The Curious Case of Intelligence

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Can We Be Intelligent About Intelligence?
Why Education Needs the Concept of Plastic General Ability

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Abstract
The notion of general cognitive ability (or 'intelligence') is explored and why the time might now be ripe for educators to reconsider the power offered by a general intellectual capacity which is itself amenable to educational influence. We review existing knowledge concerning general intelligence, including the cohabitation of general and special abilities, cognitive modules, development, and evidence for plasticity of the general processor. We examine why this knowledge is generally absent from educational practice and present a number of models that attempt to synthesise the main aspects of current psychological theories. We explore how the models might be used in educational applications and look at examples of effective cognitive stimulation considering both practicalities and theoretical notions of what in our cognitive models is affected by stimulation. We discuss finally the possible political, cultural and social barriers to the inclusion of general ability as central to educational aims.

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Overview

• What is it? Why don’t we like it?
• General or Special?
• Fixed or Plastic?
• Cognitive Stimulation
• What key features do we need to explain?
• What mind models explain these features?
• Implications for Education
When I ask teachers what counts to them as ‘smart’, they say…

- Going beyond the ‘given’
- Seeing connections between different ideas
- Seeing patterns in data
- Applying concepts to new contexts
- Managing abstract ideas, which (by definition) exist in the mind but not in concrete reality

*Holding a number of ideas in mind at once*
This idea of ‘connectivity’, held by education professionals, is closely related to psychologists’ formulations, e.g. Spearman’s ‘eduction of relations’ and Bruner’s ‘going beyond the information given’

In the field of cognitive psychology, “Intelligence” is generally an unproblematic given …
...so why don’t educators like it?

- Can just one construct explain so much?
- Seen as *Fixed* ... so a limitation on learning
- Doubts about its measurement
- Dislike of ‘labelling’
- Supposed hereditability has racist implications

*These reasonable concerns need to be answered*
## Is intelligence

<table>
<thead>
<tr>
<th>General …</th>
<th>… or Context-dependent?</th>
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</thead>
<tbody>
<tr>
<td>“All abilities determined by a general intellectual processor”</td>
<td>“Ability varies completely with the context / topic”</td>
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</table>

**Evidence:**
- Correlation between tests of different abilities
- Transfer of training

**Evidence:**
- Brain localisation
- ‘Good at language, poor at science’

John Carroll: *Human Cognitive Abilities.*

A general core plus special abilities
Intelligence is plastic - modifiable

- The Flynn Effect
  IQ scores grow generation on generation
- The anti-Flynn effect
  Drop in conservation scores over 15 years in England
- Head Start and similar
  Mixed evidence but real effects follow proper implementation
- Cognitive Acceleration …
Evidence for the effectiveness of Cognitive Acceleration has accumulated over the years since 1987. It includes:

- Effect sizes of 0.3 to 1.0 s.d. in cognitive gains of experimental over control students
- Long term effects: gains in national test results taken 3 years after the end of a two-year intervention programme.
- Far transfer: significant effects in English from an intervention delivered in science.
Here are some characteristics of intelligence which we need to be able to explain:

• Intelligence as Connectivity

• The *general* nature of intelligence (plus special abilities)

• The development of intelligence in individuals

• Individual differences

• Plasticity
Modelling Intelligence

1. Information processing

- **Sense Organs**: Convert external stimuli to neural signals
- **Working memory**: Information from outside and from L.T. memory is processed
- **Long-term memory**: Information is stored by association - ‘neural networks’
Modelling Intelligence

2: Cognitive Development (Piaget, Inhelder, et al.)

• The mind *operates on* perceptions, making meaning

• The mind develops through distinct stages of increasingly sophisticated mental operations, for example:

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<tr>
<th></th>
<th>Pre-operational</th>
<th>Concrete operations</th>
<th>Formal operations</th>
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</thead>
<tbody>
<tr>
<td>Floating and sinking</td>
<td>No consistent groups, so no predictions. Anthropomorphism</td>
<td>Heavy things sink, light things float</td>
<td>Compares mass/volume ratios of solid and liquid</td>
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</tbody>
</table>
Modelling intelligence

3. Adding special abilities (after Demetreou)

The Specialised Structural Systems:

- imaginal spatial
- quantitative relational
- verbal propositional
- qualitative analytic
- causal experimental

Implications:
- the central processor is, well, central;
- the function of the executive is not yet well formulated;
- the SSSs may develop at different rates for inherent or environmental reasons
- development of the SSSs and executive are limited by development of the central processor.
Modelling intelligence

4. Adding modules (Mike Anderson)

- Verbal-propositional processor
- Spatial-visual processor

Basic Processor

Percept 3-D space

Phono. encoding

T.O.M.

Syntactic parsing

Knowledge
# What the models explain

<table>
<thead>
<tr>
<th></th>
<th>Connectivity</th>
<th>Development</th>
<th>General + Special</th>
<th>Individ. Diffs</th>
<th>Plasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information Processing</strong></td>
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<tr>
<td><strong>Cognitive Development</strong></td>
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<td><strong>Demetreou</strong></td>
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<td><strong>Anderson</strong></td>
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The Message for Education

• Once you accept the evidence for the plasticity of intelligence, it becomes an opportunity, not a constraint;

• Giving curriculum time specifically to the development of intelligence provides students with a powerful general tool for learning;

• BUT, teaching for the development of general intelligence is not easy …
Three Pillars of Cognitive Stimulation

- **Cognitive Conflict**: The mind develops in response to stimulation.
- **Social Construction**: Dialogue with others is essential.
- **Metacognition**: Becoming conscious of your own thinking.
Some programmes which employ these

- Cognitive Acceleration
- Philosophy for Children
- Instrumental Enrichment

... and others, but few have published evidence of effects
Then there is the issue of delivery

• … successful thinking programmes (which enhance general intelligence) cannot be captured in printed or software materials
• They depend on the skill of the teacher
• So a programme of professional development is essential.
Effective Professional Development

Senior Management
- Committed
- Shared vision
- Structural change

The Group
- Collegiality
- Communication
- Shared reflection

T1
- Ownership
T2
- Ownership
T3
- Ownership
T4
- Ownership

A Sound Innovation
- Theory, Evidence, Materials

Good Quality PD
- Duration, Pedagogy, Coaching

National, Local Government

Intelligence

Children's Learning
What can we expect?

- Majority of teachers to take this on board? …I think so
- Government to credit teachers with this capability? … apparently not
- Teachers need cognitive conflict, social construction, and metacognition too.