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Are children with motor problems also impaired in reading, spelling and mathematics?

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Developmental Coordination Disorder (DCD)

- DSM-IV-TR:
  - **Criterion A.** Motor coordination substantially below expected, given the chronological age and intelligence
  - **Criterion B.** Interference with academic achievement or daily living
  - **Criterion C.** No general medical condition, no PDD
  - **Criterion D.** Mental retardation: motor difficulties in excess of those usually associated with it
- Prevalence: 1.7%

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Scholastic skills in DCD

- DCD: Significant risk for developmental problems (Dewey et al., 2002)
- Co-morbidity:
  - Worse scholastic skills in comparison with TA (Losse et al., 1991)
  - Learning disability: 50% (Jongmans et al., 2003)
    - Reading disability: 56% (Kaplan et al., 1998)
    - Spelling disability: ?
    - Mathematical disability: ?
- Possible explanations:
  - Visual perception?
  - Cerebellar deficit hypothesis: automatisation deficits?

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Scholastic skills in DCD

- Reading: (Dewey et al., 2002; Kadesjo & Gillberg 1999; Tseng et al., 2007)
  (mild MC = severe MC) < control
- Spelling: (Dewey et al., 2002)
  (mild MC = severe MC) < control
- Mathematics? ~ Subtypes?

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Subtypes in mathematical disabilities (~ Geary, 2004)

Procedural subtype:
- Developmental delay in the execution of arithmetical procedures

Semantic memory subtype:
- Developmental deficits in verbal memory and errors in the retrieval of arithmetic facts

Visuospatial subtype:
- Problems with rotation, difficulties with properly aligning numeric information and sign confusion

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Relation between fine motor and mathematical skills (~ Luo et al., 2007)

- Little *theoretical* explanations, 4 *possible* explanations:
  - Biological maturation
    - Motor skill acquisition: important index of brain maturity
  - Movement may facilitate mental development
    - Montessori: the importance of movement in mental development
    - Dewey and Piaget: 'number is a construction of the mind reflecting on actions related to objects'
  - Superordinate category of general intelligence
    - Children who perform well on measures of intelligence also demonstrate better fine motor skills and higher mathematics achievement
  - Promoting of parents

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Aim and hypotheses

- Aim:
  - To investigate reading, spelling and mathematics in children with different degrees of motor problems
- Hypotheses:
  - Reading + spelling: ~ literature
  - Mathematics:
    - Number fact retrieval: ?
    - Procedural calculation: ?
    - Geometry: severe MC < mild MC < control (~ visuospatial deficits)

Participants

- 243 children:
  - 76 children with severe motor coordination problems (severe MC)
  - 77 children with mild motor coordination problems (mild MC)
  - 90 typically achieving control children (TA)
- Clinical groups recruited in:
  - Rehabilitation centers
  - Private physiotherapists
  - Special education

Inclusion criteria

- Inclusion criteria **all children**:
  - Age between 7;0 – 10;11 years
  - TIQ ≥ 85

→USED TEST:
IQ: Short version of the WISC-III: (Grégoire, 2000; Wechsler et al., 2002)
4 subtests: Similarities, Vocabulary,
Picture Arrangement and Block Design

Reliability: .92; validity: .93; correlation with total IQ full form WISC-III: .92

Additional inclusion criteria

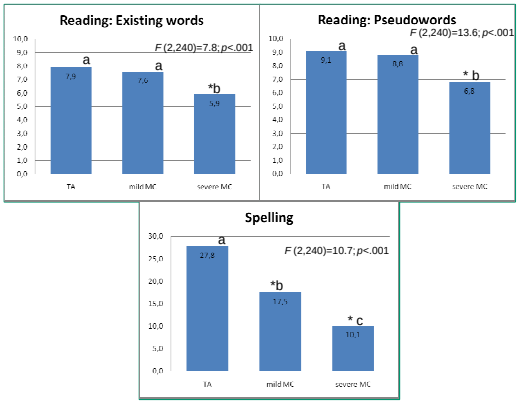
- **Severe MC** group:
  - Score ≤ pc 5 on M-ABC 2
- **Mild MC** group:
  - Score pc 6 – 16 on M-ABC 2
- **Control** group:
  - Score ≥ pc 25 on M-ABC 2

No significant differences between groups (IQ and age)

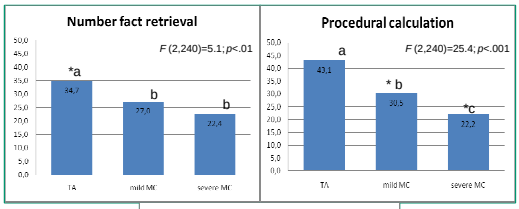
Tests

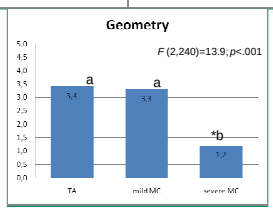
- Reading:
  - One Minute Test (EMT; Brus & Voeten, 1999)
  - Klepel (van den Bos et al., 1994)
- Spelling:
  - PI dictation (PI dictee, Geelhoed, & Reitsma, 2000)
- Mathematics:
  - Number fact retrieval: Arithmetic Number Facts Test (TTR; De Vos, 1992)
  - Procedural calculation: Courtrai's Arithmetic Test Revised (KRT-R; Baudonck et al., 2006)
  - Geometry: LVS Geometry (LVS meetkunde, Dudal; 1998-2004)

Results: Reading and spelling



Results: Mathematics





Conclusion

- Severe MC < control children
  on reading, spelling and mathematics
- Severe MC < mild MC
  on reading, spelling, procedural calculation and geometry
- Mild MC < control children
  on spelling, number fact retrieval and procedural calculation
- All MC (severe + mild) < control children
  on spelling and procedural calculation
- Only children with severe MC seem impaired on reading and geometry

Conclusion: Diagnostic assessment

- Different profile mild MC ⇔ severe MC
- At risk for additional scholastic problems
- Diagnostic assessment:
  wide range of carefully selected measures
- Early diagnosis → early intervention

Conclusion: Therapy

- Individual assessment → STICORDI advice:
  STimulation, **Co**mpensation, **R**emediation and **Di**spensation

→Specific needs of children with motor/learning disabilities:
- → Adjusting the mirror of the page
- → Using squared paper to aid in spatial placement of numbers
- → Replacing complex figures by text
- → Good position (Tripp Trapp), ergonomic pencils

Take home message

- Co-morbidity is rather rule than exception
- Research on children with DCD should take into account co-morbid disorders such as learning disabilities and other developmental disorders

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