Cognitive Flexibility: Preschoolers’ Performance Refines the Construct

Gedeon O. Deák
Cognitive Science Department
Human Development Program
University of California, San Diego

Collaborators: Nicholas Cepeda, Cristine Legare, Gayathri Narasimham
What is cognitive flexibility (CF)?

- Listed as an executive function
- Increasing interest in CF
  - Many studies use a single measure
  - This implies a unitary trait-like factor
  - Is CF a unitary trait?
Example of cognitive flexibility

“...is a tulla”

“...has a framm”

“...is made of snorb”
New conclusions about cognitive flexibility

1. Cognitive flexibility improves from 3 to 4 years, but not as a singular or unitary factor
2. CF is stable between tests of the same type, …but not between dissimilar types of tests
3. What develops? No evidence inhibition is limiting factor
1. CF improves from 3 to 4 years

Most 3-year-olds perseverate; most 4-year-olds switch correctly.
- only one possible error
- no variability

*Does CF develop as a unitary exec. function?*

Zelazo, Frye et al: DCCS (Dimension Change Card Sorting)
New tests of cognitive flexibility

- Complex / multiple options & task switches / controlled
  Prototype: Flexible Induction of Meaning (FIM; Deák, 2000)
  1. FIM-Objects
  2. FIM-Animates
  3. 3DCCS
  4. Flexible Induction of Function (FIF)

*Does flexibility increase from 3 to 4 years across tests?*
General paradigm for CF tests (FIM-Ob)

"is made of tulla"

"is made of brec"

"is made of zof"

block 1: generalize by material
General paradigm for CF tests

“has a feef”

“has a bix”

“has an orid”

block 2: generalize by part
General paradigm for CF tests

“is a toma”
“is an emic”
“is a ligut”

block 3: generalize by shape
FIM-An: do FIM-Ob results generalize?

“...is a sennec”

“...lives in a fen”

“...holds an entity”

generalize words by species, habitat, & possession
3DCCS: do rule-switch results generalize?

sort the same cards by shape, color, or size rule
FIF: do results generalize to non-verbal test?

generalize function by effect on clay, sand, paper
Age differences in four tests of flexibility

**FIM-Ob (Deák, 2000)**

**FIM-An (Deák et al, in prep.)**

**3DCCS (Deák et al, in prep.)**

**FIF (Deák, in prep.)**
Single/unitary factor?

no: at least 4 distinct response patterns

Deák et al., in prep., Exps 2 & 3
2. CF stable between tests?

- \( N = 85 \) 3-4-year-olds (Cepeda & Deák, in prep.)
  - 3DCCS, FIF, FIM-Ob, FIM-An, plus:
    - processing speed, WM, PPVT-3
    - Stroop Day-Night; tapping test
    - causal inference, detecting indeterminacy
  - age, PS, inhibition, & vocabulary partialled out:

<table>
<thead>
<tr>
<th>correct switches</th>
<th>3DCCS</th>
<th>FIF</th>
<th>FIM-An</th>
<th>FIM-Ob</th>
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<tr>
<td>3DCCS</td>
<td>*</td>
<td>.03</td>
<td>.03</td>
<td>.18</td>
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<tr>
<td>FIF</td>
<td></td>
<td>*</td>
<td>.19</td>
<td>.14</td>
</tr>
<tr>
<td>FIM-An</td>
<td></td>
<td></td>
<td>*</td>
<td>.64***</td>
</tr>
</tbody>
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\[ \text{cognitive flexibility is not a stable trait in young children} \]

- Variants of FIM-Ob (Deák, 2000; Deák & Narasimham, 2003)
  - delay between blocks, trial order, priming: no effect
- No relation between FIM tests and Stroop interference
  - Deák & Narasimham, 2003; Deák, Narasimham & Legare, in prep.
- So what is developing?
  - FIM-Ob flexibility related to reasoning performance
Conclusions for now; questions

- “3-to-4 shift” misses changes in CF
  - Continuity: other tests shift later (Morton & Munakata) or earlier (Harris)
  - Not a single factor (different error patterns, etc.)
- Causes of error patterns are unknown
  - Not related to individual differences in inhibition
- “Weakest link” model: CF requires skills for each subtask, plus set-switching processes
  - Inefficiency of any component reduces flexibility
  - Components cause different “breakdowns”

Cognitive Flexibility: Refine or Replace?
Thanks to...

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how minds adapt to a changeable world

How does ability to adapt develop?
Cognitive flexibility as executive function.
general paradigm for CF tests

“is an emtic”
“is a weffop”
“is a rypod”
“is a lepsic”
“is an eefeb”
“is a toma”
discontinuity in age trend?

$N = 184$ (3 experiments)
2. CF stable between test?

\[ r = .53 \text{ with age, preswitch accuracy, Stroop Day/Night partialled out} \]

Deák et al, in prep., Exp. 1
...not different ones

- 3-5-year-olds ($N = 60$)
  - Deák et al, in prep., Exp. 5

- **FIM-An and 3DCCS: inductive vs. deductive**
  - age, verbal WM, 1st block accuracy partialled out
  - “easy” order group $r = .07$ between tests
  - “hard” order group $r = .33$ ($p = .12$)