

# Examining G-E transactions in child development: a few lessons from the twins.

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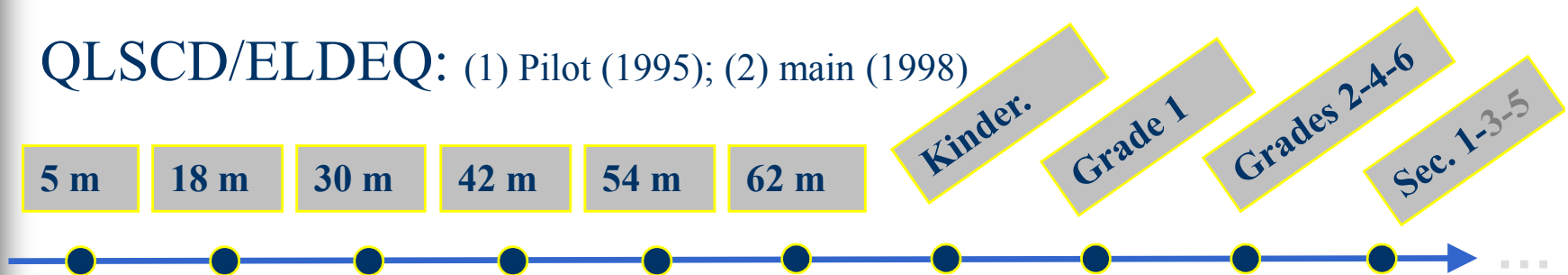


International Summer School Program  
“Thinking, Education, Knowledge, Genetics”  
Tomsk State University, July 1-6 2012

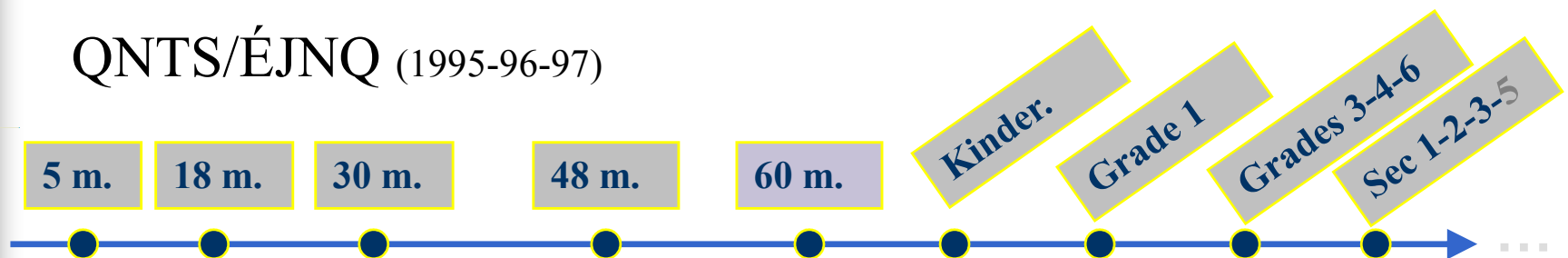


# A family of birth cohorts from Québec

QLSCD/ELDEQ: (1) Pilot (1995); (2) main (1998)



QNTS/ÉJNQ (1995-96-97)



**LSCDQ (ÉLDEQ):** A prospective longitudinal study of 2000 children, starting at the age of 5 months, who were sampled to be representative of all infants between 59 and 60 gestational weeks of age in 1998 in the province of Quebec. Supported \$\$ by the Government of Québec, the L&A Chagnon Foundation, GRIP, and piloted by ISQ.

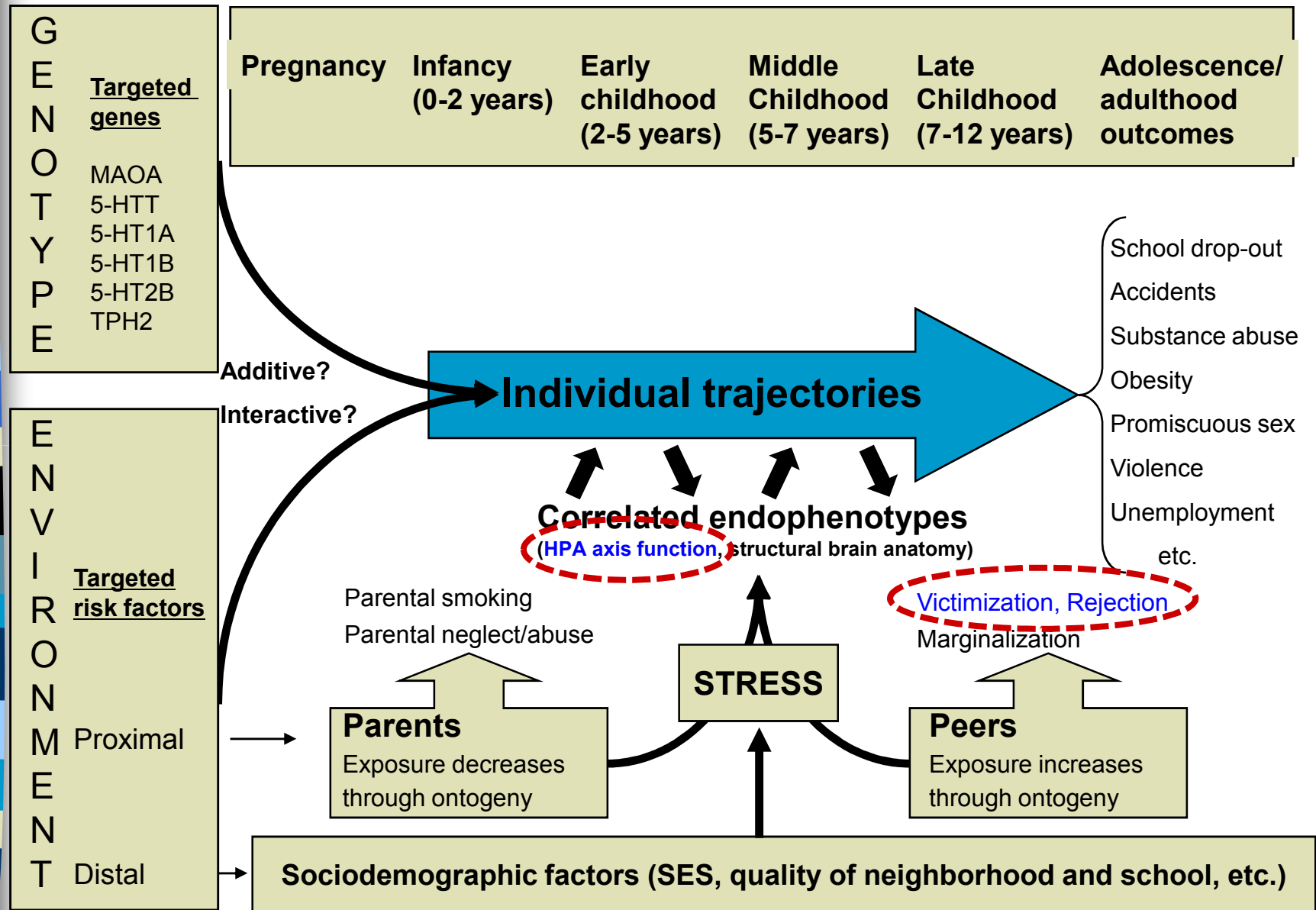
**QNTS (ÉJNQ):** A prospective longitudinal study of 630 families of twins of the greater Montreal region. Financed par GRIP: Michel Boivin, Mara Brendgen, Ginette Dionne, Daniel Pérusse, Philippe Robaey, Richard Tremblay, Frank Vitaro et al. (MSSSQ, ISQ-SQ, IRSC, PNRDS, CRSHC, FRSQ, CQRS, FCAR, CLLRnet)



# Specific features

- **Birth cohorts** (birth registry) followed longitudinally: developmentally informative during a **highly sensitive period**
  - Six annual data collections in preschool
- **Representative sample**
  - Relevant for public policy.
- **Multivariate assessments of child phenotypes measured longitudinally (i.e., trajectories)**
- **Multi-level assessments of environmental factors, including parenting, peer and school experiences.**
  - Extensive visits to schools starting at T7 (K).
- **Links (shared features) with other major longitudinal studies, including NLSCY.**

# Bio-social developmental model



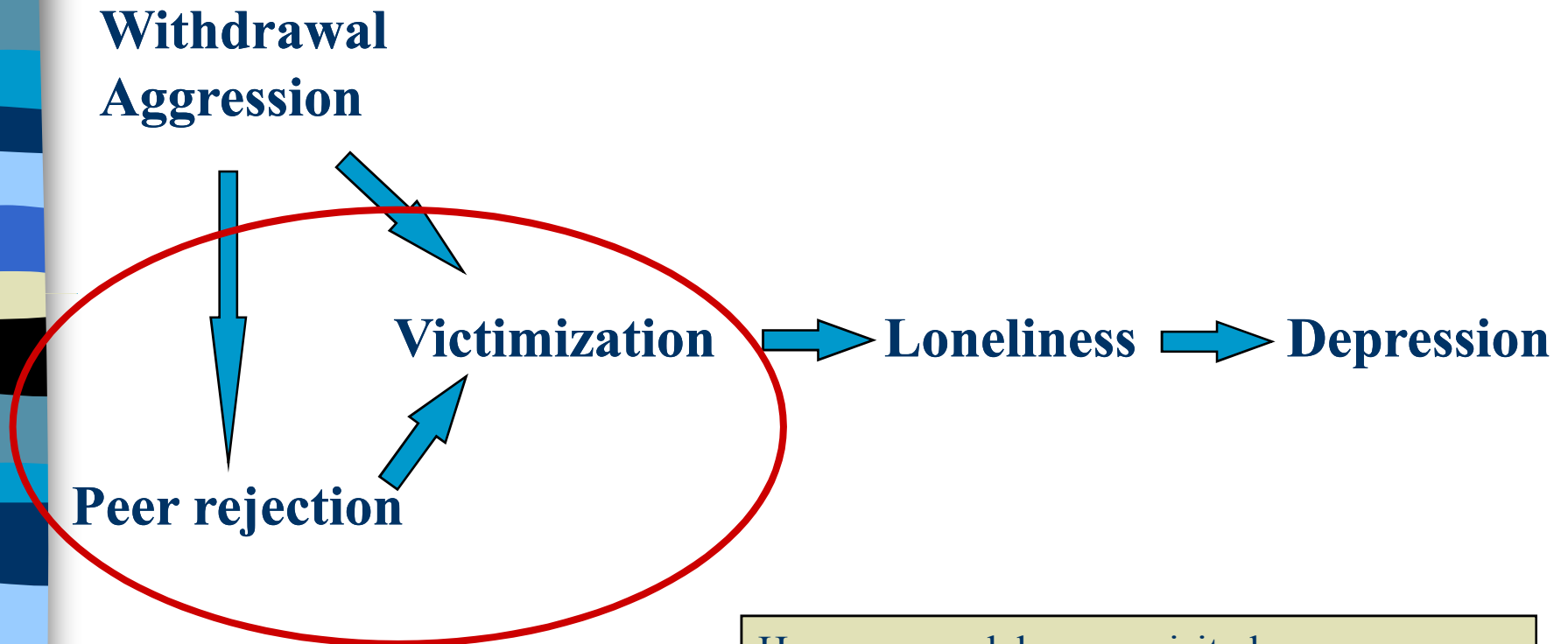


## Why should we be concerned by peer relation difficulties in childhood?

- 5-10% of children experience chronic peer relation difficulties
  - Peer rejection-neg.status / peer victimization-harassment
- Childhood peer difficulties predict later social/health problems
  - But not sure of the developmental processes
- Bullying extends beyond the child who bullies and the child who is victimized.
- Context is important (school climate, local group norms, social reputation), **BUT** individual risk factors are also important

## A sequential model:

Behaviors may initiate a negative social process with consequences for the child



However model was revisited:

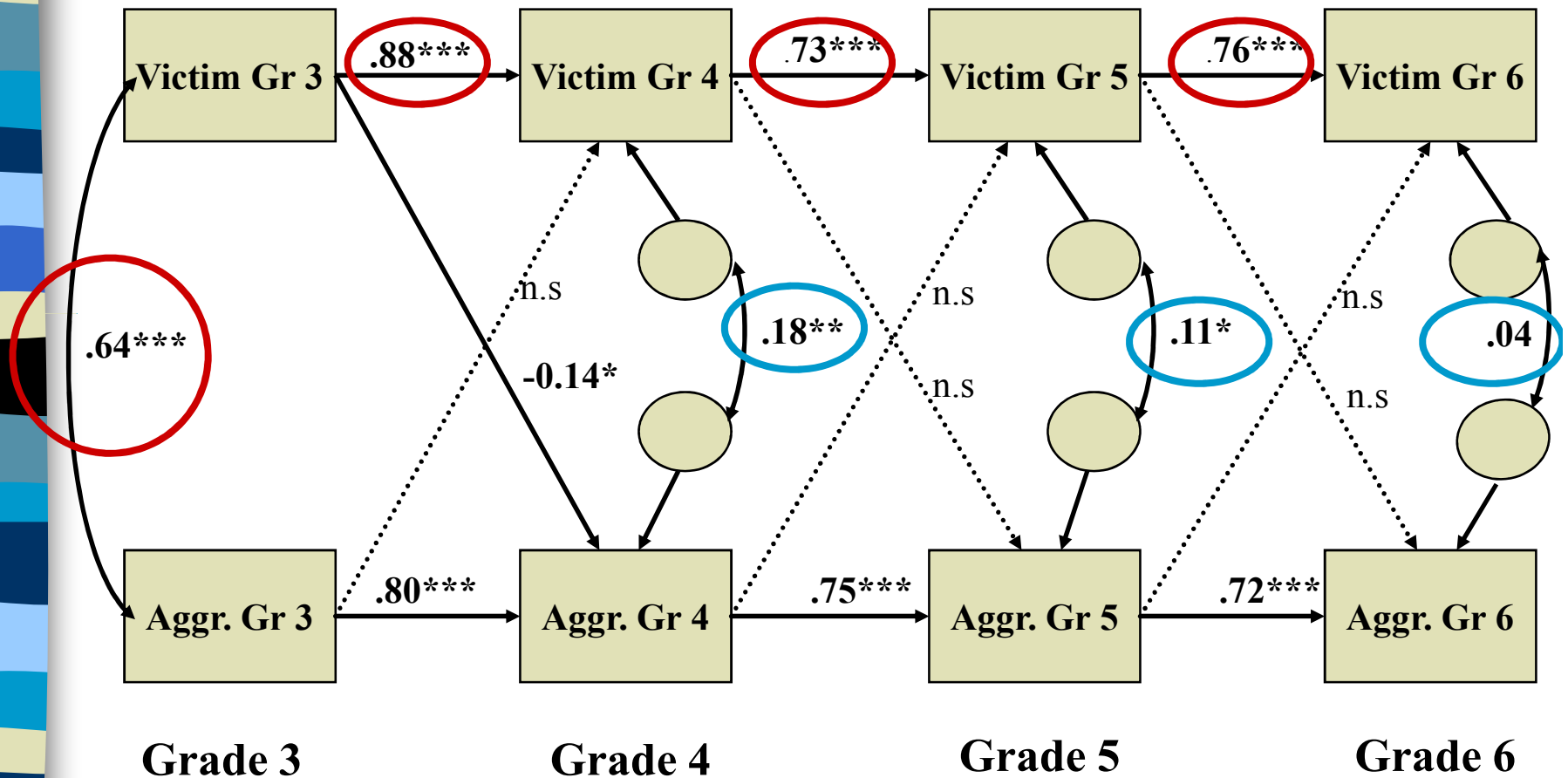
- Direct pathway to negative self-perceptions
- The protective role of friendship
- Active withdrawal rather than shyness
- ++ bidirectional influences

Adapted from Boivin, Hymel & Bukowski (1995);  
Boivin & Hymel (1997)



But prediction is only a crude way of assessing directionality.

# Assessing directionality: Victimization-aggression associations across primary school

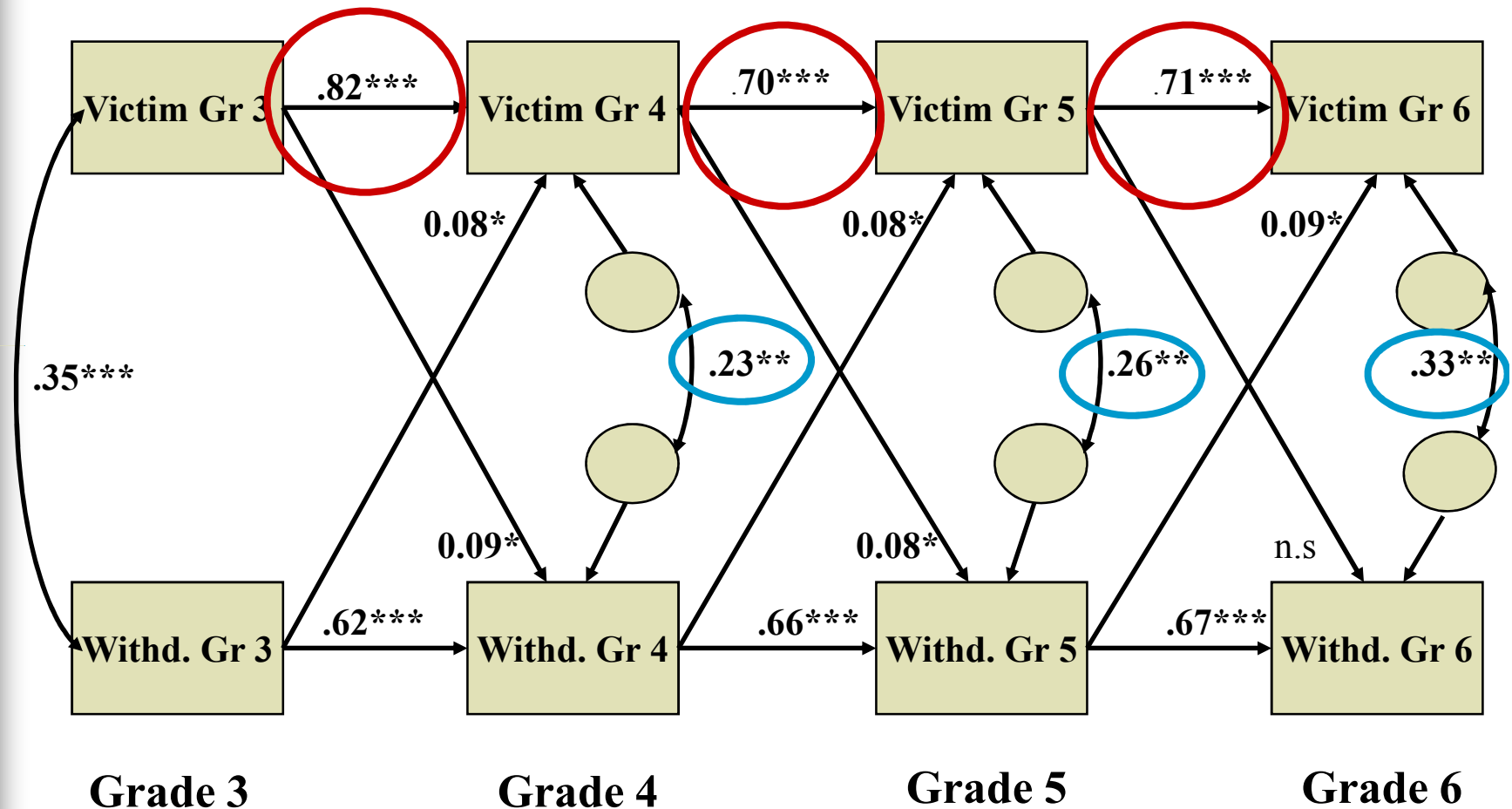


Boivin et al., (MPQ, 2010)

N=1035  
 Y-B $\chi^2$ =59.64, DF=14, p=0.000  
 CFI=1.000  
 RMSEA=0.000



# Assessing directionality: Victimization-withdrawal associations across primary school.



N=1035  
 Y-B $\chi^2$ =36.00, DF=14, p=0.001  
 CFI=1.000  
 RMSEA=0.000

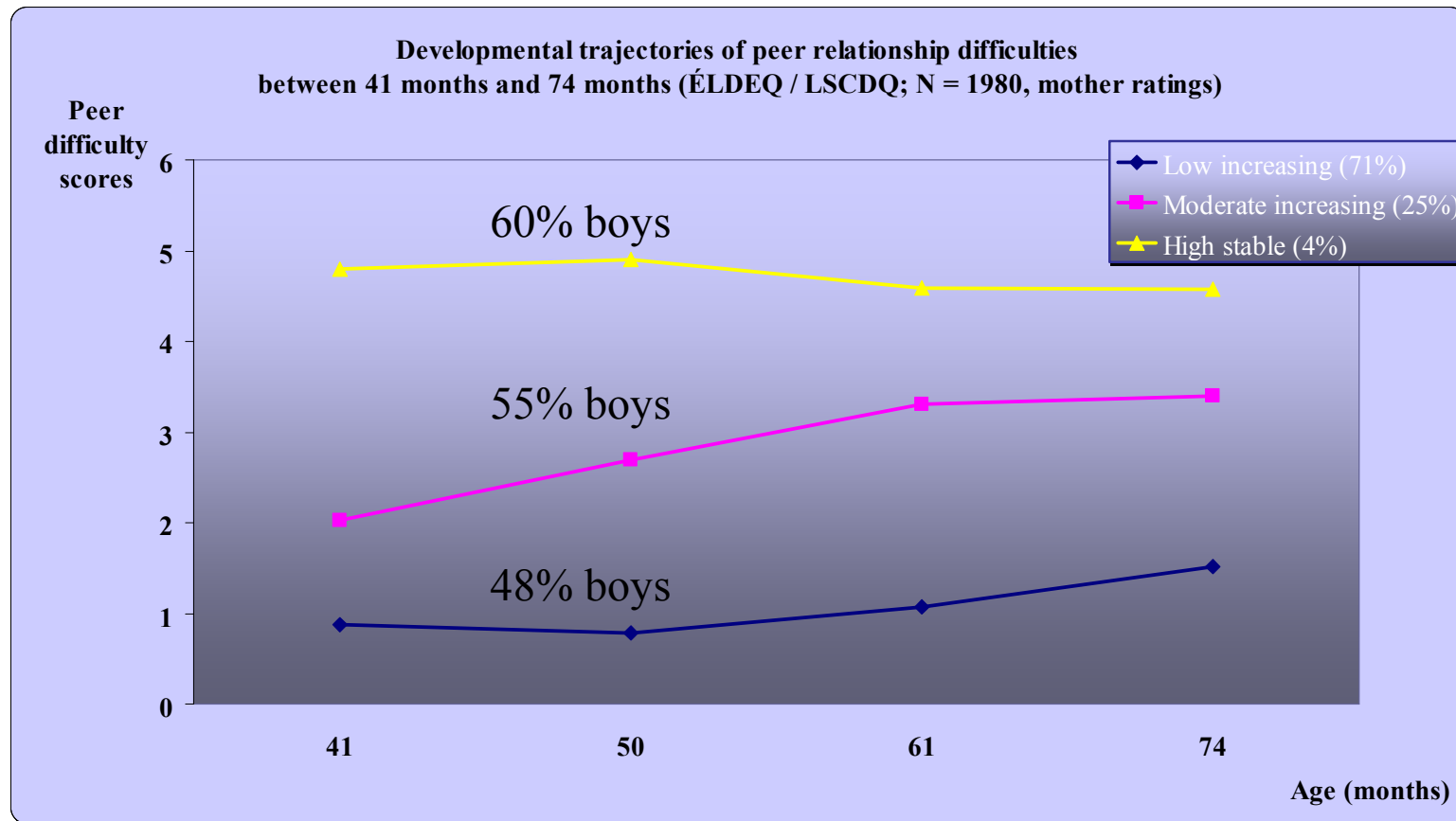
Boivin et al., (MPQ, 2010)



## Early development?

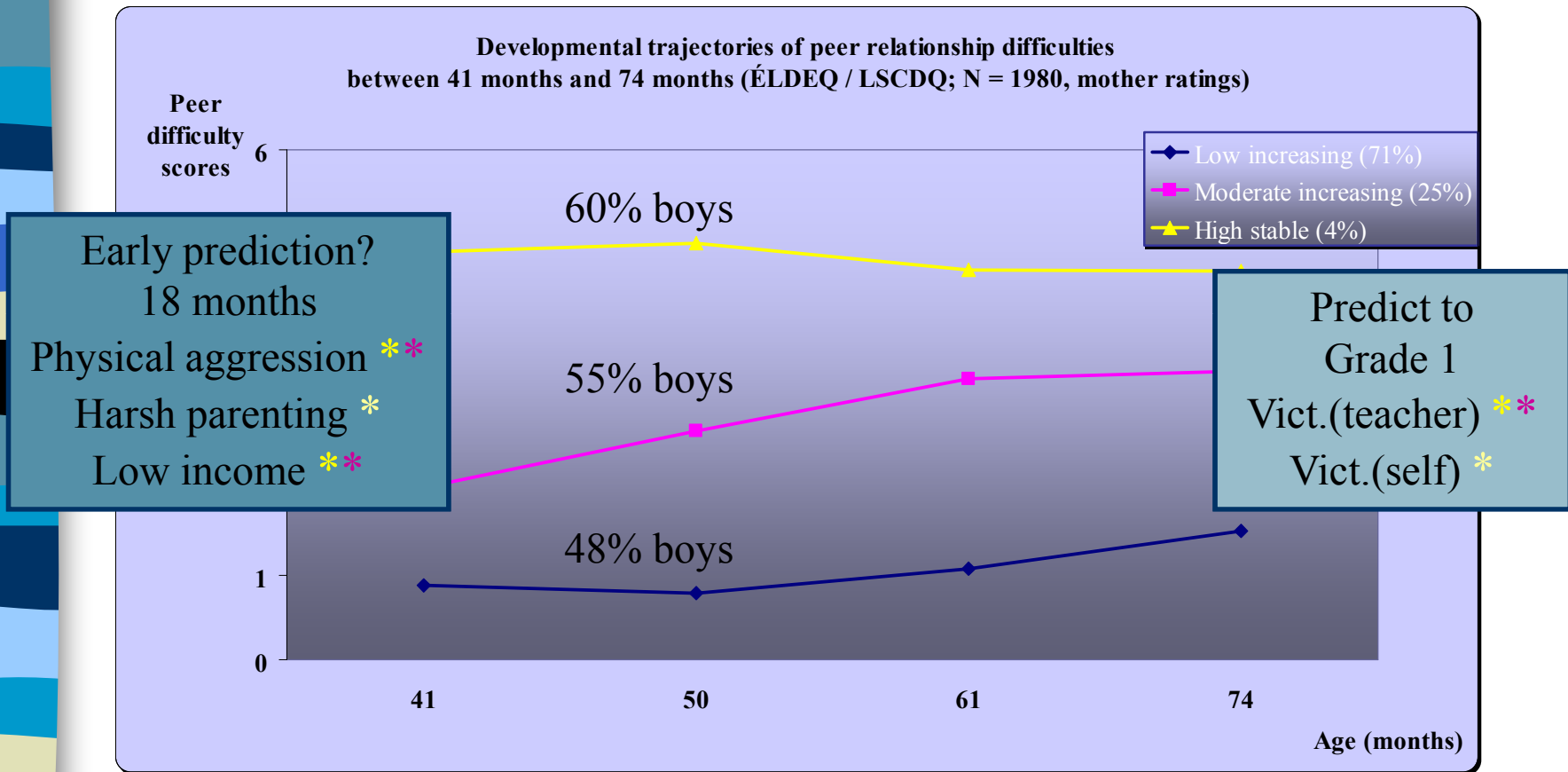
- How early can we reliably document peer relationship difficulties ?
- Can we identify risk factors ?
- What are the developmental processes involved?

# Developmental trajectories of peer relation difficulties during preschool



Note: these trajectories significantly predict to teacher ratings and self-ratings in school.

# Developmental trajectories of peer relation difficulties in preschool



# The twin design: a powerful tool for the study of development process



A gold mine for developmental studies

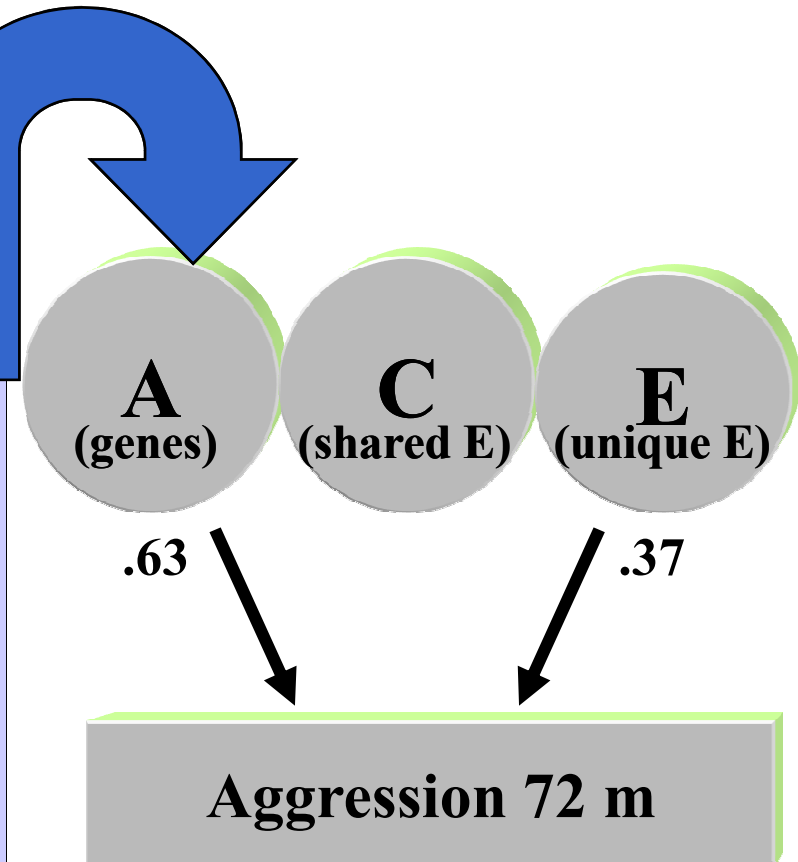
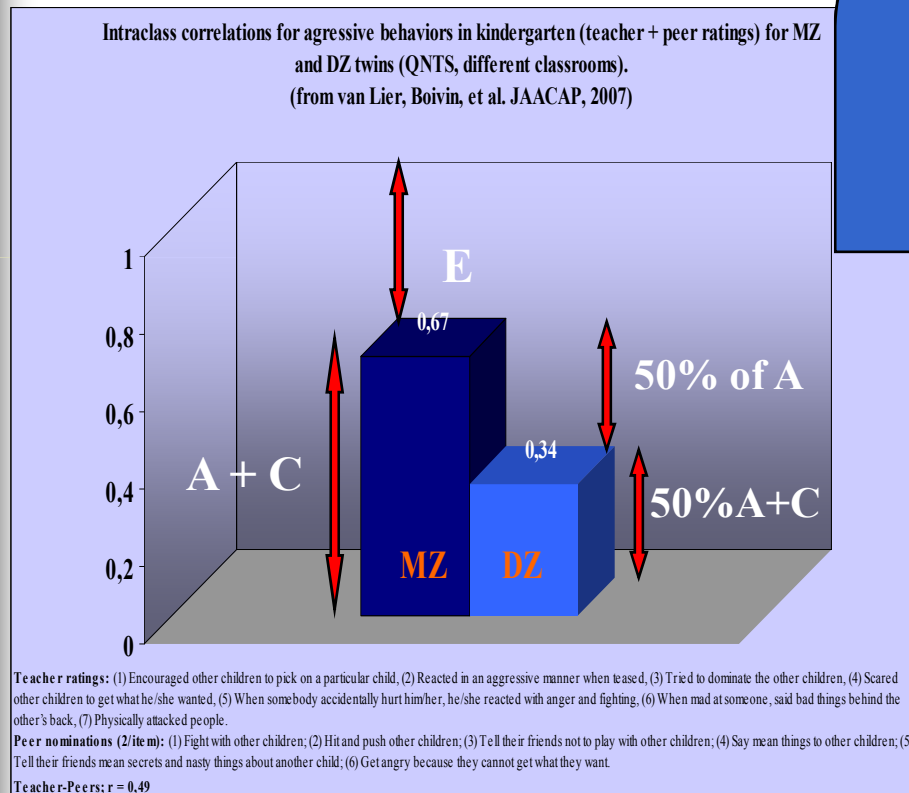
Powerful tool for disentangling family and individual factors

Natural experiment of genetic relatedness

# AE pattern dominates

E makes children of the same family grow apart.

## The case of aggressive behaviors

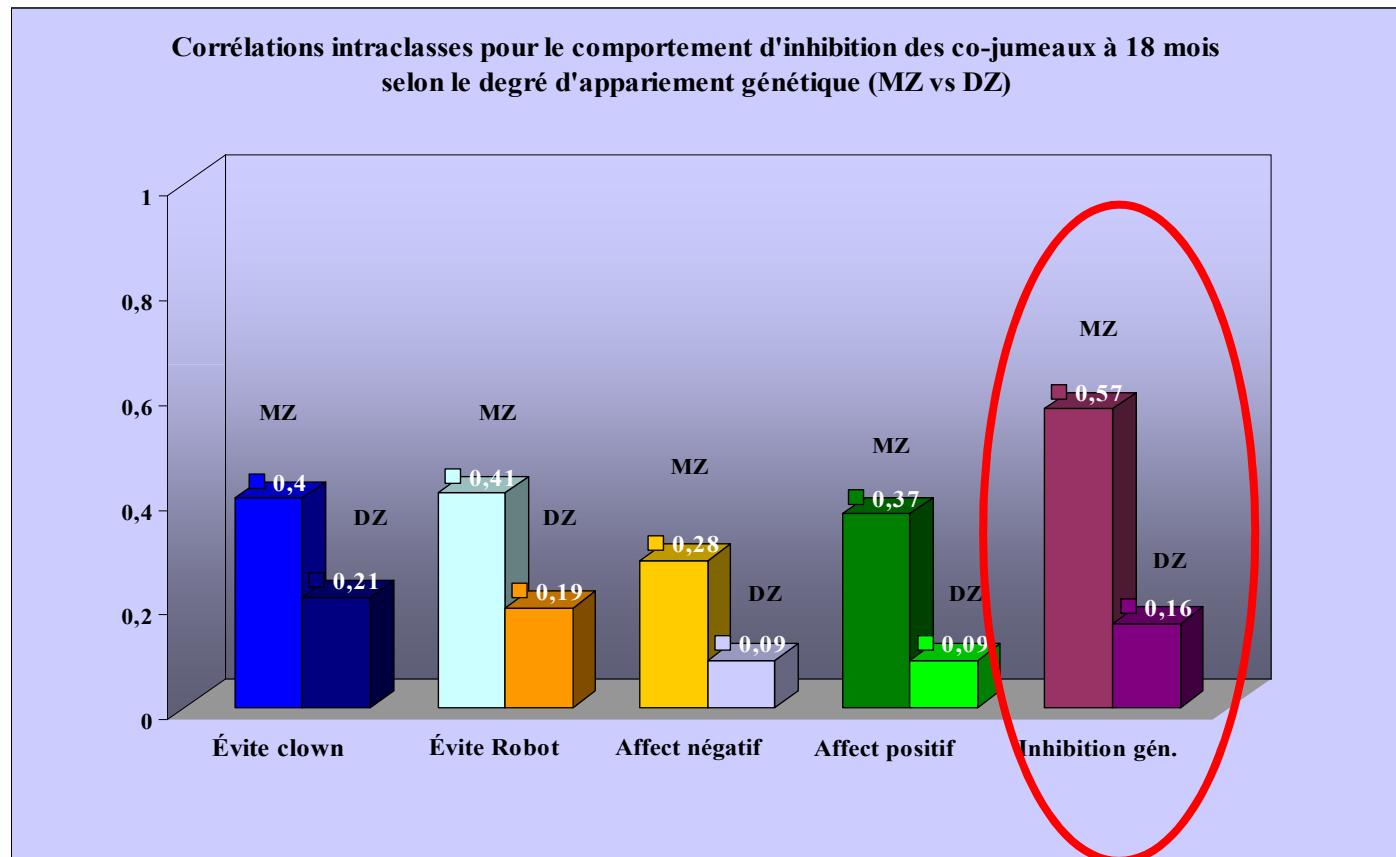


(van Lier, Boivin et al., JAACAP, 2007)

# AE pattern dominates

## The case of behaviour inhibition

Novelty situation



Note: Avoid C (transf. sqrt); Neg aff & Pos aff (Transf. log).

A variety of self-regulation behaviors were associated with BI.

The 4 dimensions are associated to temperament ratings by mothers at 18 months and predict shyness at 30-48-60 mois.



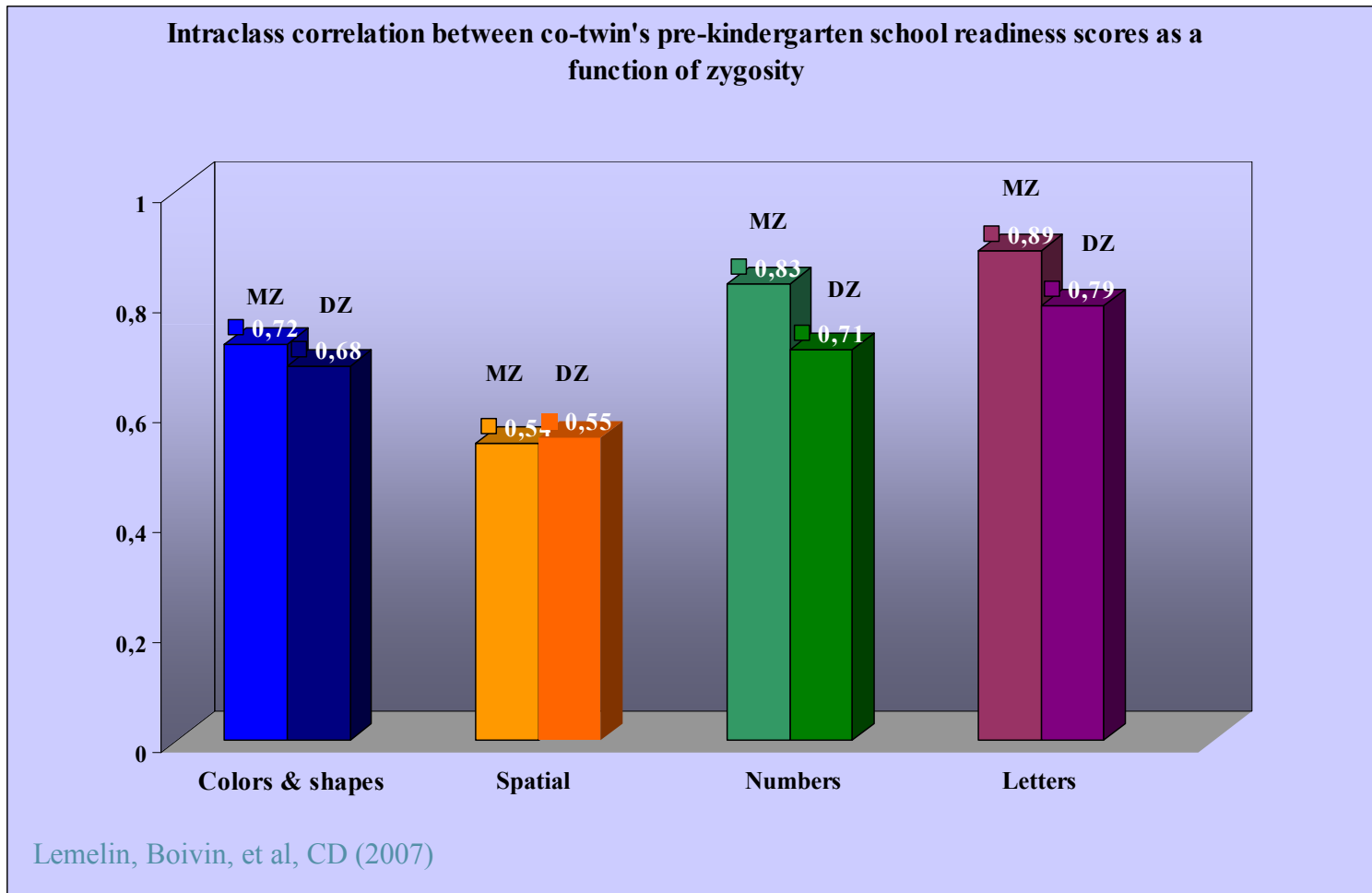
## Lesson 1

The environment **often** seems to  
create differences  
rather than similarities  
among children of the same  
family.

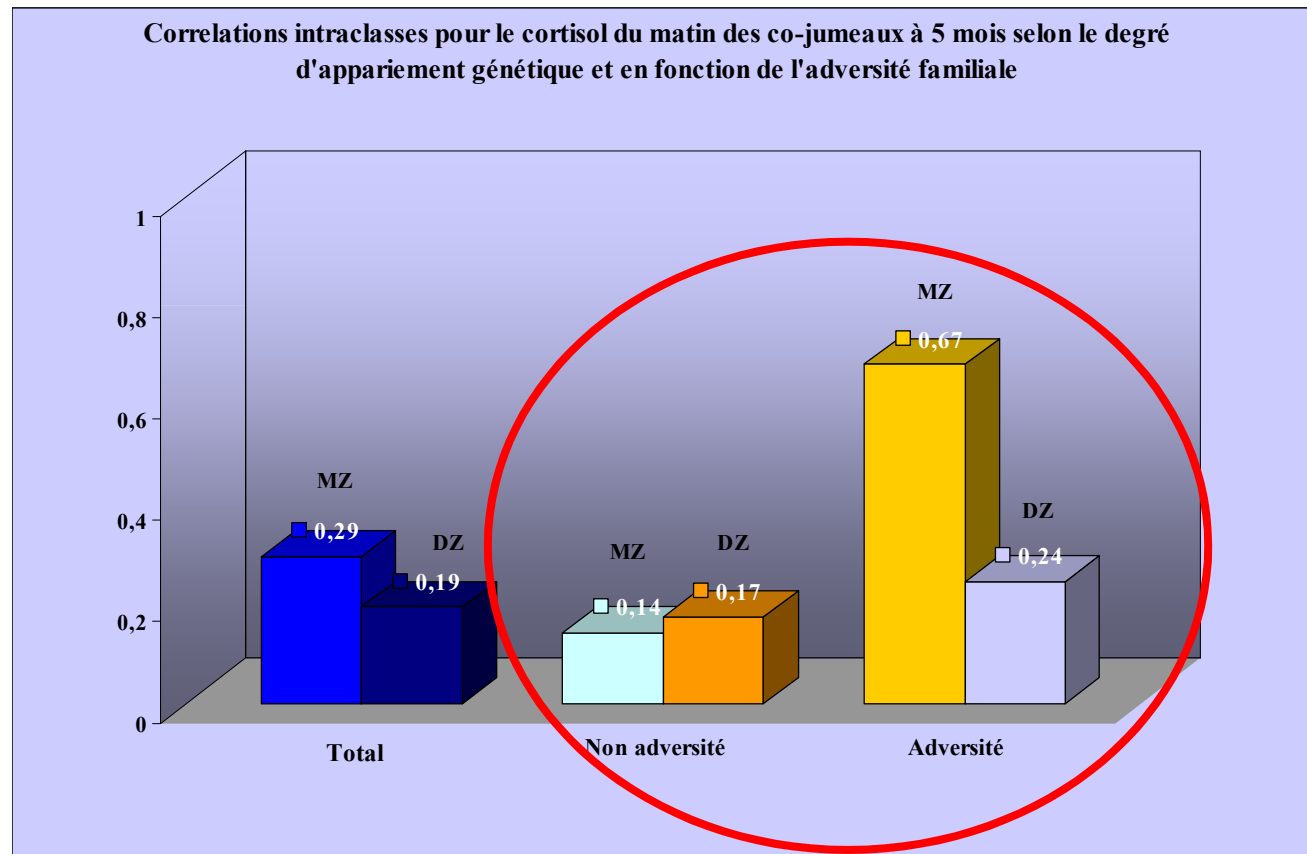


# Often, but not always...

## The case of cognitive school readiness

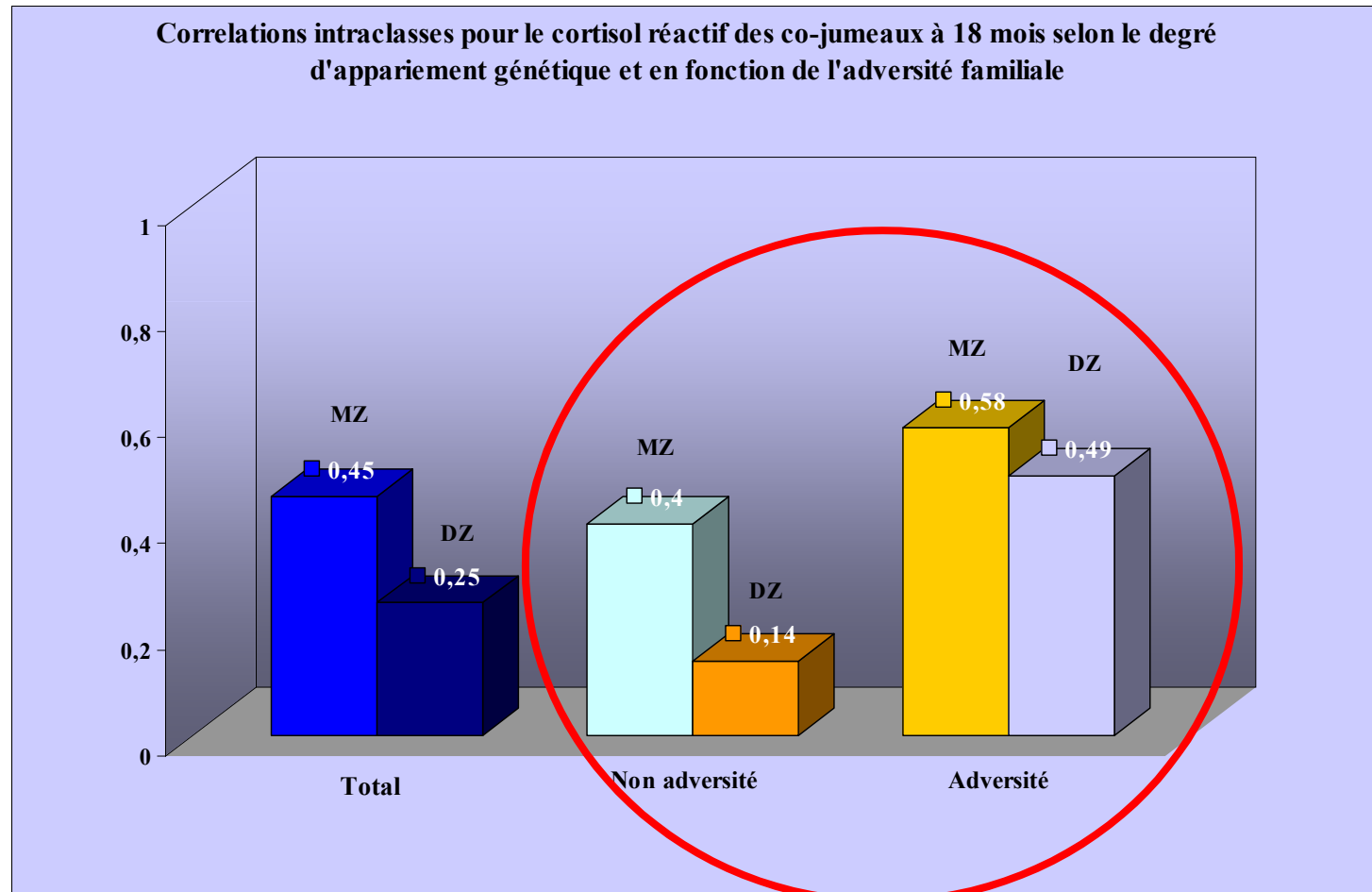


AE pattern does not always dominate.  
Gene expression depend on the environment  
The case of cortisol at 5 months (morning cortisol)

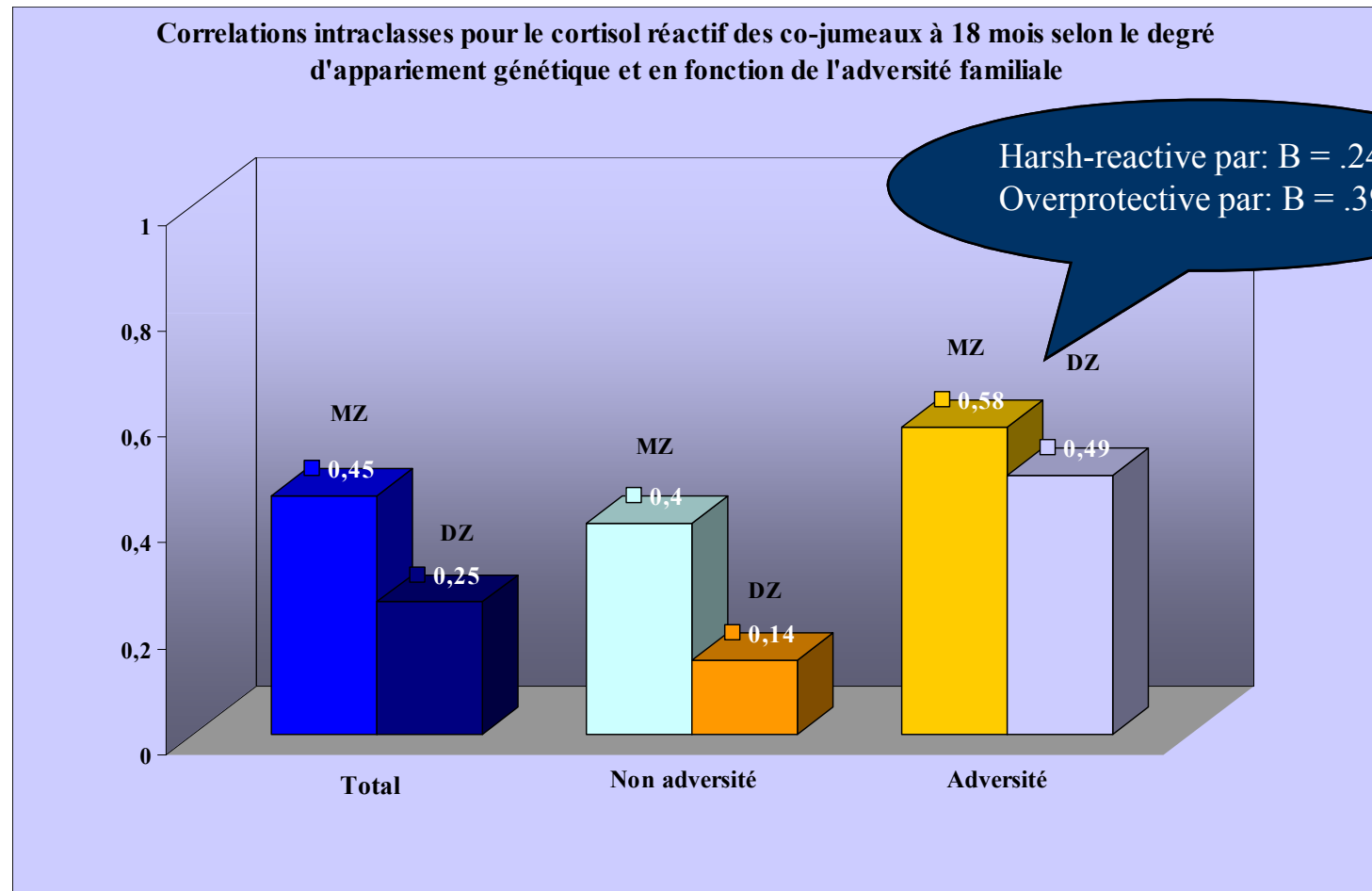


Ouellet-Morin et al. (Biological Psychiatry, 2009)

AE pattern does not always dominate.  
Gene expression depend on the environment.  
The case of cortisol (reactive) response at 18 months.



AE pattern does not always dominate.  
Gene expression depend on the environment.  
The case of cortisol (reactive) response at 18 months.



Ouellet-Morin et al. (AGP, 2008)



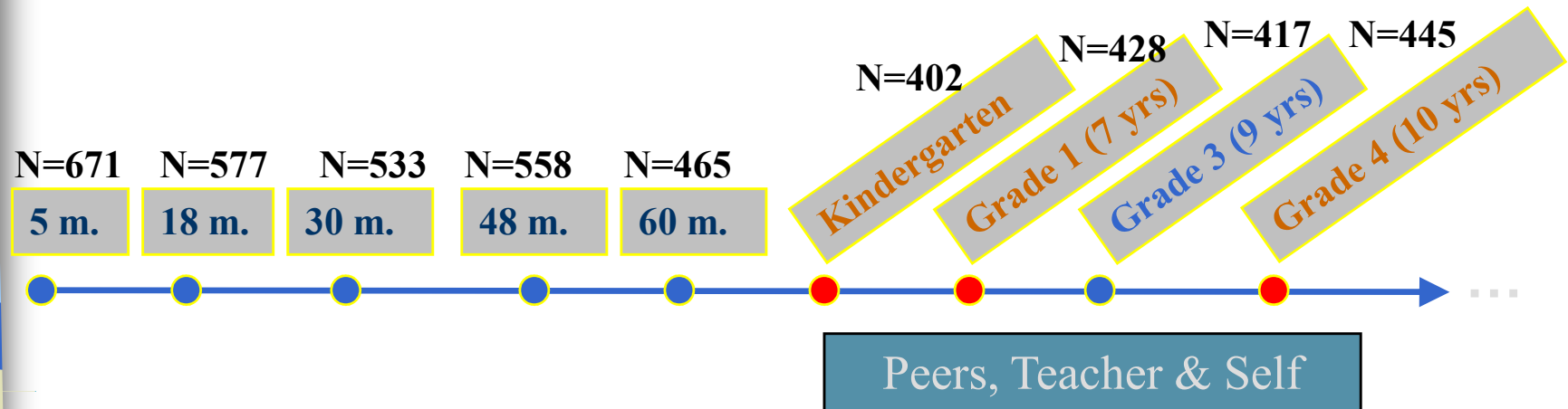
## Lesson 2

Genes contribution are conditioned by the environment, and environmental effects depend on genetic factors.

### GxE interactions

GxE are pervasive and developmentally dynamic

# Measures of peer relation difficulties in QNTS



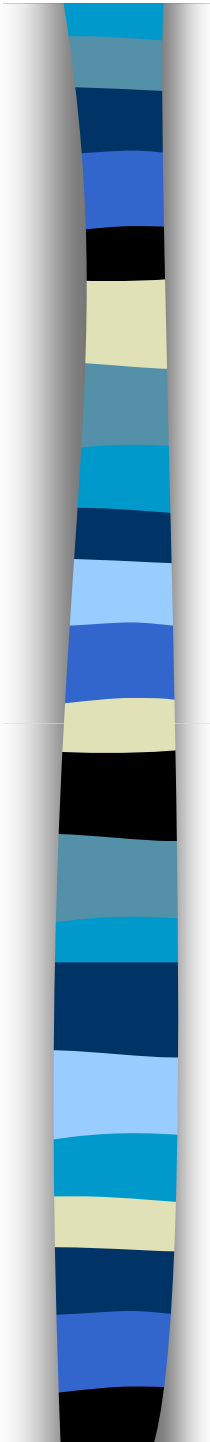
**Teacher ratings:** same as in ÉLDEQ / LSCDQ

**Self-ratings:** same as in ÉLDEQ / LSCDQ

**Peer nominations:** Picture roster of classmates.

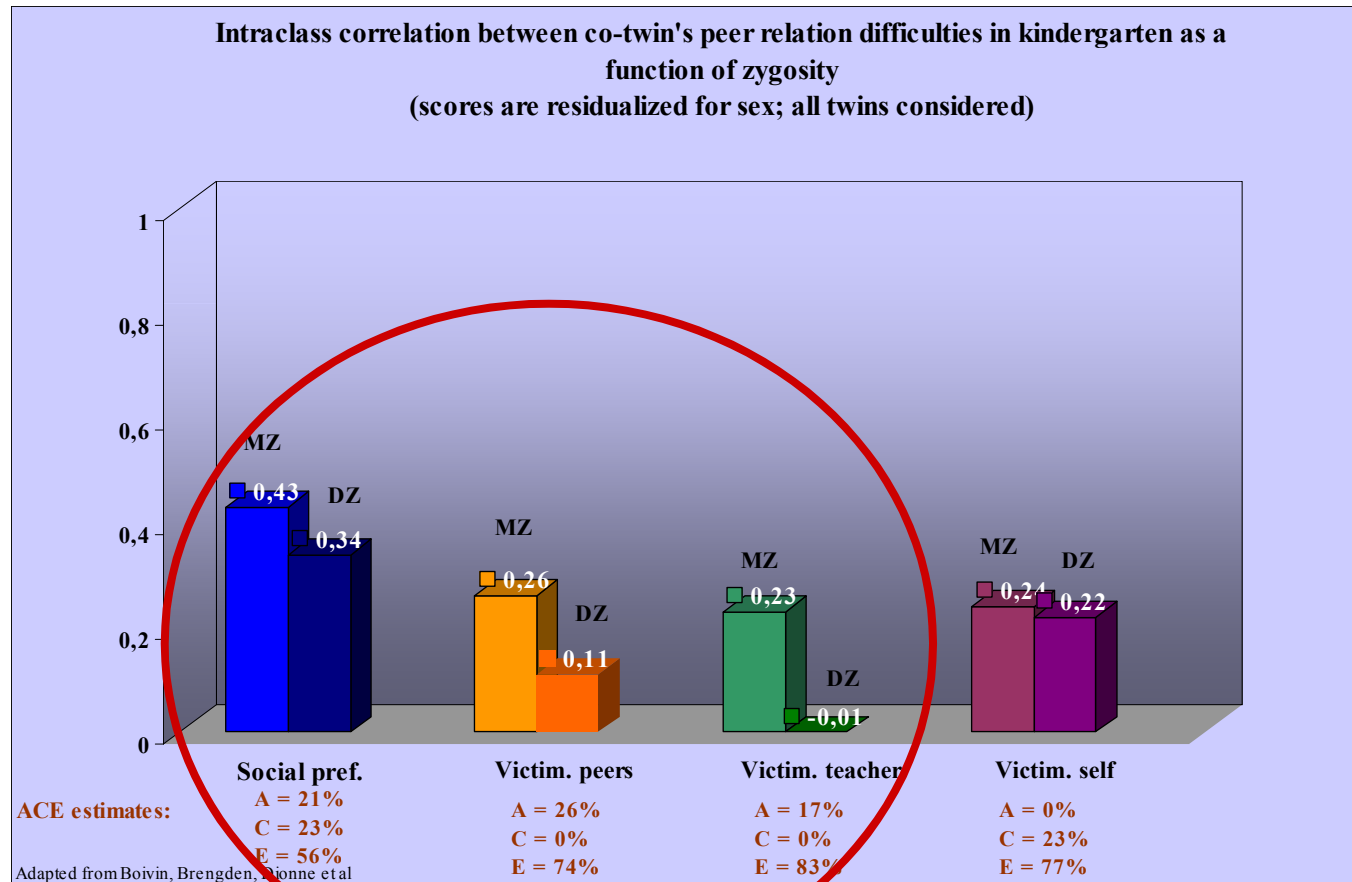
**Peer status:** 2 items (play with liking & disliking nominations): Social Preference (SP) scores.

**Peer victimization:** 2 items (who get called names most often by other children?...are often pushed and hit by other children, who get the hits?)



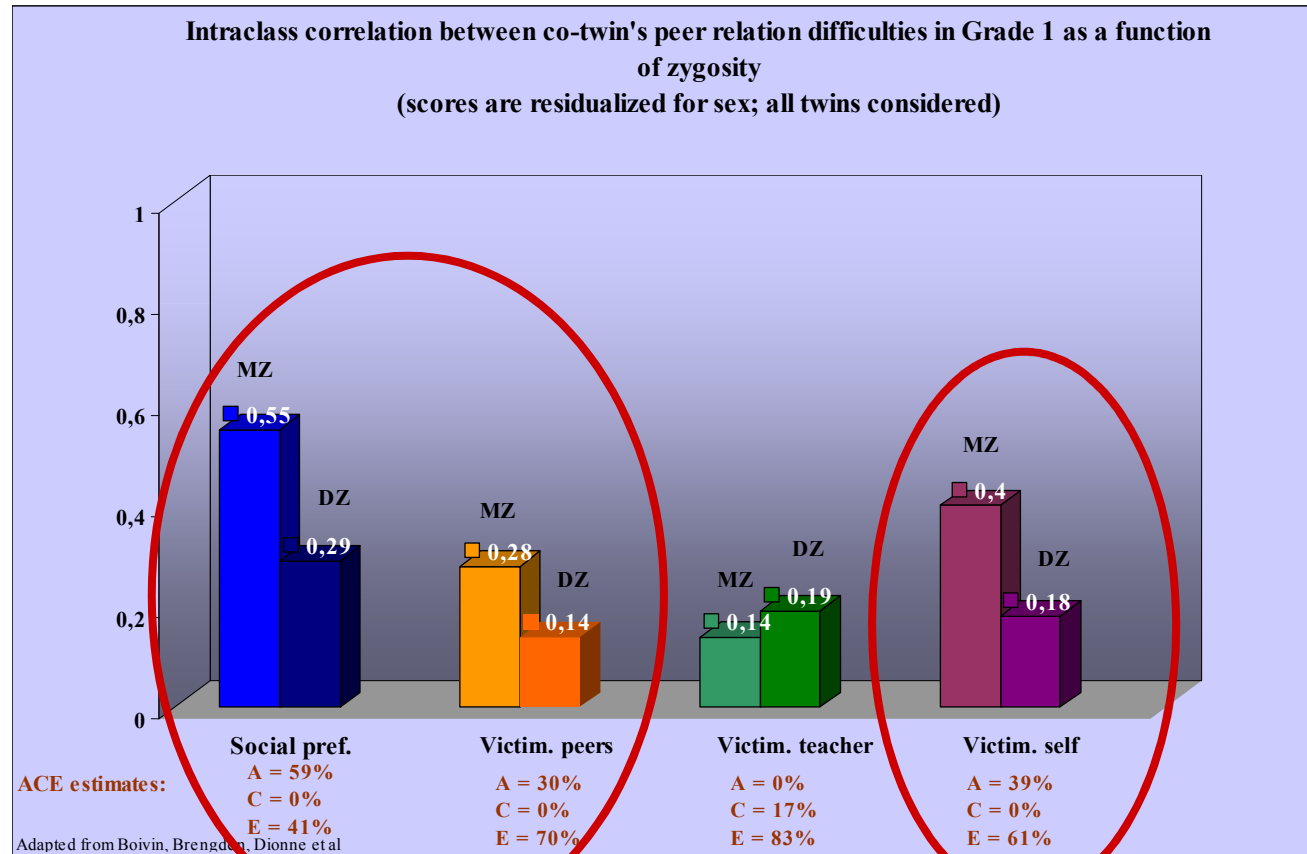
Do peer difficulties show familial aggregation  
and is this familial aggregation accounted for  
by genetic factors?

# G-E analyses of peer relation difficulties in kindergarten

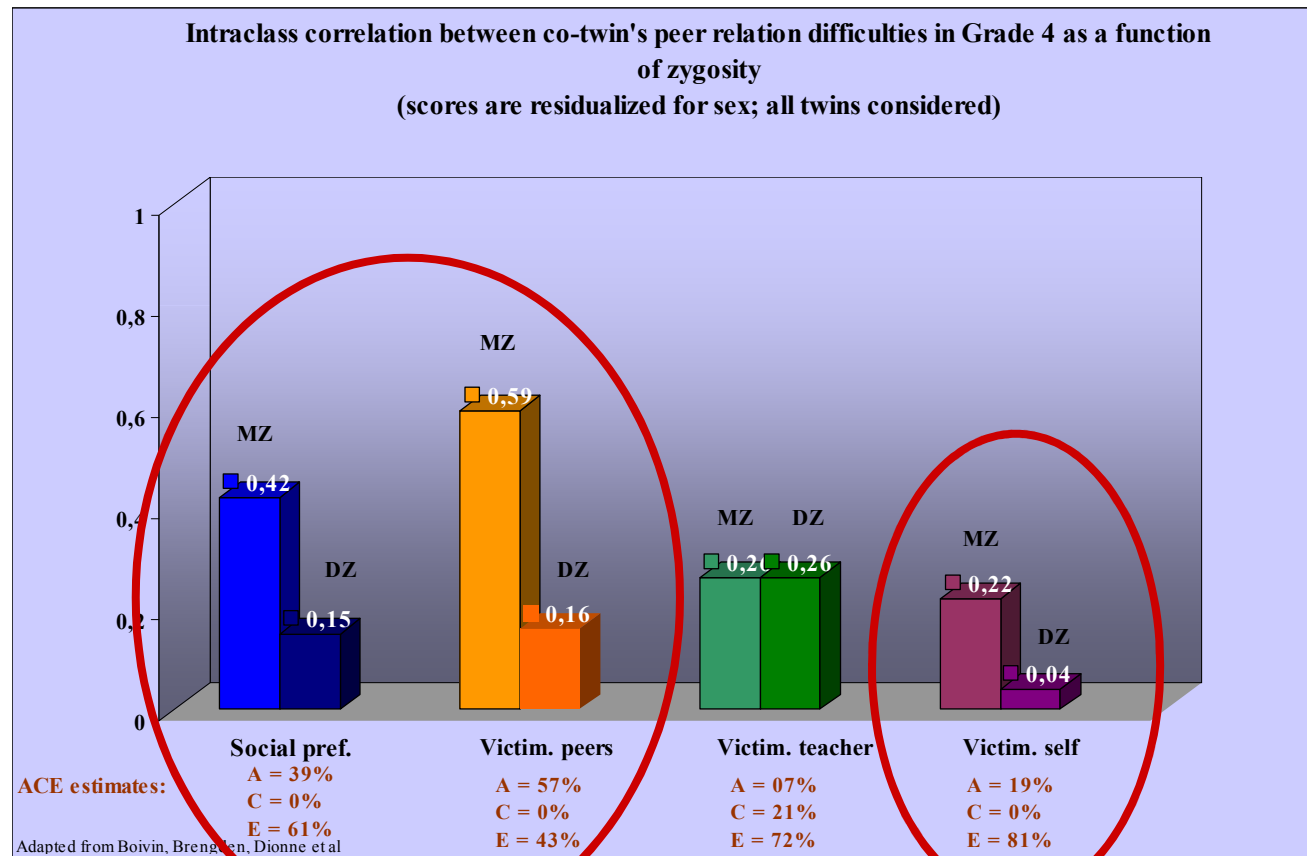




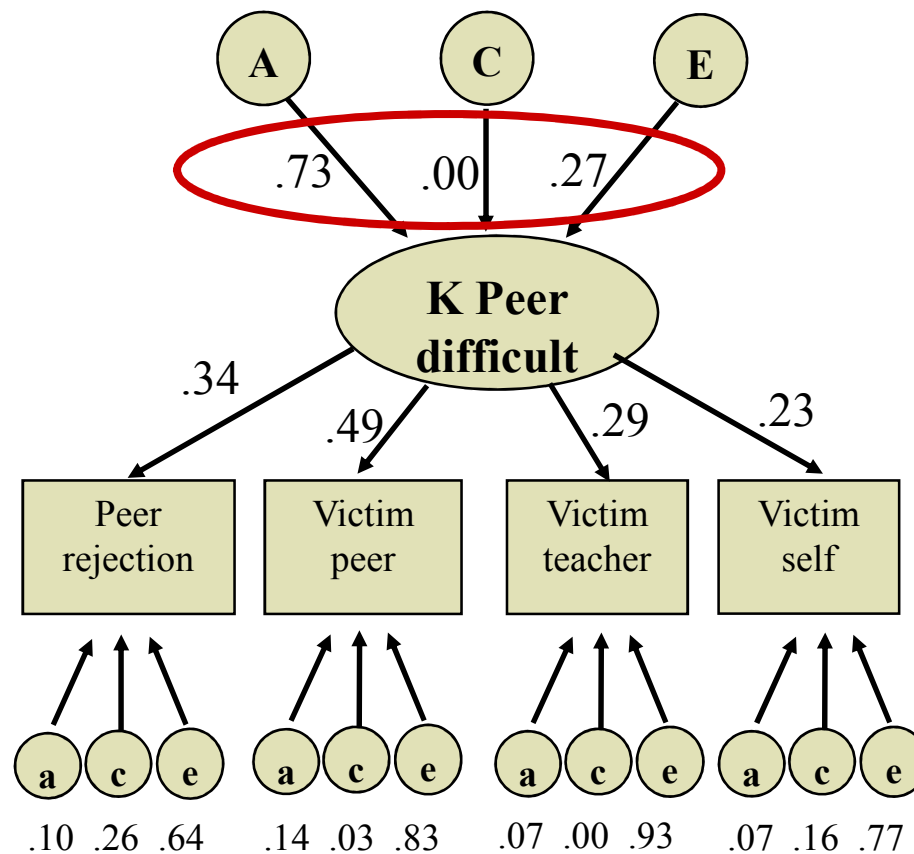
# G-E analyses of peer relation difficulties in Grade 1



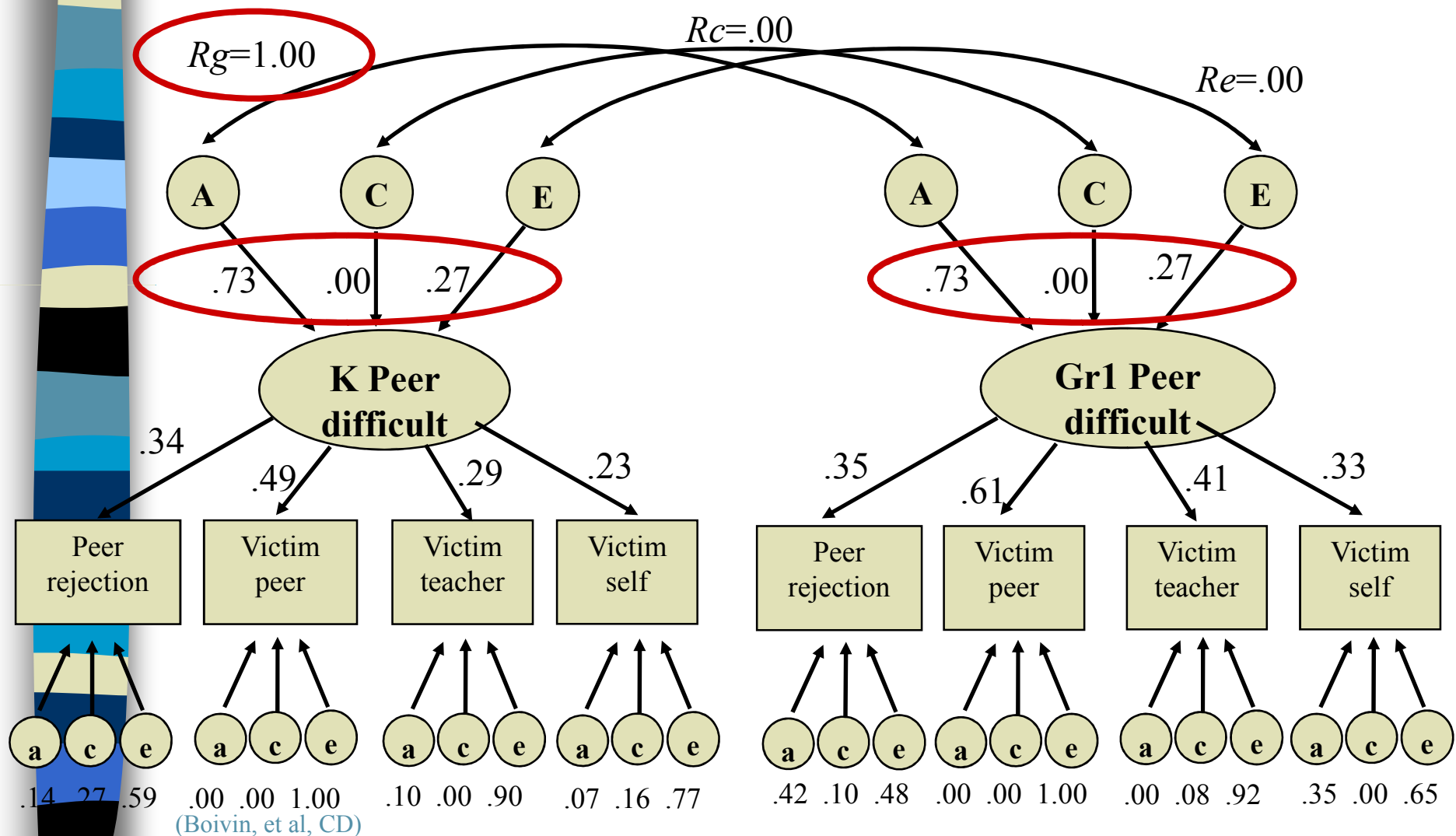
# G-E analyses of peer relation difficulties in Grade 4



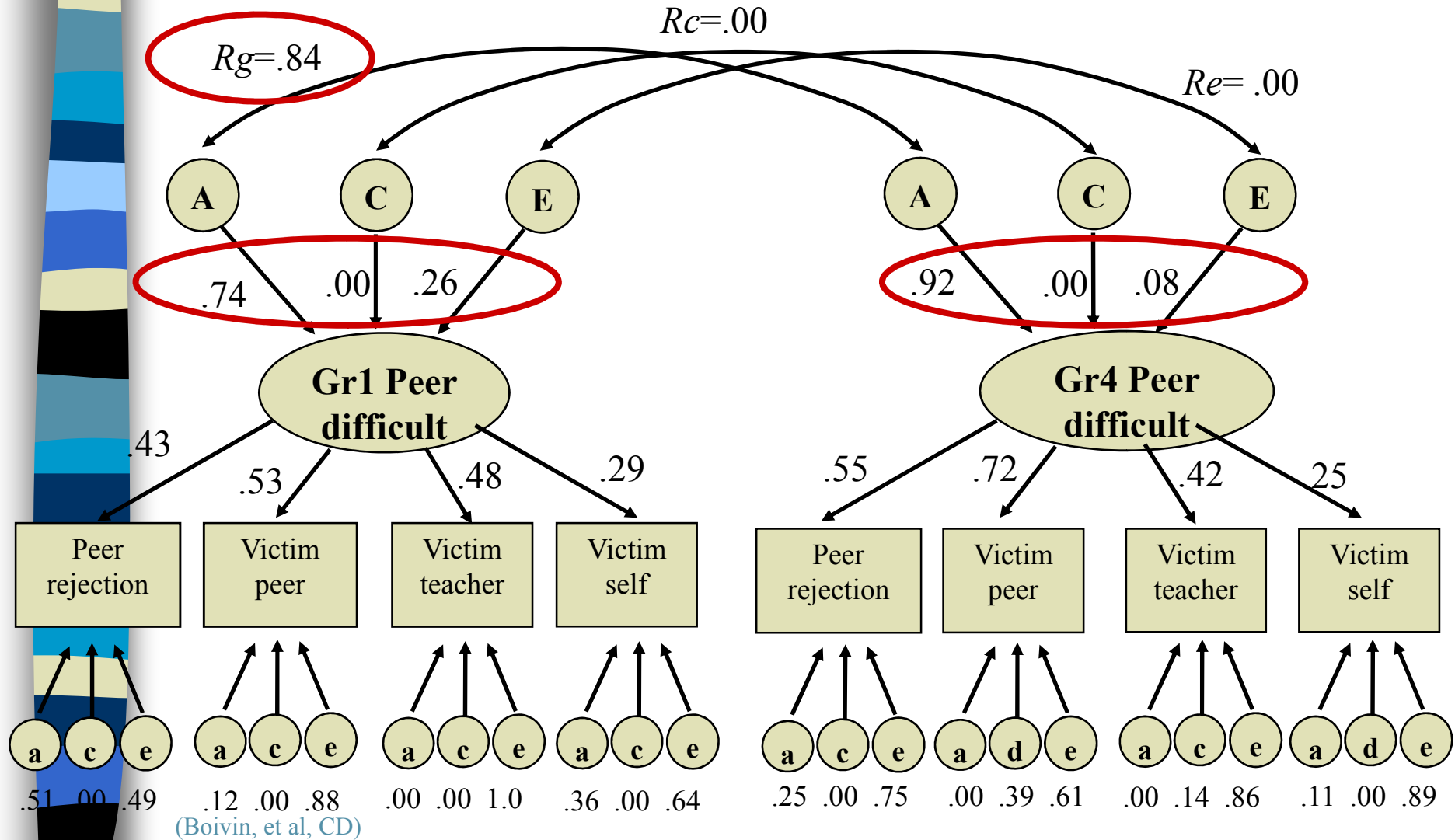
# G and E contributions to peer relation difficulties in kindergarten



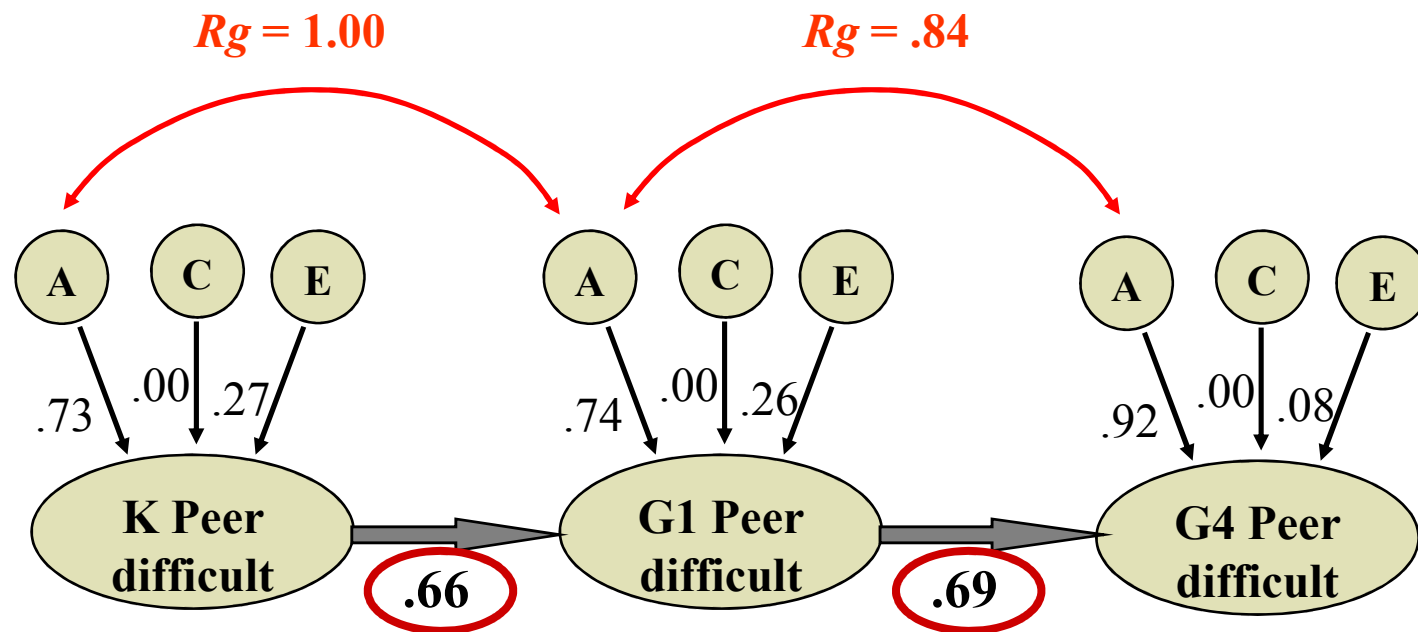
# G and E contributions to peer relation difficulties from Kindergarten to Grade 1



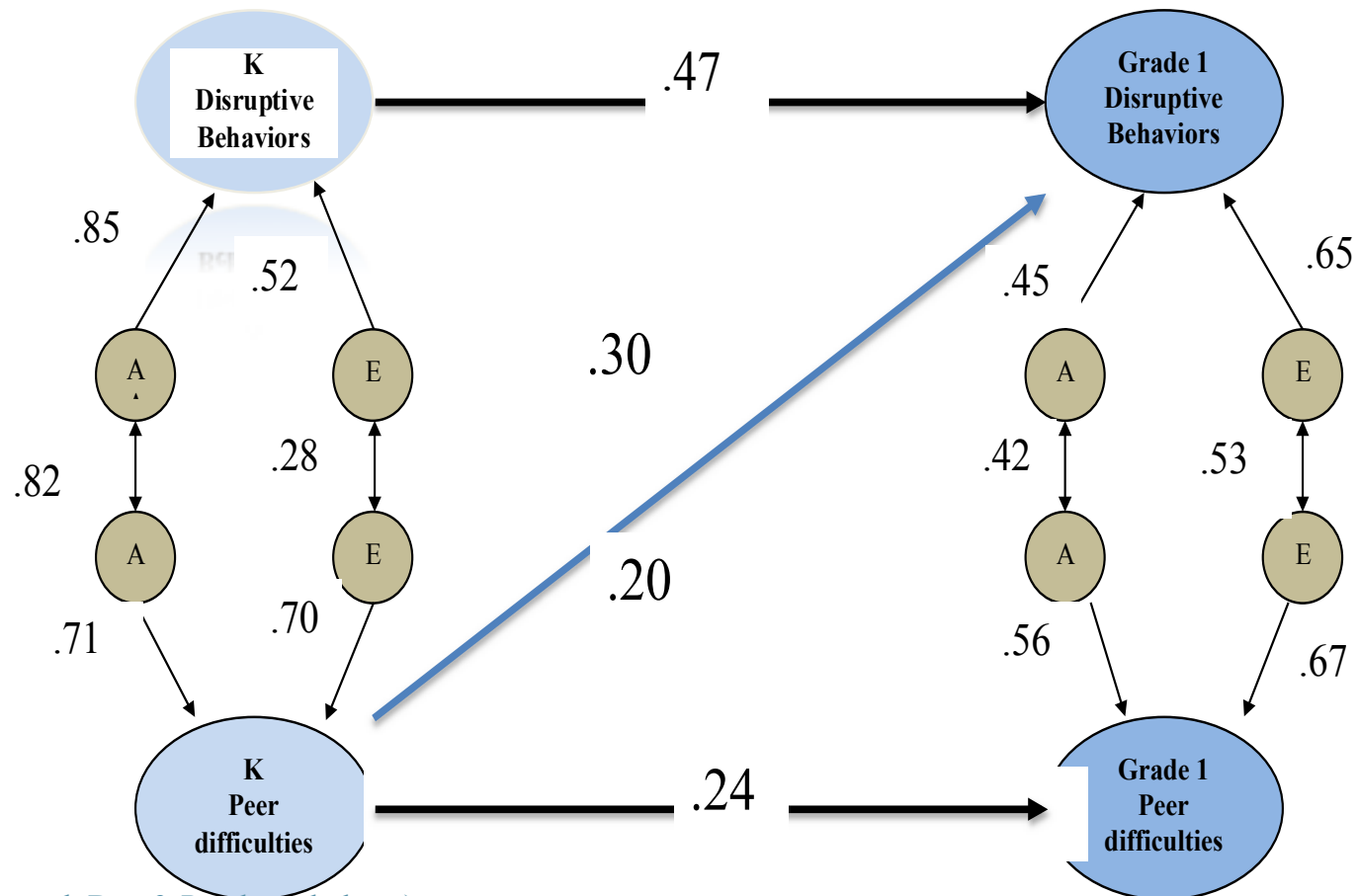
# G and E contributions to peer relation difficulties from Grade 1 to Grade 4



# G and E contributions to the stability of peer relation difficulties in early primary school



# Testing directionality: disruptive behaviors as proximal determinants of peer relation difficulties



(Boivin, et al, Dev & Psychopathology.)

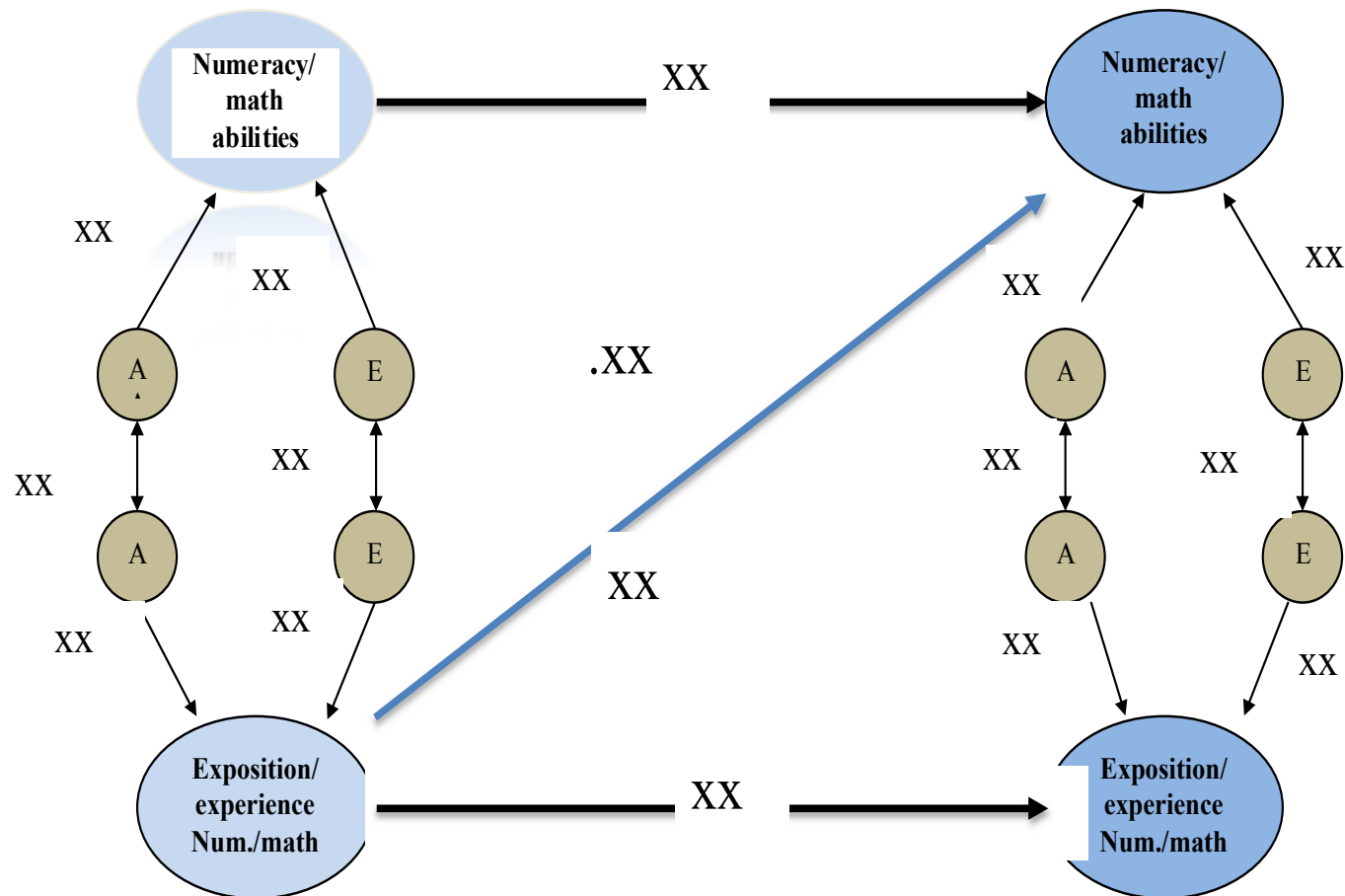
*Squared standardized path coefficients and corresponding percentages of variance accounted for in peer difficulties and disruptive behaviors in Grade 1*

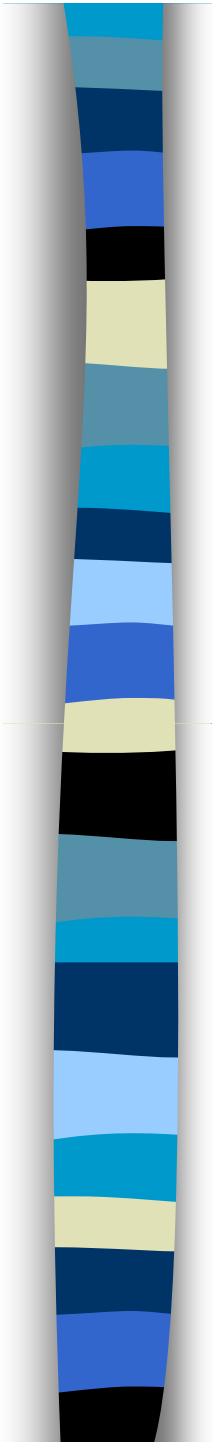
	Variance			
	$a^2$	$c^2$	$e^2$	Total phenotypic
<b>Peer difficulties in Grade 1</b>				
Kindergarten peer difficulties	.03 (6%)	0	.029 (6%)	.059
Kindergarten disruptive behaviors	.065 (14%)	0	.024 (5%)	.089
Common Kindergarten	.073 (15%)	0	.014 (3%)	.087
Factors unique to Grade 1	.313 (65%)	0	.451 (87%)	.764
Total ACE in Grade 1	.481	0	.518	1
<b>Disruptive behaviors in Grade 1</b>				
Kindergarten disruptive behaviors	.159 (33%)	0	.056 (11%)	.215
Kindergarten peer difficulties	.021 (4%)	0	.02 (4%)	.041
Common Kindergarten	.094 (20%)	0	.019 (4%)	.113
Factors unique to Grade 1	.204 (43%)	0	.425 (82%)	.629
Total ACE in Grade 1	.478	0	.52	1

Note.  $a^2$  = additive genetic variance,  $c^2$  = shared environment variance,  $e^2$  = non shared environment contributions



# Testing directonality in the longitudinal associations between numeracy/math abilities and exposition/experience.





## Lesson 3

Exposition to environment may  
depend of genes.

**GEcor**

GEcor may develop,  
but not well documented.

Do peer difficulties lead to internalized difficulties through environmental mediation?

**Withdrawal  
Aggression**

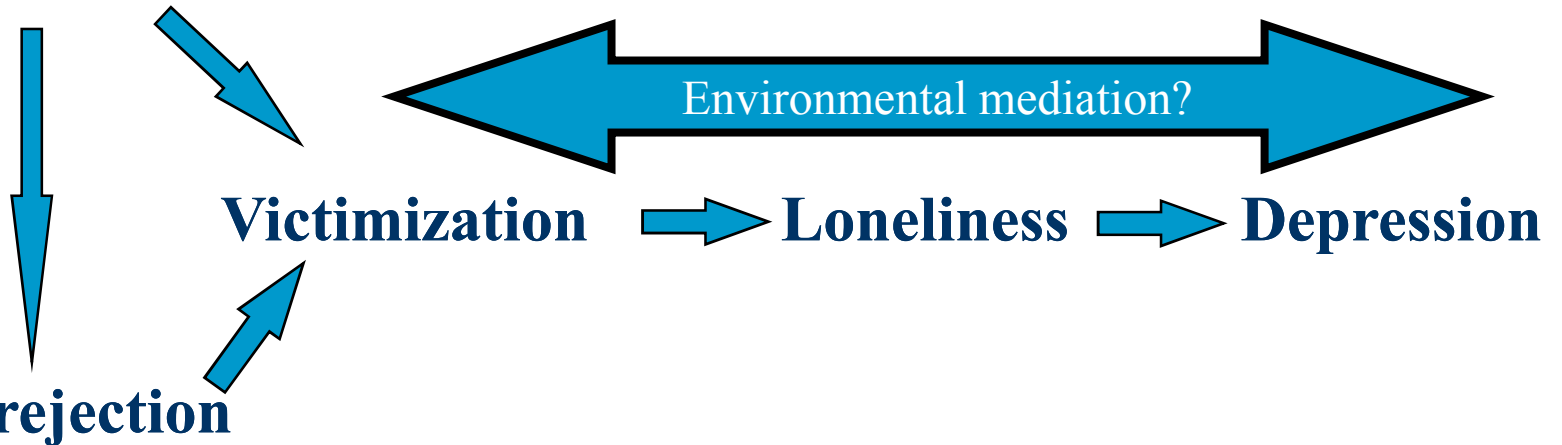
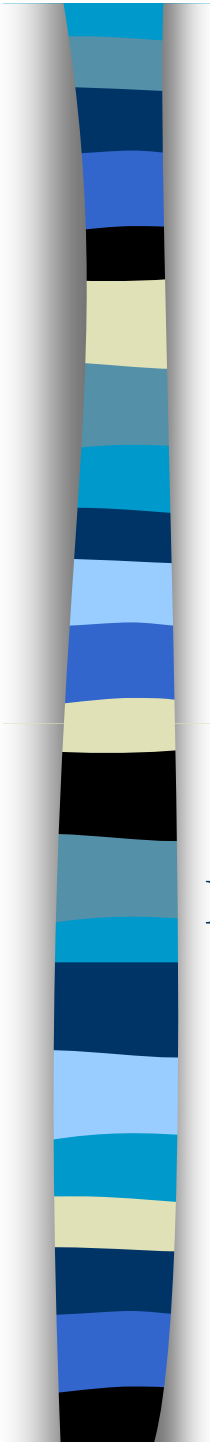
**Peer rejection**

**Victimization**

**Environmental mediation?**

**Loneliness**

**Depression**





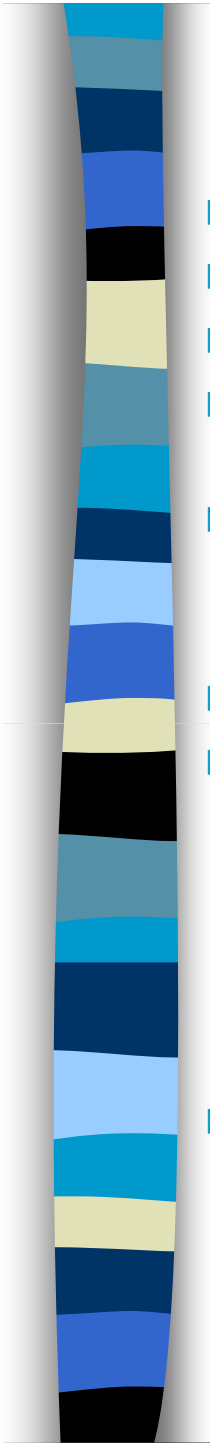
# Testing for environmental mediation through the discordant MZ-twin method

- Basic rationale:
  - MZ twins share 100% of their genes
  - Any difference among MZ twins results from unique environmental influence.
- The D-MZ-twin method examines whether differences among MZ twins in environmental exposure (e.g., victimization) co-vary with MZ differences in a given adjustment outcome (e.g., depression symptoms).
- Possible ways to increase the internal validity of the design:
  - The longitudinal study of MZ provides for additional control by:
    1. Assessing change; i.e., controlling for T1 (i.e., kindergarten) in predicting the outcome;
    2. Assessing direction of the prediction;
    3. Statistical control of other relevant environmental variables.

# Predicting depressive symptoms in Grade 1 through the discordant MZ-twin method

Depressive symptoms in Grade 1 (teacher ratings)				
Step	Cumul R <sup>2</sup>	Change. R <sup>2</sup>	Variable	Beta std.
1	.04*	.04*	Depression K	0.18*
			Gender (girls)	-0.13
2	.10***	.06*	Family income	-0.06
			Mother host-reac	-0.01
			Rejection K	0.02
			P. Aggression K	0.05
			Victimization K	0.22**

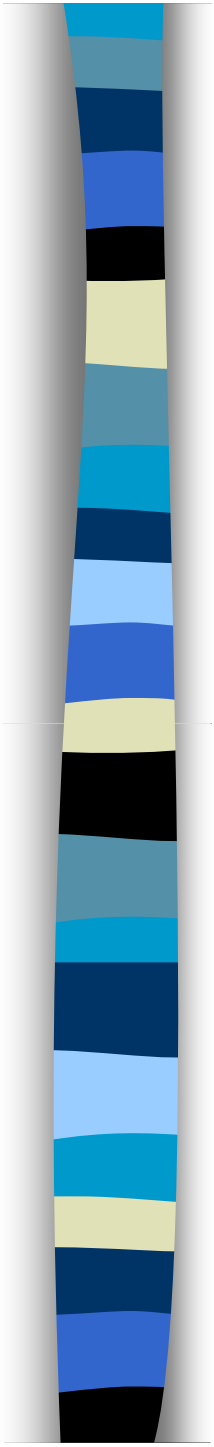
# Conclusion

- 
- Some children experience peer difficulties early in school
  - These children show clear behavioral risk factors
  - These difficulties and the behavioral risk factors starts in preschool.
  - These peer difficulties are associated with genetic vulnerabilities in the child (G-E cor)
  - Disruptive behaviours (Agr + Hyper: self-regulation?) partly mediates this association.
  
  - However...
  - these genetic vulnerabilities combine with developmental / social-contextual processes.
    - They progressively unfold in school
      - Kindergarten as a « window of opportunity » for prevention in school?
  
  - Over and above these G-E correlations, victimization may have an environmental impact on internalized difficulties



## General implications; why is this important?

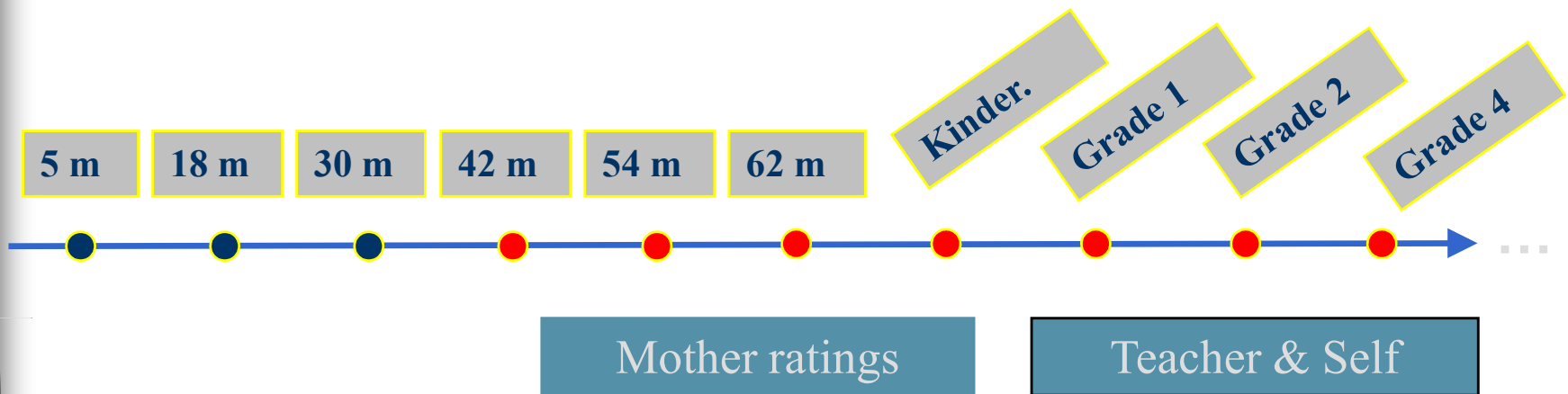
- Emphasizes the need to adopt:
  1. an early developmental (i.e., 0 to 6) framework
    - Prevention of PRD should start in preschool
  2. a bio-social perspective in the understanding and prevention of peer relation difficulties
- **Careful:** Heritability points to vulnerability, not to inevitability.
- **Cumulative burden of risk:** Environmental vulnerabilities (i.e., PRD) add to genetic vulnerabilities







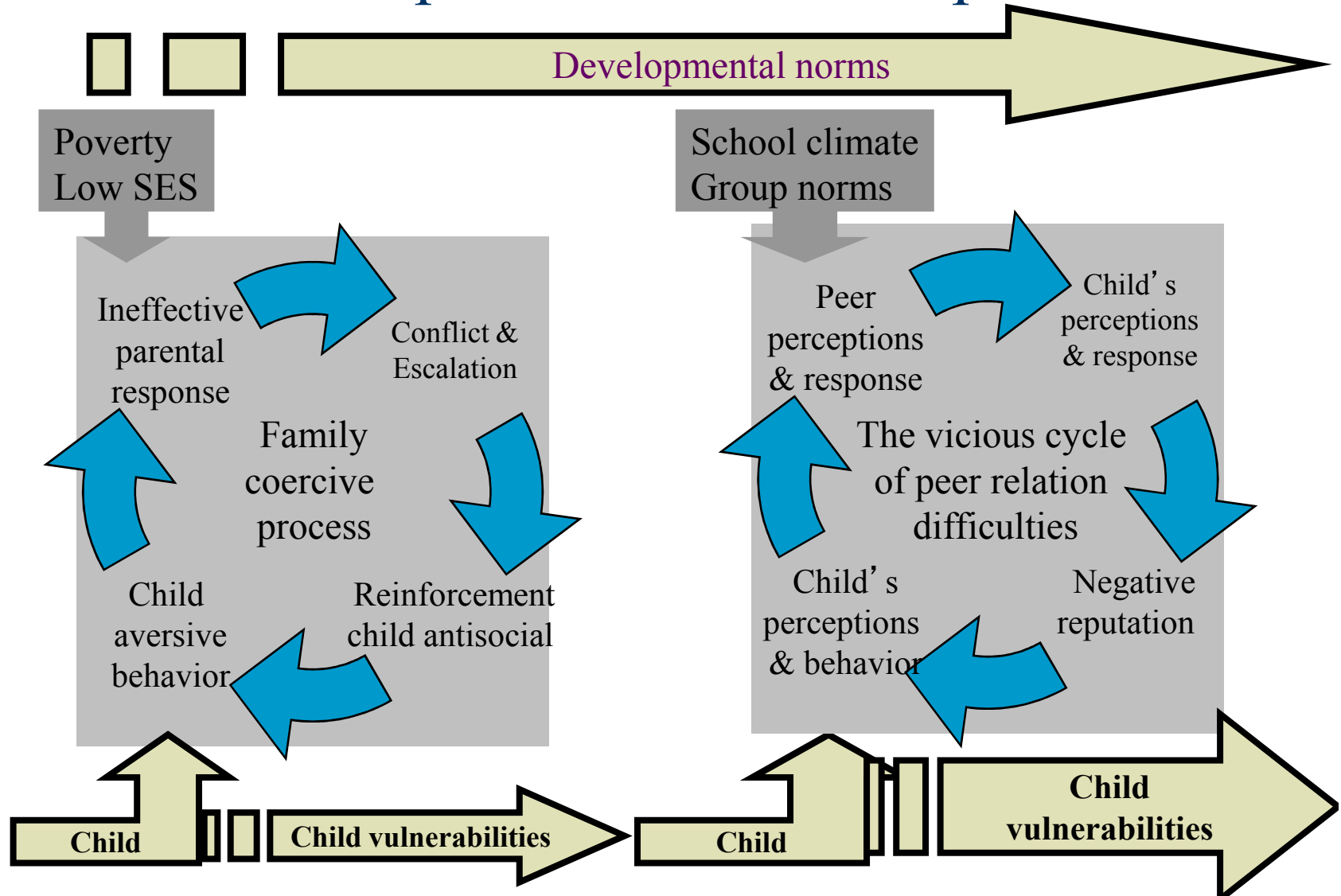
# Measures of peer relation difficulties in QLSCD.



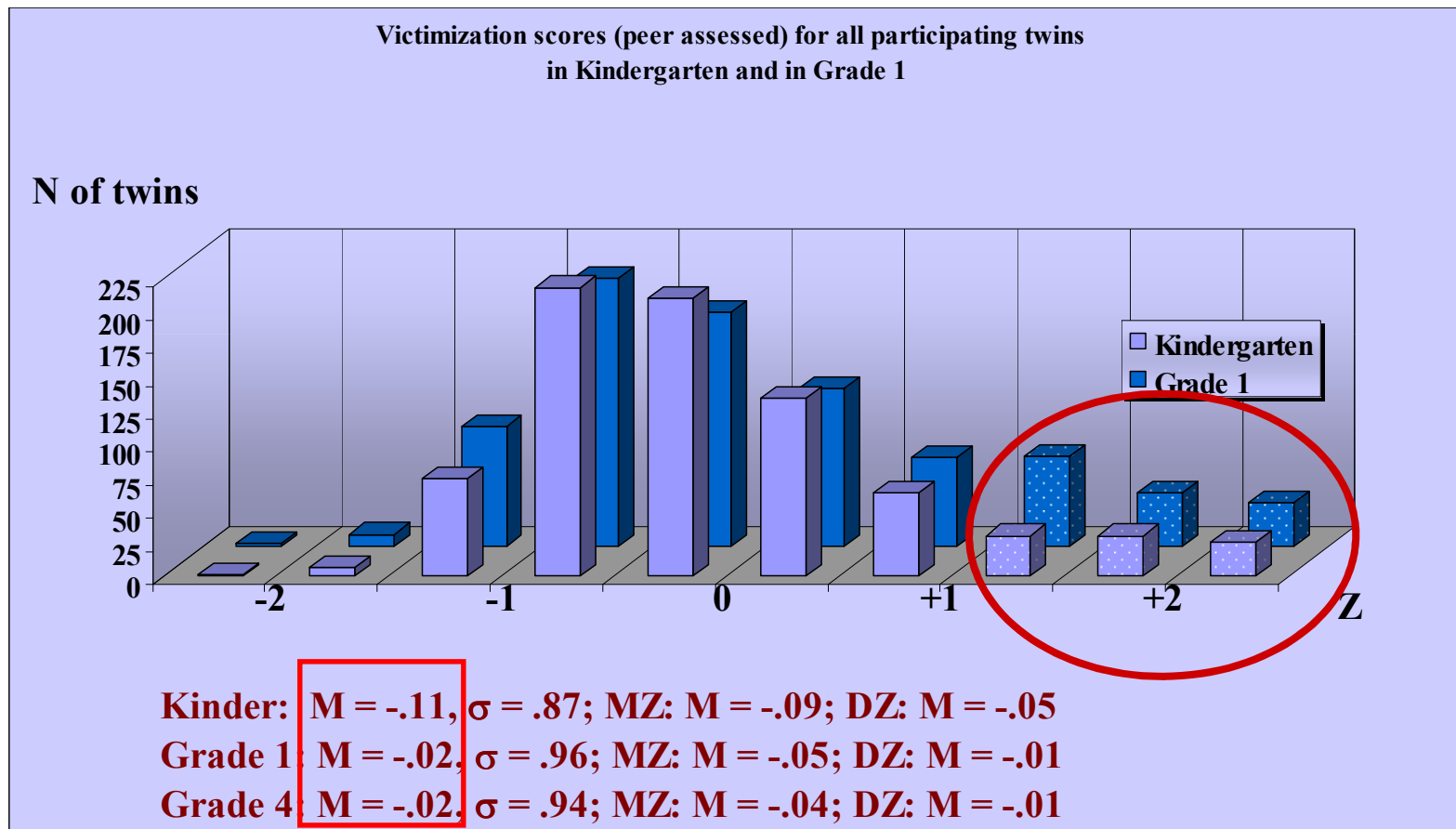
**Mother and teacher ratings:** 3 items; 3-point scale; In the past 6 months, how often would you say that X...was made fun of by other children? ...was hit or pushed by other children?...was called names by other children? (All Cronbach alphas > 0.60).

**Self-ratings:** 5 items; 3-point scale; Does it ever happen that ...some children at school call you names or say bad things to you? ...some children at school say bad things in your back to other children?...a child at school won't let you play with their group?...a child at school pushes, hits or kicks you?...a child at school teases you in a mean way? (Cronbach alphas > 0.70)

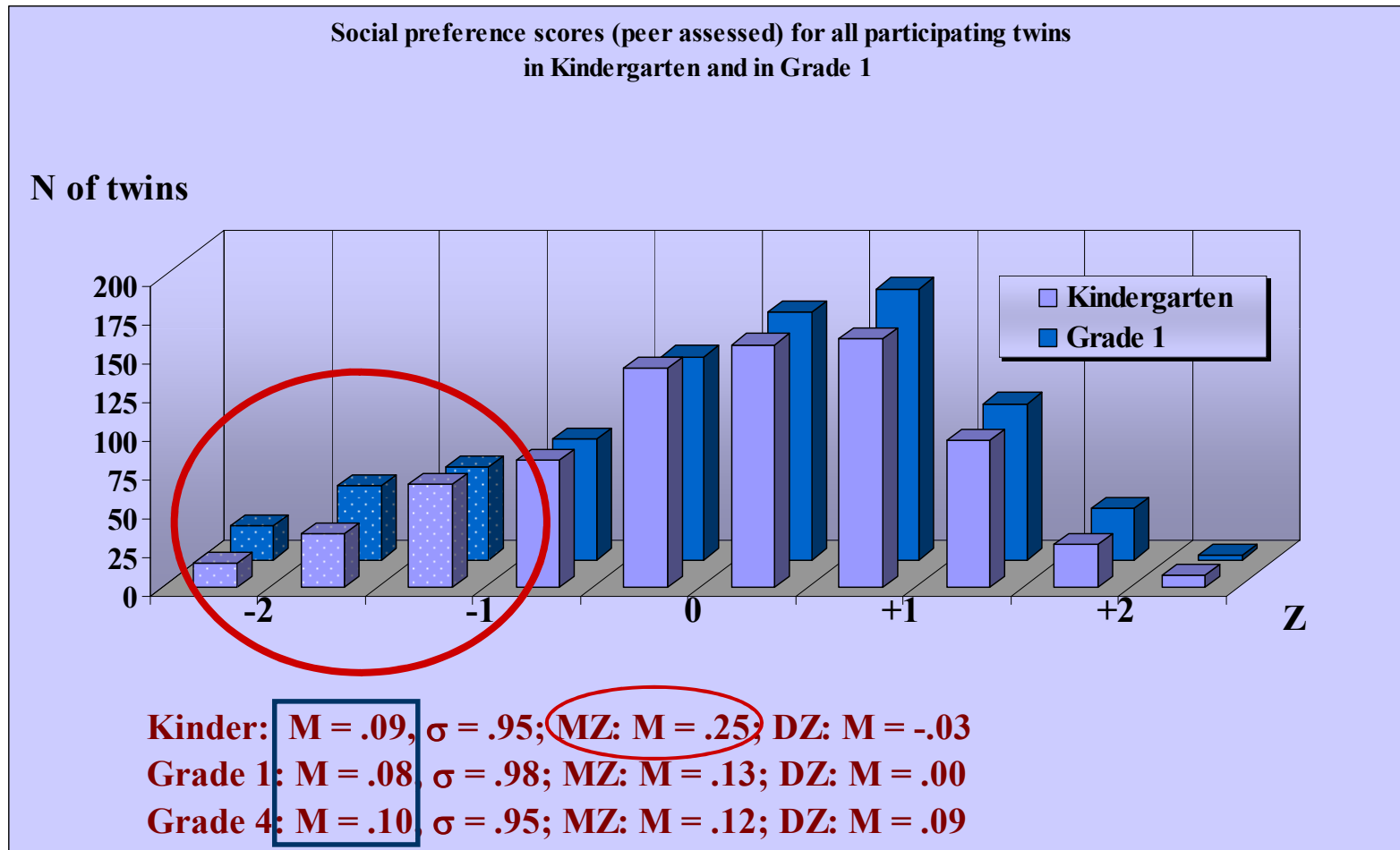
# Genetic vulnerabilities in the child combine with developmental/contextual processes



# Preliminary analyses: distribution of victimization scores in kindergarten and in grade 1

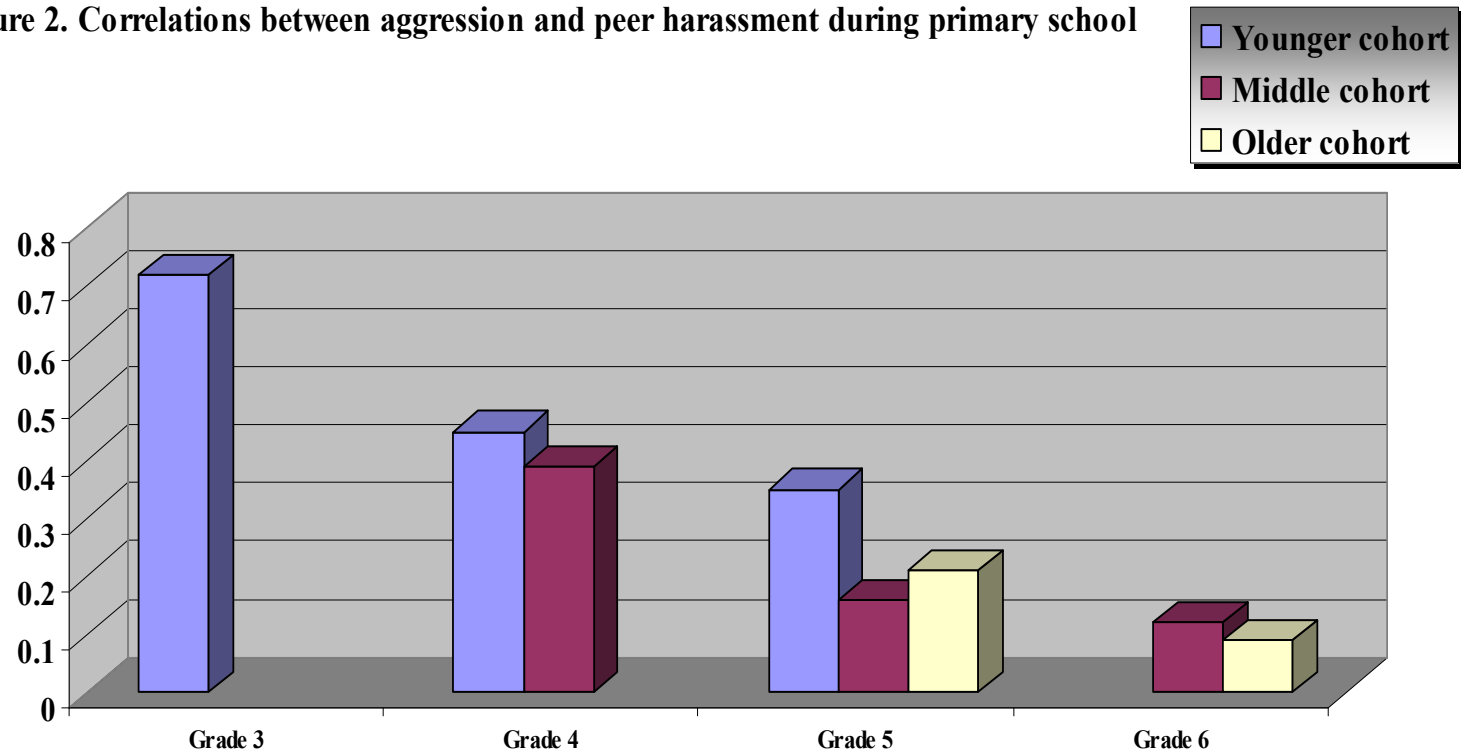


# Preliminary analyses: distribution of social preference scores in kindergarten and in grade 1



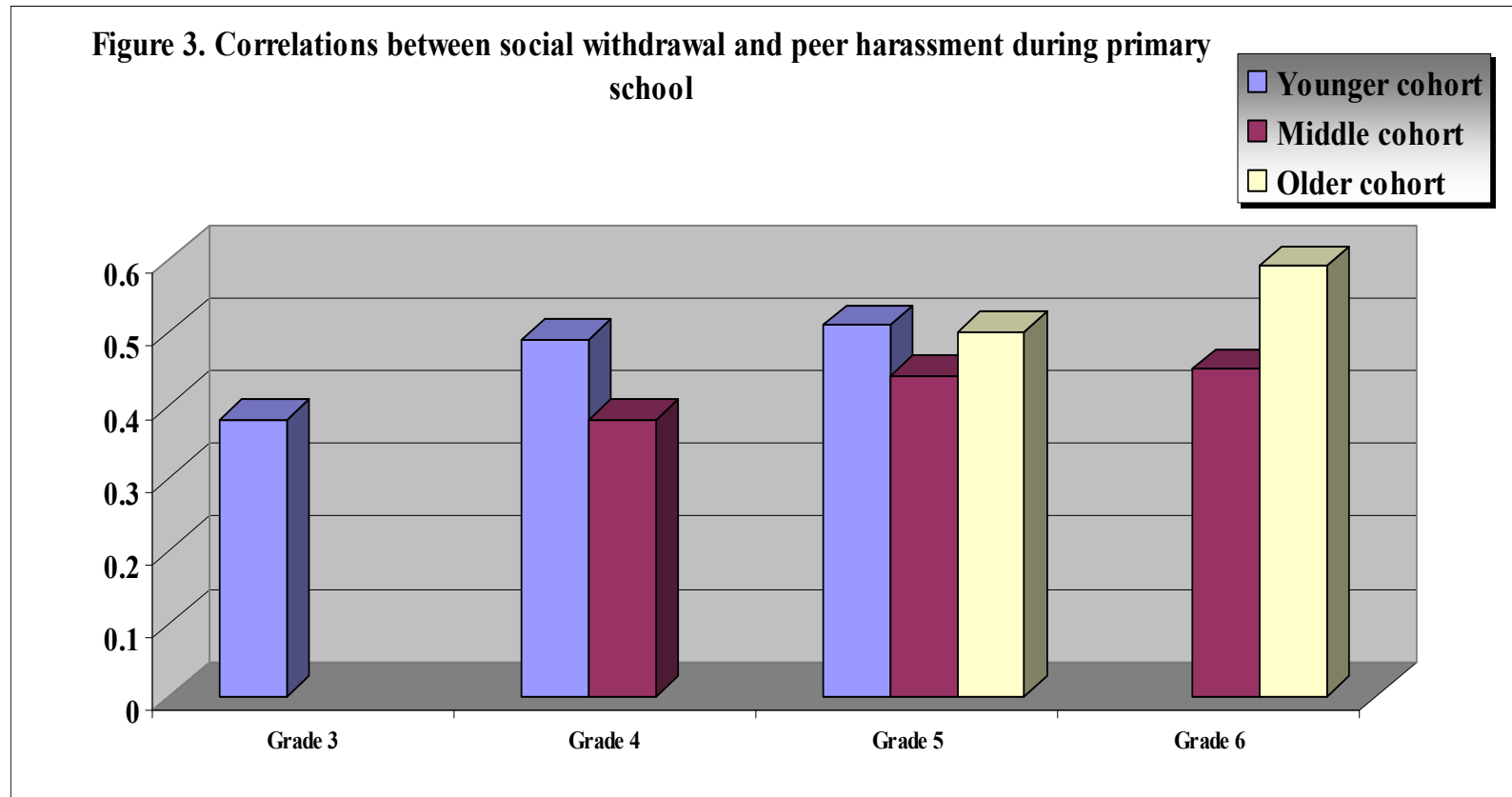
## BUT change in developmental norms: The *vanishing* link between aggression and peer harassment

Figure 2. Correlations between aggression and peer harassment during primary school



Adapted from Boivin, Hymel & Hodges (2001)

# Developmental norms change: The *growing* link between social withdrawal and peer harassment



Adapted from Boivin, Hymel & Hodges (2001)



## Future directions

- Beyond Grade 4. What about later development?
- Beyond face-to-face victimization. What about cyberbullying?
- Assessing possible GxE interaction in examining the impact of repeated victimization on internalized difficulties
- Biological transcription of these negative experiences
  - The role of HPA axis (physiological stress)
  - Possible epigenetic mechanisms