# Intra-individual change in children's mental-attentional capacity from 17 to 29 months of age

Julie Brousseau, Ph.D.

Raymond Baillargeon, Ph.D.

David Laplante, Ph.D.

Hong-Xing Wu, M.Sc.

- *Research Unit on Children's Psychosocial Maladjustment and Ste-Justine Hospital Research Center, University of Montreal*
- *Douglas Hospital Research Center, McGill University*

# Cognitive development 0-5 years

- Research performed with limited and non-representative samples
- Epidemiological studies
  - Direct assessment starts with school entry

# Cognitive measures

- Standardized developmental tests
  - Ex: *Bayley Scales of Infant Development* (0-42 mo.)/*Stanford-Binet Intelligence Scale* (2-23 years)

    Disadvantages: cost /duration / training / age range

- Screening instruments
  - Ex: *Batelle Developmental Inventory* (0-8 years) / *Vineland Adaptive Behavior Scales* (0-adult)

    Disadvantages: subjected to bias/predictive validity

# Cognitive assessment

- Need for direct assessment measure adapted to epidemiological research constraints
  - Non-professionals /cost
  - Time limit
  - Home-setting
  - Transition from infancy to preschool age

# How is toddler's cognitive development assessed in the LSCDQ?

- Imitation Sorting Task (IST; Alp, 1994)
  - Imitation of the sorting of various objects into 2 containers
  - Nb of objects = nb of info. processed
- Mental-attentional capacity (MAC):
  - Nb of units of information (schemes) simultaneously coordinated in a goal-oriented activity

# Imitation Sorting Task (IST)

- Psychometric properties (12-42 mo.)
  - Reliability
    - Test-retest **(.80/.87)** /6-month follow-up **(.75/.73)**
    - Different cultures / different interviewers
  - Validity
    - Object permanence task **(.72)**
    - Balance beam task **(.78)**
    - Elicited Imitation task **(.63)**
    - Semantic-pragmatic paradigm **(.79/.81)**
    - Semantic complexity task **(.81)**

(Ref: Alp, 1994, 1996, 2001; Benson, 1989)

# Objective

- Assess the MAC of a representative sample of Quebec children 17 and 29 months of age
  - Are there pronounced individual differences?
  - Do boys and girls develop at the same pace?
  - How does the MAC evolve between 17 and 29 months of age?
  - Do children whose MCA seemed less advanced at 17 months catch up at 29 months?

# Methods

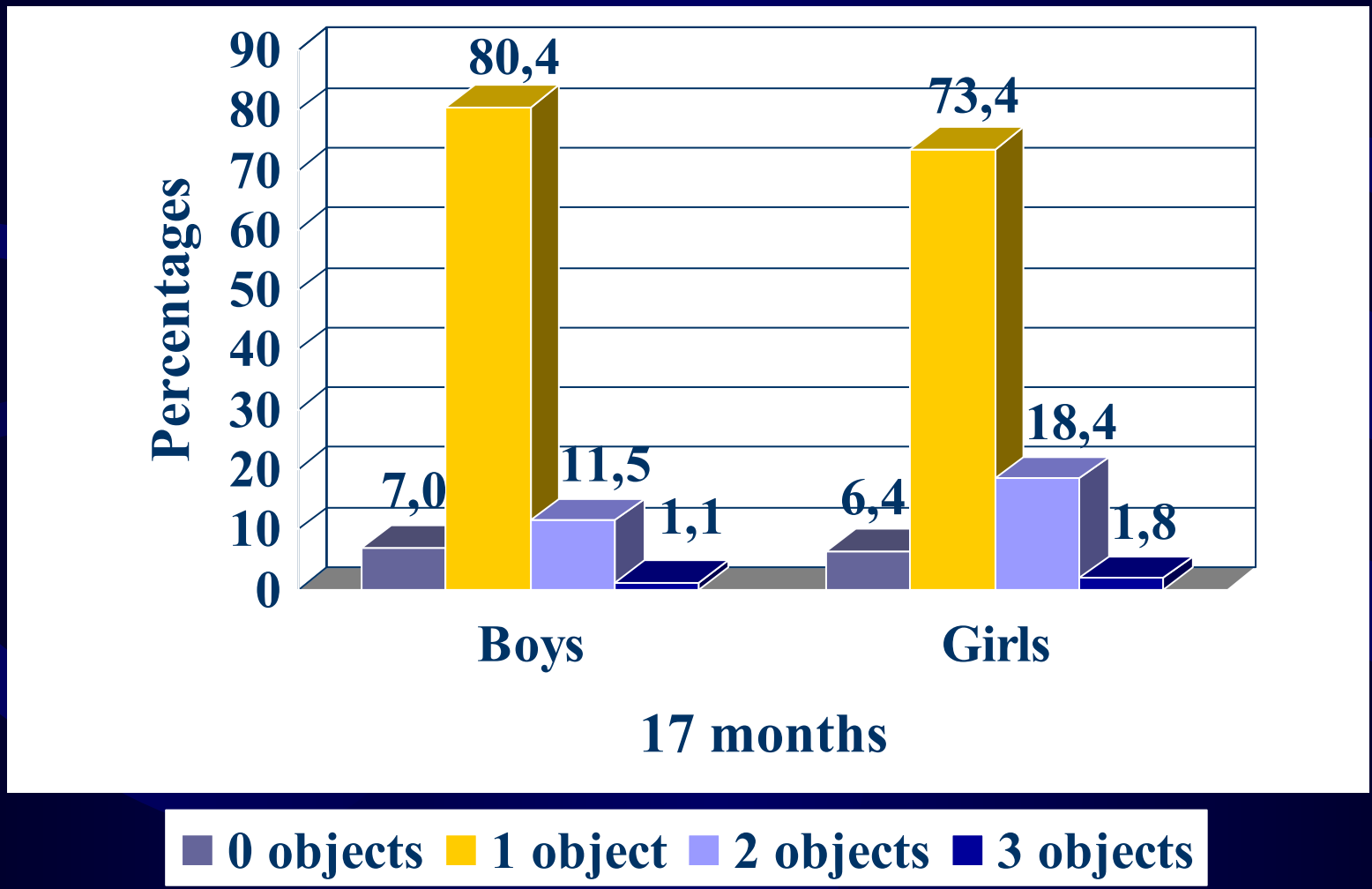
- 17 months (N=1715)
  - –3 levels of difficulty: 1, 2 and 3 objects
    2 trials / level = 6 items
- 29 months (N=1692)
  - –4 levels of difficulty: 1, 2, 3 and 4 objects
    1 trial / level = 4 items
- Scoring: Success / failure
  - -Correct sorting of the same number of objects

# 17 months

## 4 classes of individuals

| | Class | | | |
|---|---|---|---|---|
| Item | 0 objects | 1 object | 2 objects | 3 objects |
| 1 object-trial 1 | ↓ | ↑ | ↑ | ↑ |
| 1 object-trial 2 | ↓ | ↑ | ↑ | ↑ |
| 2 objects-trial 1 | ↓ | ↓ | ↑ | ↑ |
| 2 objects-trial 2 | ↓ | ↓ | ↑ | ↑ |
| 3 objects-trial 1 | ↓ | ↓ | ↓ | ↑ |
| 3 objects-trial 2 | ↓ | ↓ | ↓ | ↑ |

# Mental-attentional capacity at 17 months

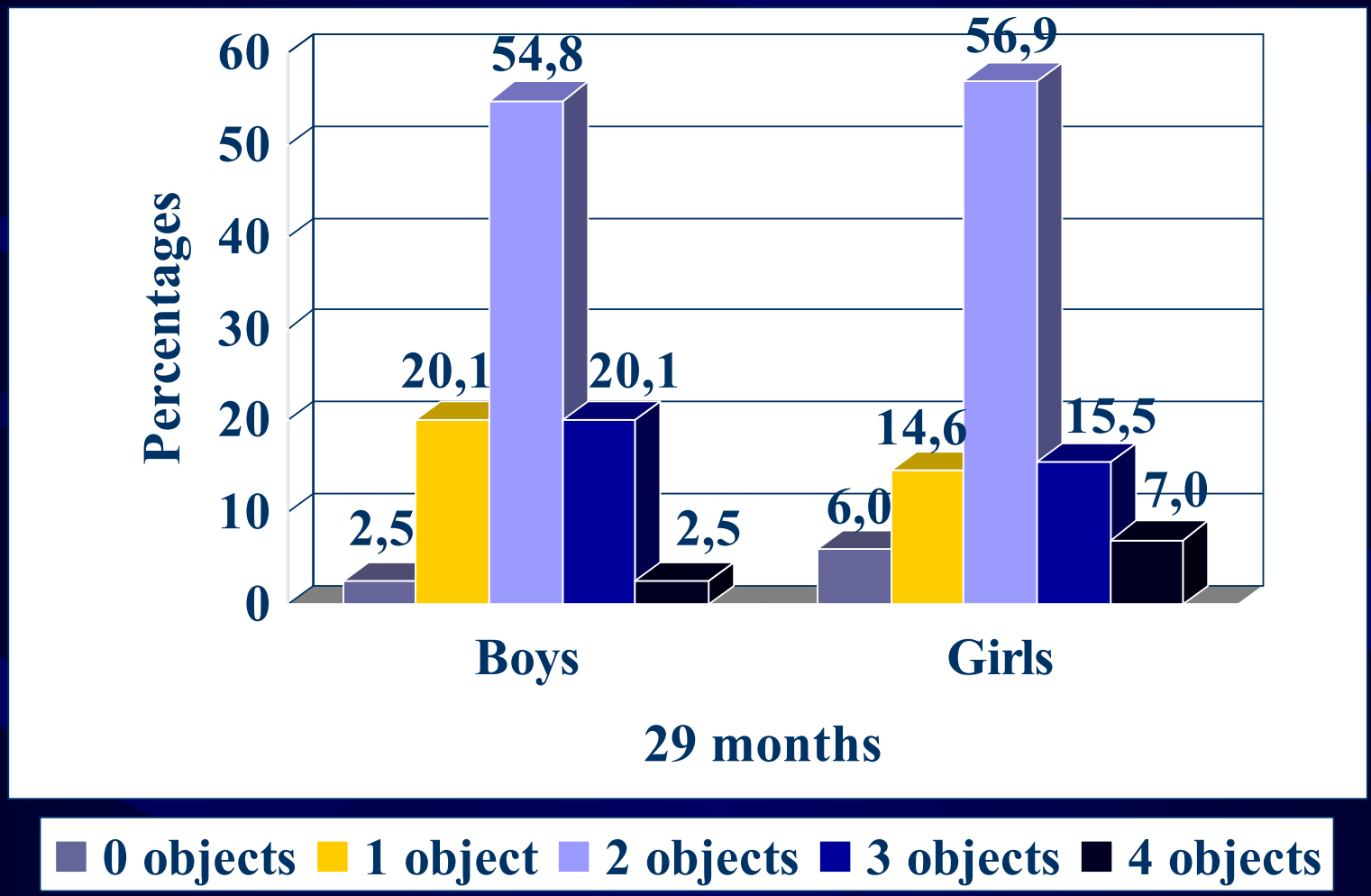


# 29 months

5 classes of individuals

| | Class | | | | |
|---|---|---|---|---|---|
| Item | 0 objects | 1 object | 2 objects | 3 objects | 4 objects |
| 1 object | ↓ | ↑ | ↑ | ↑ | ↑ |
| 2 objects | ↓ | ↓ | ↑ | ↑ | ↑ |
| 3 objects | ↓ | ↓ | ↓ | ↑ | ↑ |
| 4 objects | ↓ | ↓ | ↓ | ↓ | ↑ |

# Mental-attentional capacity at 29 months



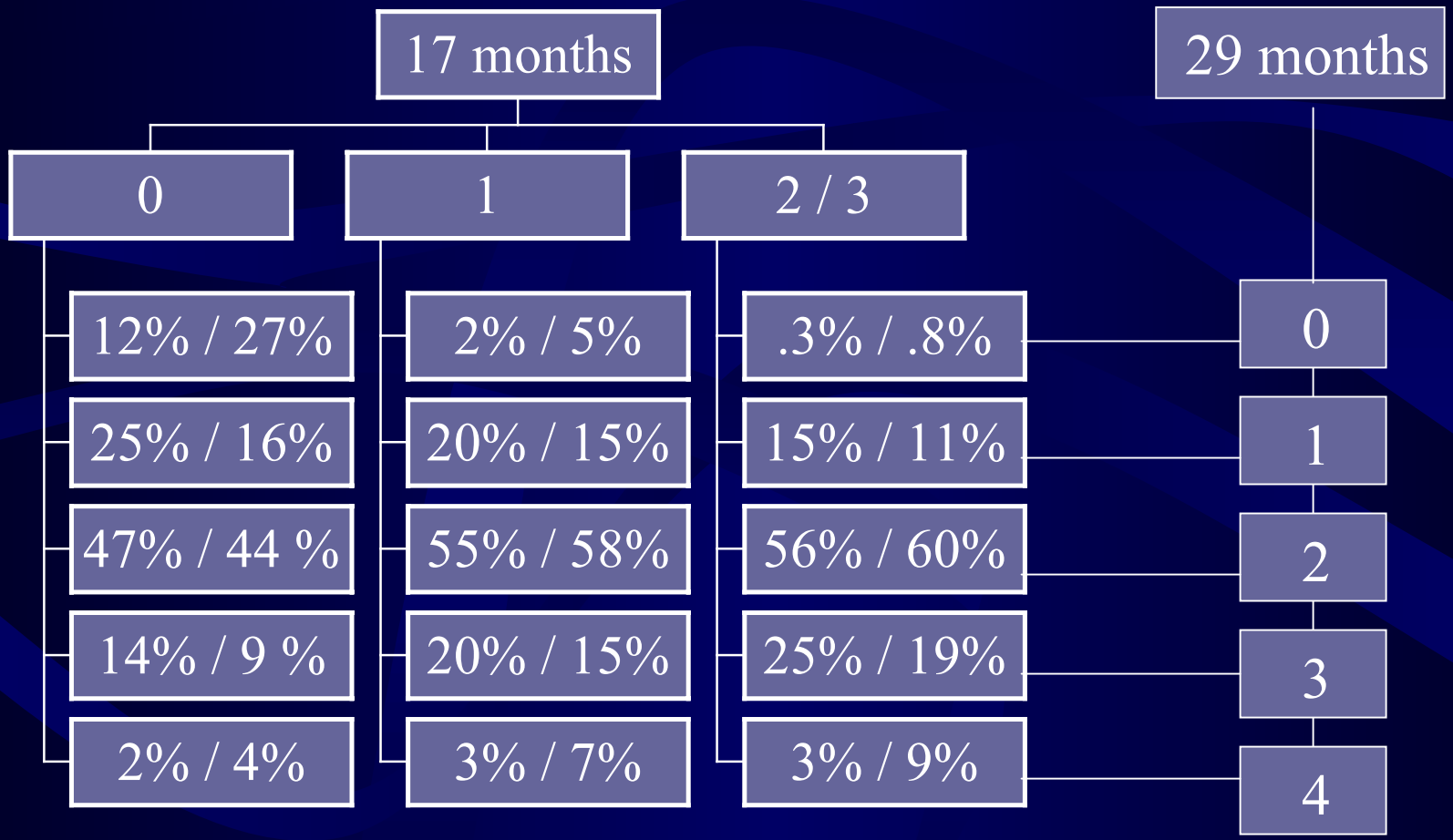
# Odd ratios

- 17 months
  - 2 vs 1 objects:
    Girls / boys = **1,76**

- 29 months
  -4 vs 3 objects:
    Girls / Boys = **3,66**
  -2 vs 1 objects:
    Girls / Boys = **1,40**
  -1 vs 0 objects:
    Boys / Girls = **3,19**

($p < .01$)

# Percentages of boys/girls sorting objects: 29 months/17 months



# Discussion

- IST as a measure of cognitive development in surveys
- Different categories of children in terms of the development of the MAC
- Normal development / less optimal
- Intra-individual change from 17 to 29 months
- Sex differences

# Future directions

- IST validity
  - 41 months:
    - Peabody Picture Vocabulary Test-revised (receptive language)
    - WPPSI-R's Block design subtest (visual-spatial)
- Cognitive measures
  - 5 months (Uzgiris & Hunt)
  - 53 months (Number concepts/memory/field dep.-indep.)
- Psychosocial factors
  - Child (Behavior / temperament)
  - Family environment / Early experience (HOME, SES, day-care)

# Sensorimotor substages and mental-attentional capacity (MAC)

| MAC | Sensorimotor substage | Age (months) (Obj. sorted) |
|---|---|---|
| 0 | Reflex acts | 0-1 |
| 1 | Primary circular reactions/begins to develop new skills | 1-4 |
| 2 | Secondary circular reactions/repeats actions that by chance produce results | 4-8 |
| 3 | Secondary circular reactions/applies acquired skills to new situations | 8-12 (0 obj.) |
| 4 | Tertiary circular reactions/seeks to acquire skills through experimentation | 12-18 (1 obj.) |
| 5 | Invent new skills by interiorizing combinations of them | 18-26 (2/3 obj.) |
| 6 | Transition to mental processing | 26-34 (4 obj.) |

# Models assessed at 17 months

| | $L^2$ | dl | p | AIC | BIC |
|---|---|---|---|---|---|
| **Model** | | | | | |
| | | | | | |
| **4 classes (0,1,2,3,objs) (column ass.)** | 144.85 | 114 | .0270 | -704.16 | -83.15 |
| | | | | | |
| **4 classes** | 156.88 | 117 | .0082 | -714.48 | -77.12 |
| **(no sex effect)** | | | | | |
| | | | | | |
| **4 classes** | 153.73 | 116 | .0109 | -710.18 | -78.27 |
| **(uniform ass. with sex)** | | | | | |
| | | | | | |
| **Independence** | 896.90 | 120 | .0000 | 3.20 | 656.90 |
| **(1 class)** | | | | | |
| | | | | | |
| **3 classes** | 199,12 | 116 | .0000 | -664.78 | -32.88 |
| **(0,1,2,objs)** | | | | | |
| | | | | | |
| | **$L^2$ difference** | **dl difference** | **p** | | |
| **Model comparison** | | | | | |
| | | | | | |
| 4 classes vs no sex effect | 12.03 | 3 | .0073* | | |
| 4 classes vs uniform ass. with sex | 8.88 | 2 | .0118* | | |
| 4 classes vs independence | 752.05 | 6 | .0000* | 752.05/896.90 = | |
| 4 classes vs 3 classes | 54.27 | 2 | .0000* | 83.8% explained variance | |
| | | | | | |

# Models assessed at 29/17 months

| | $L^2$ | dl | p (boot.) | AIC | BIC |
|---|---|---|---|---|---|
| **Model** | | | | | |
| | | | | | |
| **Final model {YS, ass2 (Y, X, 5a, 3, 4)}** | 635.82 | 2018 | .022 | -3400.2 | -14365.0 |
| | | | | | |
| **Saturated model (Y/XS)** | 606.80 | 1998 | .041 | -3389.2 | -14245.4 |
| | | | | | |
| **Log-linear model (YX, YS)** | 618.60 | 2010 | .044 | -3401.4 | -14322.8 |
| | | | | | |
| **Uniform ass. model {YS, ass2 (Y, X, S, 2b)}** | 649.26 | 2020 | .007 | -3390.7 | -14366.4 |
| | | | | | |
| | **$L^2$ difference** | **dl difference** | **p** | | |
| **Model comparison** | | | | | |
| | | | | | |
| | | | | | |
| Final model vs saturated | 29.02 | 20 | .0874[a] | | |
| Final model vs log-linear | 17.22 | 8 | .0279[a] | | |
| Final model vs uniform ass. | 13.44 | 2 | .0012* | | |
| | | | | | |
| X=latent var. at 17 mths (4 classes), Y=latent var. at 29 mths (5 classes), S=sex. | | | | | |