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>I worry about how I am going to pass exams</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>I worry about things that happen in school</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>II. I Cope (M = 4.08, SD = 0.50)</td>
<td></td>
<td></td>
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<tr>
<td>It is easy for me to meet the teachers demands</td>
<td>0.71</td>
<td>-0.39 (0.64)</td>
</tr>
<tr>
<td>I normally manage to do the tasks that I am given</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>I can normally answer correctly when I get a question</td>
<td>0.62</td>
<td></td>
</tr>
<tr>
<td>I try to avoid failing/making mistakes in school</td>
<td>0.31</td>
<td></td>
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<tr>
<td>III. Parents Ask (M = 3.77, SD = 0.85)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How well I do in different subjects</td>
<td>0.89</td>
<td>-0.01 0.21 (0.72)</td>
</tr>
<tr>
<td>How I work during lessons</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td>How I did on a test or test of homework</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>IV. Test Frequency (M = 3.79, SD = 0.69)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing test</td>
<td>0.07</td>
<td>0.18 0.29 (0.45)</td>
</tr>
<tr>
<td>Having written homework tests</td>
<td>0.43</td>
<td></td>
</tr>
</tbody>
</table>
Parents want grades, but with more grade points than the then current 3-point scale. Moderate level of demand from homework, pace of study, and responsibility. Generally rejected the idea that school work and testing was too much pressure on their child.

- **IQ model**
  - Crystallised: antonyms & synonyms
  - Fluid: metal folding & number series

- **Fit:**
  - $\chi^2=7.23; df=1; \chi^2/df=7.23, p < .01; CFI=0.99; \gamma\hat{=}0.99$; RMSEA=0.04; SRMR=0.01
  - NB: synonyms & antonyms correlated $r=0.48$
SEM results

- Model 1: IQ predictor
  - Fit:
    - $\chi^2=1815.43; df=278$
    - $\chi^2/df=6.53, p=.01; CFI=0.95$
    - $\gamma = 0.97$
    - $\text{RMSEA}=0.034; \text{SRMR}=0.041$
    - $\text{AIC}=334,565.416$
  - $\Delta \text{AIC}=317.516$, this model smaller so preferred

- Model 2: IQ dependent
  - Fit:
    - $\chi^2=2113.77; df=284$
    - $\chi^2/df=7.44, p< .01$
    - $CFI=0.94; \gamma = 0.97$
    - $\text{RMSEA}=0.037; \text{SRMR}=0.047$
    - $\text{AIC}=334,882.932$

Greater coping with school and reduced parental concern present among intellectually more able children

Parents beliefs do influence student coping

Cognitive tests are moderately strong predictors of student beliefs about achievement

Lower IQ means parents influence students to be less coping with demand

Only substantive influence...
Significance

- Large, representative sample of the population with little (if any) shared genetic environments.
- Thus is generalizable to the full population in schooling.
  - Unlike twin/triplet studies
- Increasing IQ will help students cope better
  - Can we stimulate children during the neuro-plastic phases of schooling to greater intelligence? Surely yes!

Further research

- Need to prove that changing IQ has the impact we want on self-regulation
  - IQ ➝ Self-regulating Beliefs ➝ Academic Achievement
  - Longitudinal or experimental studies
  - Follow cohort to university entrance for NCEA/IB/A Levels final year grades and then 1st year performance
- ETF
  - Add more tests for $G_f$ and $G_c$, so correlated residuals not required
  - Add school achievement measures
  - Add attitudes about the IQ tests themselves
Further reading


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