Cognition at Adolescence

Formal Operations
- “structured whole”
- think systematically
- “operate on operations”

Deductive Reasoning
The Scientific Method
- inspect data
- generate hypotheses
- deduce what should follow on basis of logic
- test theory
Wason problems

Supply a rule.
Show instances.
Decide if the rule is broken.

If there is a vowel on one side, then there is an even number on the other side.

E  O  4  7

Which card or cards must be turned over to see if the rule is violated?

IF A PERSON IS DRINKING BEER, THEN THE PERSON MUST BE 21 OR OVER

Which card or cards must be turned over to see if the rule is violated?
• Familiarity - “human sense”

Percent Using Formal Operational Thought (De Lisi & Staudt, 1980)

Type of Problem

• Expertise
Obstacles to FOT

• Confirmation bias
• Prior beliefs
• Failure to separate theory from evidence

Everyday Thinking

• Do not consider every possibility
  – not plausible
  – real constraints
  – short-cuts
• Different goals (Tschiri, 1980)

Gender Differences
**Controversial**

- great variability within gender
- increase prejudice/discrimination
- limit opportunities
- stereotype threat

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**Stereotype Threat**

when negative stereotypes about one’s group are made salient, performance declines

Claude Steele

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Mean performance on a difficult math task as a Function of Gender & Test characterization

<table>
<thead>
<tr>
<th>Gender Diff</th>
<th>No Gender Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>females</td>
<td>10</td>
</tr>
<tr>
<td>males</td>
<td>30</td>
</tr>
</tbody>
</table>

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or...

- biological and social factors that vary with gender is a legitimate focus of scientific study
- tell us what IS, not what OUGHT to be

Math and Science Achievement

- elementary and middle school, no gender differences*
- *except at extremes
- by high school, males outperform females on standardized tests

- tasks that favor females...
perceptual speed

object displacement
L__ __ __ __
Limp, Livery, Love, Laser, Liquid, Low, Like, Lag, Live, Lug, Light, Lift, Liver, Lime, Leg, Load, Lap, Lucid...

Ideational fluency

precision tasks involving fine motor coordination

14 \times 3 - 17 + 52
2 (15 + 3) + 12 - 15/3

mathematical calculation
tasks that favor males...

target-directed motor skills

disembedding tasks
If only 60 percent of seedlings will survive, how many must be planted to obtain 660 trees?

mathematical reasoning

spatial reasoning
mental rotation

Explanations

- evolutionary psychology
- socialization
- genes, hormones, brains

Toys

“Math class is tough”
“I love dressing up”
“Do you want to braid my hair?”
Games
• baseball, football, etc.

Activities
• boys roam farther from home
• money

Values
• Burkam, et al, 1997
• 8th through 10th graders
“I have always associated chemistry and physics with boys, and I have always associated biology with girls. So when I thought of chemistry, I thought, well, boys mostly, so I just scored it out. I don’t see why a girl shouldn’t be able to do chemistry and physics. I’d like to have carried on with them, but, as I said before, boys’ subjects so I just dropped them”.

(Burkam, et al, 1997, p. 303)

“I chose biology because it seemed to cover more areas of life, whereas chemistry and physics seems to be only pouring liquids, powders, and gases into test tubes which didn’t really appeal to me. Biology, I thought...could be of help to me in the future...But I could not understand much reason to know whether one liquid was heavier than the other.”

(Burkam, et al, 1997, p. 303)

Attributions

• Stipek & Gralinski, 1991
• 8- and 13-year-olds
• regularly scheduled math test
Attributions

- Girls
  - rated ability lower
  - expected to do less well
  - less likely to attribute success to ability
  - more likely to attribute failure to ability
  - more shame, less pride

Hormones

- Kimura & Hampson
Hormones

- when Estrogen high, females performed better on “female” tasks, less well on “spatial” (i.e, male)
- when Estrogen low, reverse

Hormones

- male undergrads with below ave testosterone perform better on spatial tasks than other males
- in northern hem., testosterone levels for males higher in fall. Therefore:
  - males should do better on spatial tasks in the spring
Conclusions

• as always, development involves an interaction between biology and environment