Individual and Age Differences in Preschool Children’s Flexible Cognition

Nicholas J. Cepeda\textsuperscript{a}, Gedeon O. Deák\textsuperscript{b}, Sam Sedlik\textsuperscript{b}, & Rachel Weisser\textsuperscript{b}

\textsuperscript{a}Department of Psychology, University of Colorado-Boulder
\textsuperscript{b}Department of Cognitive Science, University of California-San Diego

\section*{Introduction}
Flexible thinking is an aspect of cognition that varies across individuals and develops with age. It is considered an executive function (processes that integrate information, emotion, and memory to control behavior). Executive functions change radically in early childhood. However, there is little evidence that flexibility is a stable, cohesive dimension of executive function.

There are few tests of flexible cognition for young children. However, new tests have recently been developed: the 3DCCS (Deák & Narasimham, 2003); FIM (Deák, 2000, 2003) and FIF (3-205 [pod 7]). These tests assess flexible verbal/inductive (FIM), non-verbal/inductive (FIF), and verbal/deductive (3DCCS) thinking. Given as a battery, these tests will show whether cognitive flexibility develops as a general executive function, or as loose task-specific skills. Other capacities that change during the same age range—processing speed, working memory, and inhibition (Cepeda et al, 2001)—might contribute to between-test shared-variance in flexibility.

\section*{Method}

\subsection*{Participants}
\textit{N} = 37 three-year-olds; 58 four-year-olds

\subsection*{Tests}
- Flexibility Tests: 3DCCS, FIM-Animates, FIM-Objects, FIF [see below]
- All tests: 3 test trial blocks; same items in each block, choose between same 4 items in each block
- Processing Speed (Box Completion)
- Verbal Memory (Memory for Names; W-J Test)
- Inhibition (Luria’s Tapping test)

\subsection*{General Design}
Three sessions, in preschools, 4-6 tasks/session

\subsection*{Variables}
- Flexibility Tests: Number of correct switches
- Process. Speed: Boxes completed in 30 sec
- Verbal Memory: Correct recognition score
- Inhibition test: Percent trials w/ correct # of taps

\section*{Results}

\subsection*{\textbullet Task switching performance}
In all 4 tests, 3- and 4-year-olds are above chance in block 1
- In all 4 tests: 4-year-olds more flexible than 3-year-olds:
  - Age effect: \textit{F}(1,93)=33.2, \textit{p}<.001
  - Individual differences:
    - Mean SD = 35% correct switches

\subsection*{\textbullet Do processing speed, verbal memory, and/or inhibition underlie flexibility?}
- Stepwise regression: dependent measure = correct switches in flexibility tests
- Results averaged across tests
- Complete model: \textit{R}^2 = .34

\subsection*{\textbullet Do separate abilities underlie verbal vs. nonverbal, or inductive vs. deductive, flexibility?}
- Partial correlation, control for age and processing speed
- FIM-Ob & -An highly correlated
- Among other tests, correlations are equivocal. Suggests distinct kinds of verbal, non-verbal, inductive & deductive flexibility

\section*{Conclusions}

- Between 3 and 4 years, flexible cognition improves across a range of experimental tests
- Two underlying capacities account for about 10% of variance in children’s cognitive flexibility
  - Processing speed and Inhibition
- Flexibility is stable across verbal inductive tests, but does not generalize to other tests:
  - Inferring new word meanings, inferring new object functions, using new classification rules: All differ

\section*{Acknowledgements}
- Funding was provided by NSF-BCS0902027
- Thanks to Elaine Blank, Sean Marco, Ali Moeller, Mieke VanderBourght, and Cherry Vu.

\section*{References}