



Early Developmental
Experience Affects Some
Children More than
Others:
Differential
Susceptibility to
Environmental Influences

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TWO GOALS

Challenge the view that the adverse parenting and other developmental experiences that some boys receive *disrupts, disturbs and dysregulates* what would otherwise be normal development, resulting in problems with aggression, delinquency and the like.

Challenge the implicit claim that the factors and forces that undermine—or even enhance—child and adolescent development apply to all more or less equally.

GOAL 1



For quite some time now, parents, policymakers and developmental scholars have viewed child development through the lens of the Enlightenment lens, more or less presuming that the natural way for children to develop is to become secure, autonomous, achievement striving, capable of intimacy, and thus able to establish harmonious pair bonds and take good care of their own children when the time came.

I contend that this view ignores evolution by Darwinian natural selection, while romanticizing child development.

As the first goal of all living things is to pass genes on to descendants, an evolutionary perspective stipulates that there is no one—or best--way to get this fundamental goal of life done—and that how one does depends on the context of development.

Thus, what is, “natural” and “optimal” is that which gets this job done.

This way of thinking led me to advance, any number of years ago now, an evolutionary model of socialization, one which put reproduction in center stage.

This model included a unique prediction that no other model of socialization would even consider or be able to account for if it proved to be true, whether it be attachment theory, social-learning theory, life-course sociological thinking or any other prevailing perspectives on how and why children develop the way they do. The model and the unique prediction are outlined in the next slide.

Developmental Pathways of Divergent Reproductive Strategies

FAST

Marital discord
High stress
Inadequate \$ resources

Harsh, rejecting, insensitive
Inconsistent

Insecure attachment
Mistrustful internal
working model
Opportunistic interpersonal
orientation

**Early maturation/
Puberty**

Earlier sexual activity
Short-term, unstable pair bonds
Limited parental investment

A. Family Context

B. Child-rearing
Infancy/Early Childhood

**C. Psychological/
Behavioral Development**

D. Somatic Development

**E. Reproductive
Strategy**

SLOW

Spousal harmony
Adequate \$ resources

Sensitive, supportive, responsive
Positively affectionate

Secure attachment
Trusting internal working
model
Reciprocally-rewarding
interpersonal orientation

**Later maturation/
Puberty**

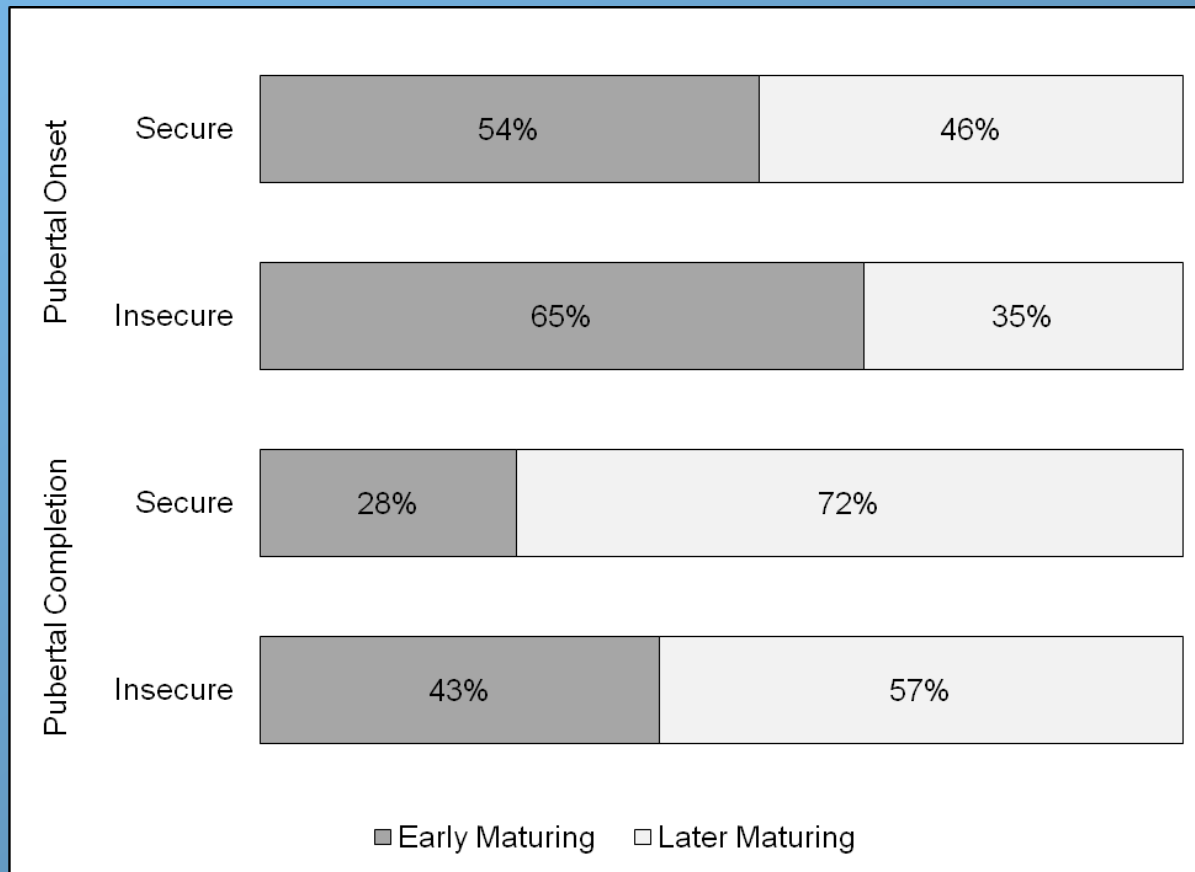
Later sexual activity
Long-term, enduring pair bonds
Greater parental investment



Evidence that different
types of developmental
adversity prove related
to pubertal timing as
predicted

Infant Attachment security and timing of female pubertal onset and completion

(Early onset: pubertal onset <10½ years; early completion: <13½ years.)





Available online at www.sciencedirect.com



Drug and Alcohol Dependence 88S (2007) S50–S59

www.elsevier.com/locate/drugaldep

Pubertal maturation and the development of alcohol use and abuse

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EFFECTS OF CHILD MALTREATMENT ON FEMALE PUBERTAL DEVELOPMENT*

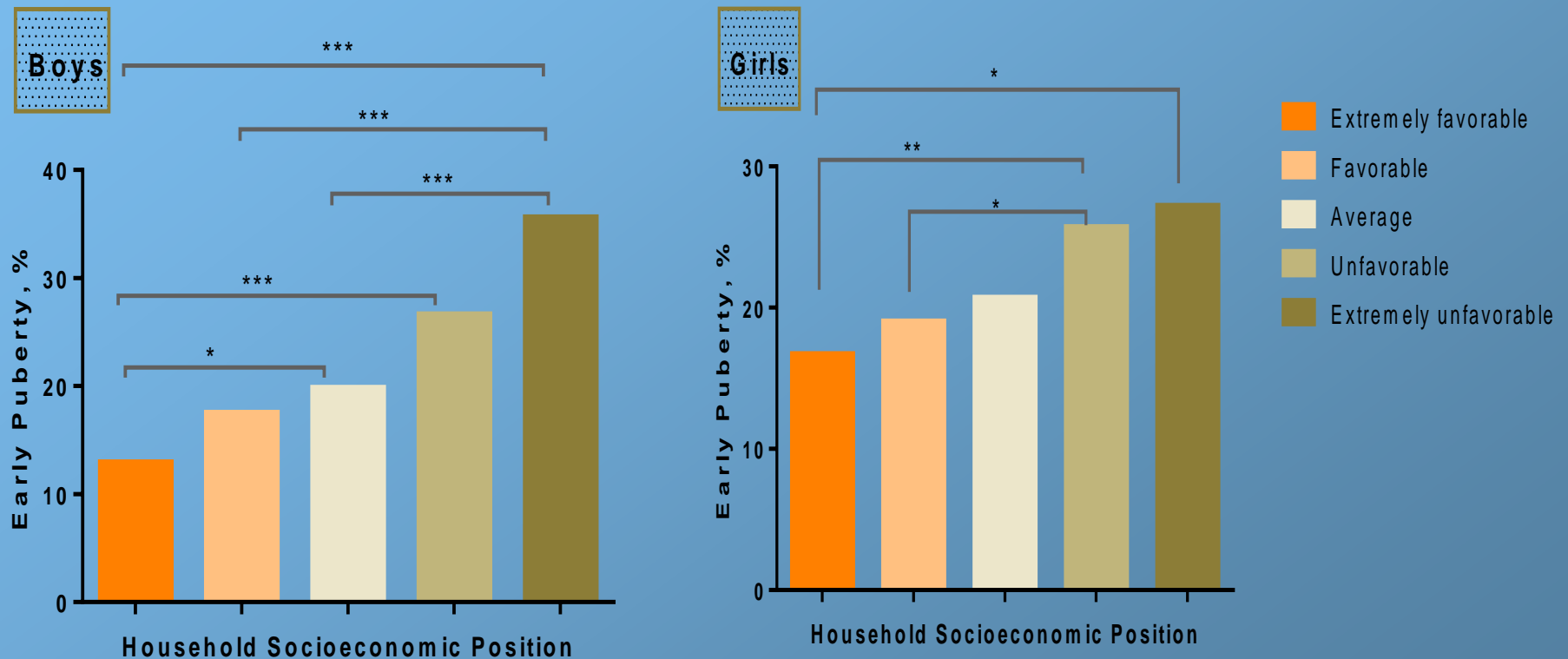
By age 13, 14.3% of sample had been maltreated according to own or parental report (4.3% physical abuse, 10.0% sexual abuse).

	<u>Mean Age of Tanner IV</u>
Maltreated	11.6 years (sd = 1.0)
Non-maltreated	12.1 years (sd = 1.3)

(OR: 0.75, $p < .011$)

***Pubertal maturation defined in terms of breast and pubic hair development and scored using Tanner Stage system, with Stage V being completed, adult-level of development**

Evidence that Boys are Affected, Too: Household SES (from 0-11 Yrs) And Early Pubertal Development



Sun, Y. (2017). Childhood social disadvantage and pubertal timing: A national birth cohort from Australia. *Pediatrics*, 139, e20164099.



BEYOND OBSERVATIONAL EVIDENCE:

TWO NATURAL EXPERIMENTS
CHRONICLING EFFECTS ON
PUBERTAL TIMING OR
ACTUAL REPRODUCTION

Earthquake Exposure and Early Puberty

A team of Chinese scientists took advantage of a widespread sexual and reproductive health survey administered to 12-20 year olds in 29 schools in 8 provinces that had and had not been exposed to the **great Wenchuan earthquake in 2008**. It included self-report measures to as to when girls had first period (menarche) and boys first ejaculation (oigarche). In a sample of almost 9,000 children who had not experienced these puberty developments at the time of the earthquake, results revealed that:

--earthquake exposure increased risk of early puberty—at age 11 or earlier—for both boys (first ejaculation) and girls (menarche)

War-Related Trauma and Reproductive Traits

Pesonen (2008) tested the life-history prediction that stressful early experiences would regulate reproductive development by taking advantage of a natural experiment. They evaluated whether a **traumatic separation from both parents during childhood** was associated with **reproductive traits later in life**, studying members of the 1934–1944 Helsinki Birth Cohort, including 396 **former war evacuees** from varying socioeconomic backgrounds, who were **sent unaccompanied by their parents to temporary foster families in Sweden and Denmark**, and 503 participants who had no separation experiences.

Former evacuees had earlier menarche, earlier first childbirth (men), more children by late adulthood (women), and shorter interbirth intervals (men), than the non-separated.

A. Pesonen et al., (2008) Reproductive traits following a parent-child separation trauma during childhood: A natural experiment during World War II. *American Journal of Human Biology*, 20, 345-351.

CONCLUSION



The primary goal of all living things is to pass genes on to descendants, either directly (e.g., children, grandchildren) or indirectly (nieces, nephews, cousins, kin).

This “biological gravity” structures the nature of child, adolescent and adult development, such that:

When risks to survival and well-being are encountered, the evolutionary strategic thing to do is mature early, engage in sex sooner, bear more children and care for them less intensively—because one’s power to shape their chances of surviving and reproducing in the future may be quite limited (due to poverty, racism,....). By having many offspring one increases the chances that some will eventually bear their own offspring, thereby enhancing parent and child reproductive success.

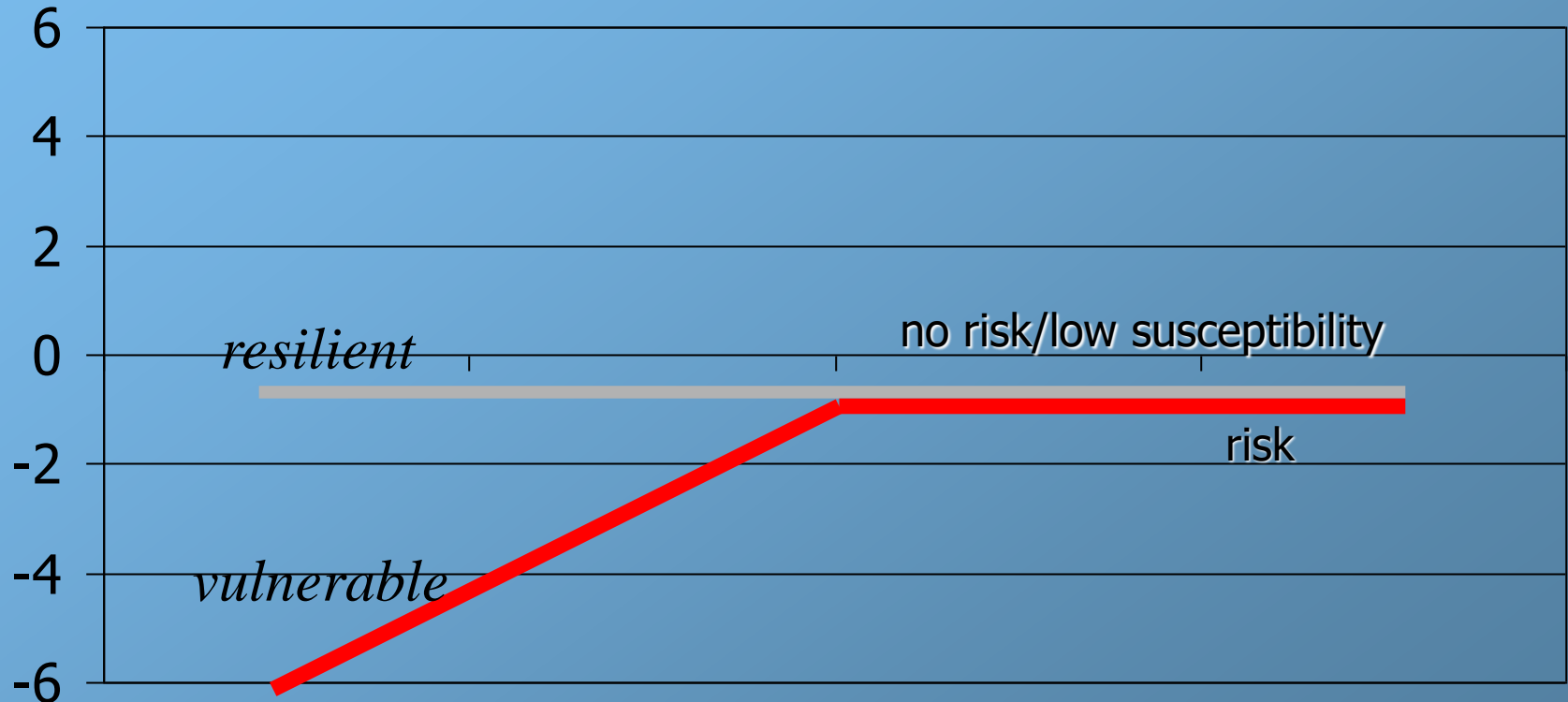
Challenge 2:

Differential Susceptibility
To
Environmental Influences

**The traditional theoretical
model of how
environmental factors,
including those experienced
early in development,
shapes human development
is the dual-risk or the
diathesis-stress model of
environmental action**

Diathesis-Stress

Positive
child outcome



Negative
child outcome

negative

→ **environment**

positive



**Two evolutionary questions
challenge the sensibility of
this model.**

QUESTION 1:

Why would nature craft a developmental system for generating disturbances in development?

QUESTION 2:

WHY WOULD NATURAL SELECTION CRAFT AN ORGANISM WHOSE FUTURE FUNCTIONING IS INFLUENCED BY ITS EARLIER EXPERIENCES?



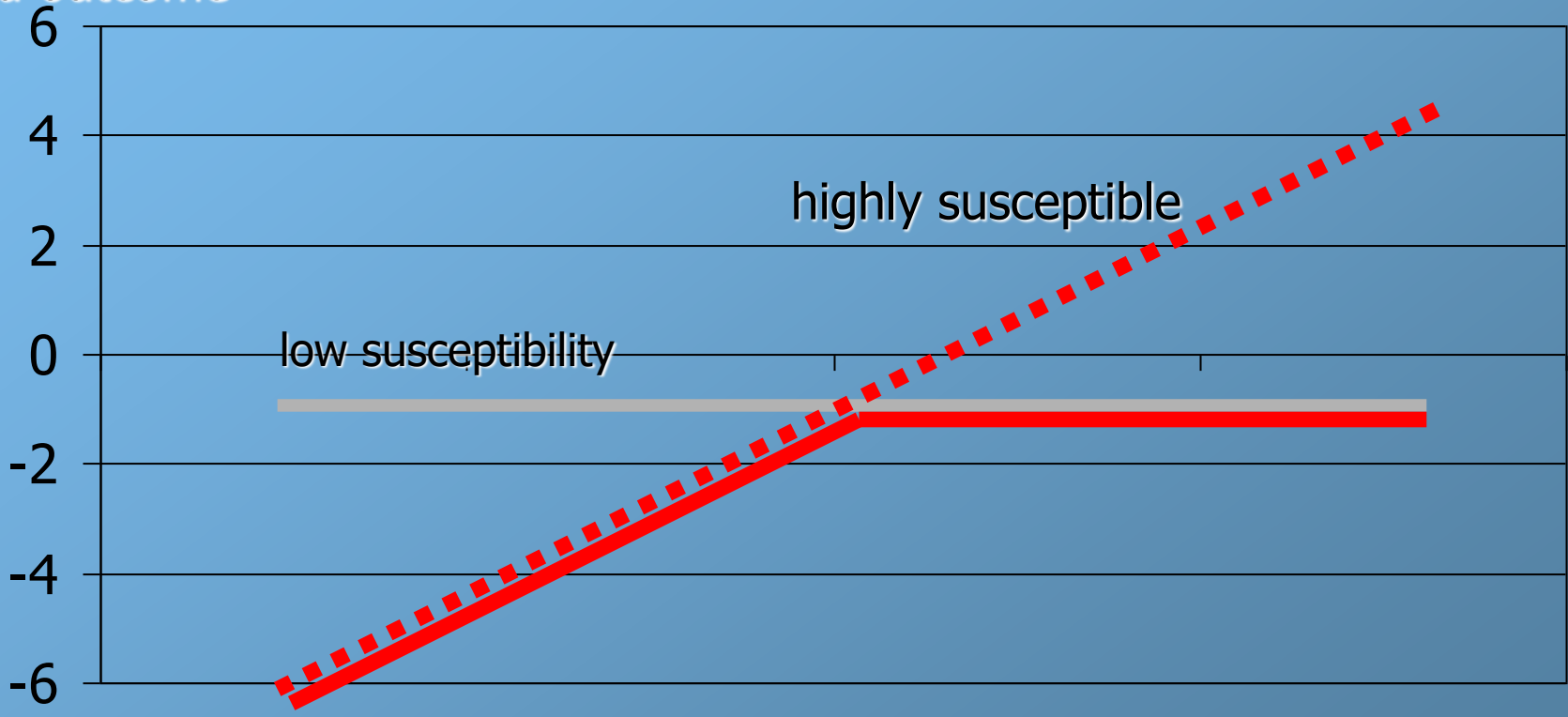
AFTER ALL, THE FUTURE IS UNCERTAIN, SO A MIS-MATCH BETWEEN EARLY AND LATER EXPERIENCE CAN OCCUR, THEREBY UNDERMINING REPRODUCTIVE SUCCESS DUE TO A BAD FIT BETWEEN HOW THE INDIVIDUAL HAS DEVELOPED AND THE WORLD THEY ENCOUNTER .



This observation led me to hypothesize that nature would “hedge its bets”, making some of us more and others less developmentally plastic, that is, susceptible to environmental influences, leading to the following alternative conceptual model of differential susceptibility to environmental influences

Diathesis-Stress vs. Differential Susceptibility

Positive
child outcome



Negative
child outcome

negative

→ environment

positive



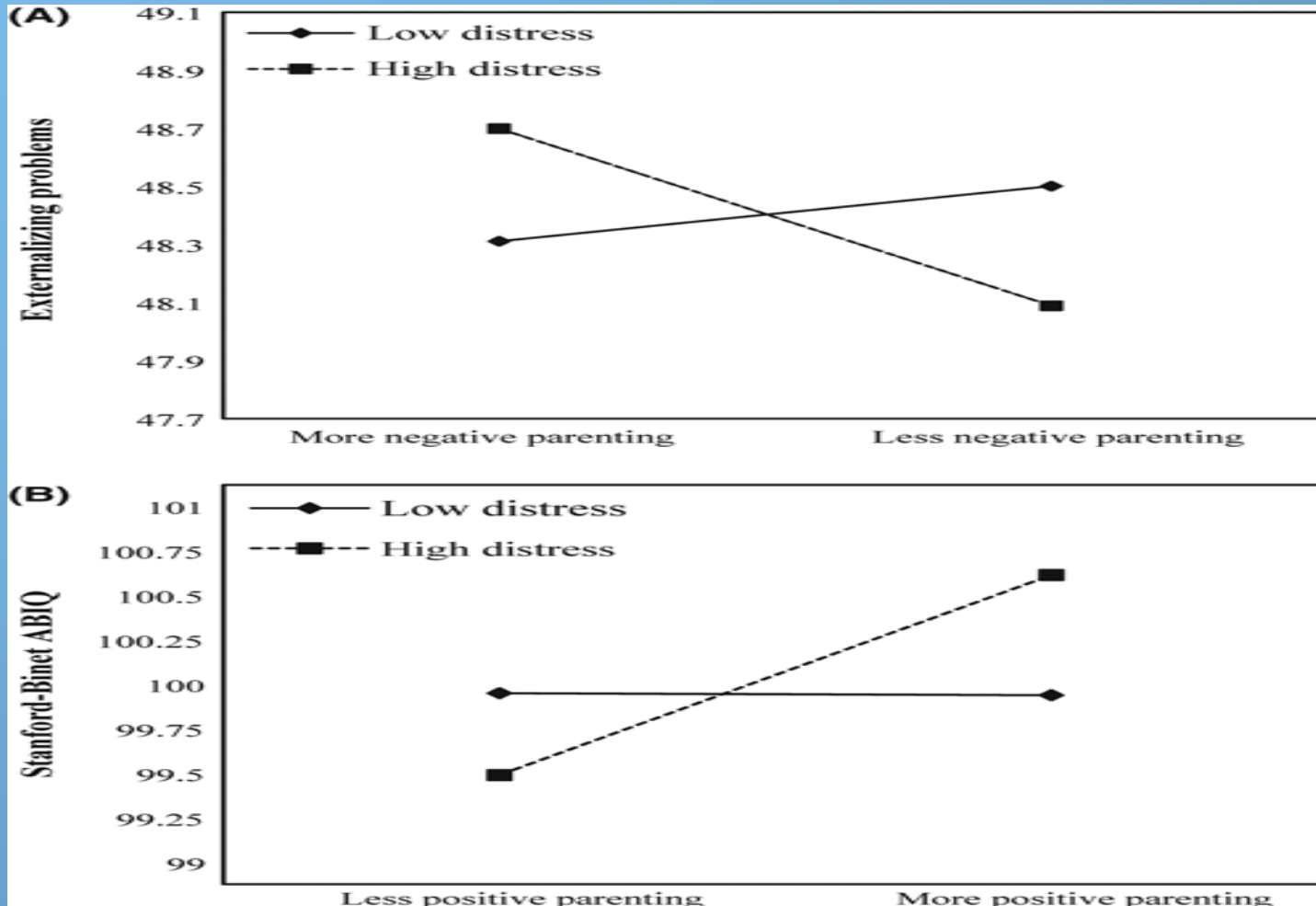
Observational Evidence of Differential Susceptibility



NEGATIVE EMOTIONALITY
AS A
SUSCEPTIBILITY MARKER

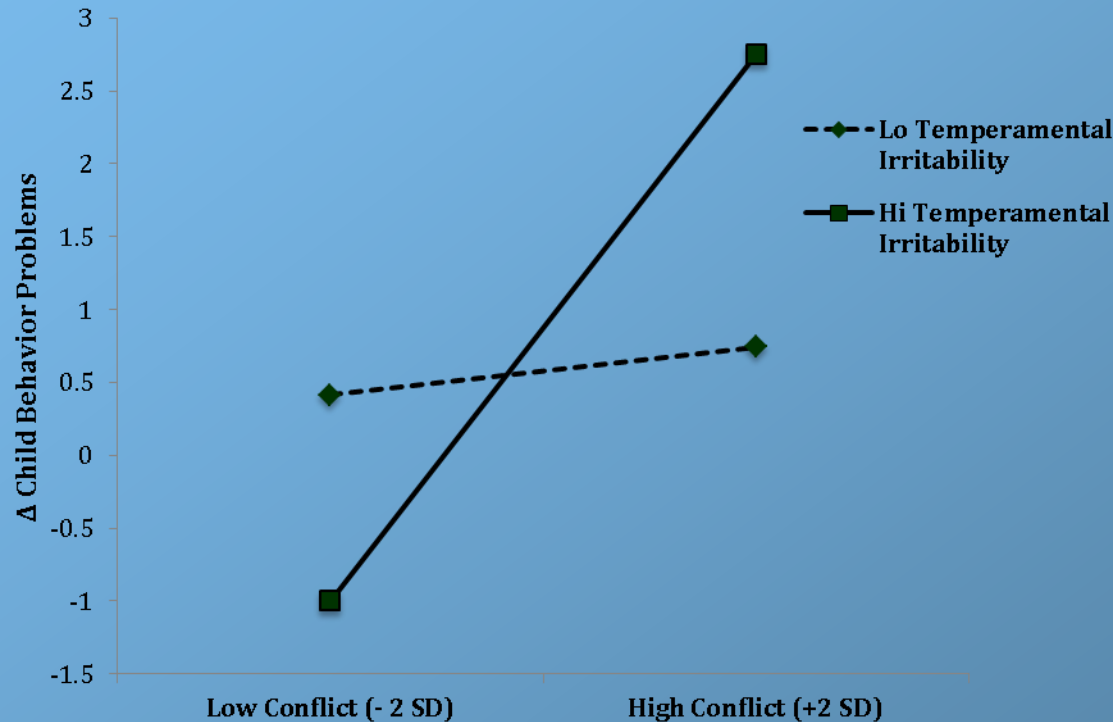


Maternal Positive and Negative Parenting (at 9 months) and Pre-term Infant Externalizing Problems and IQ at 36 Months Moderated by 9 Month Negativity





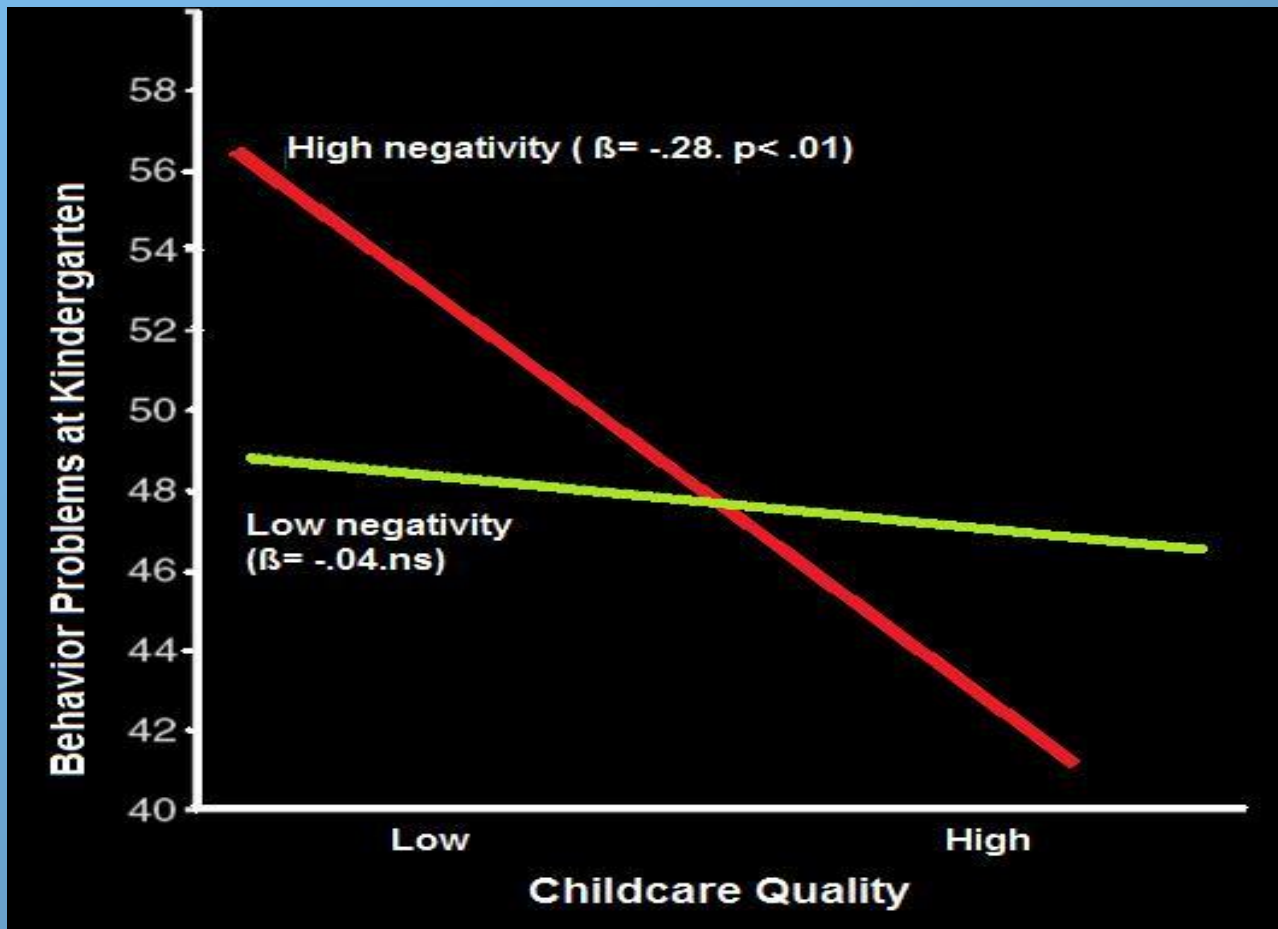
Marital Conflict and Change in Behavior Problems From Age 2-3 Moderated by Temperamental Irritability



Low conflict: constructive approaches to dealing with disagreements.
High conflict: physical violence.



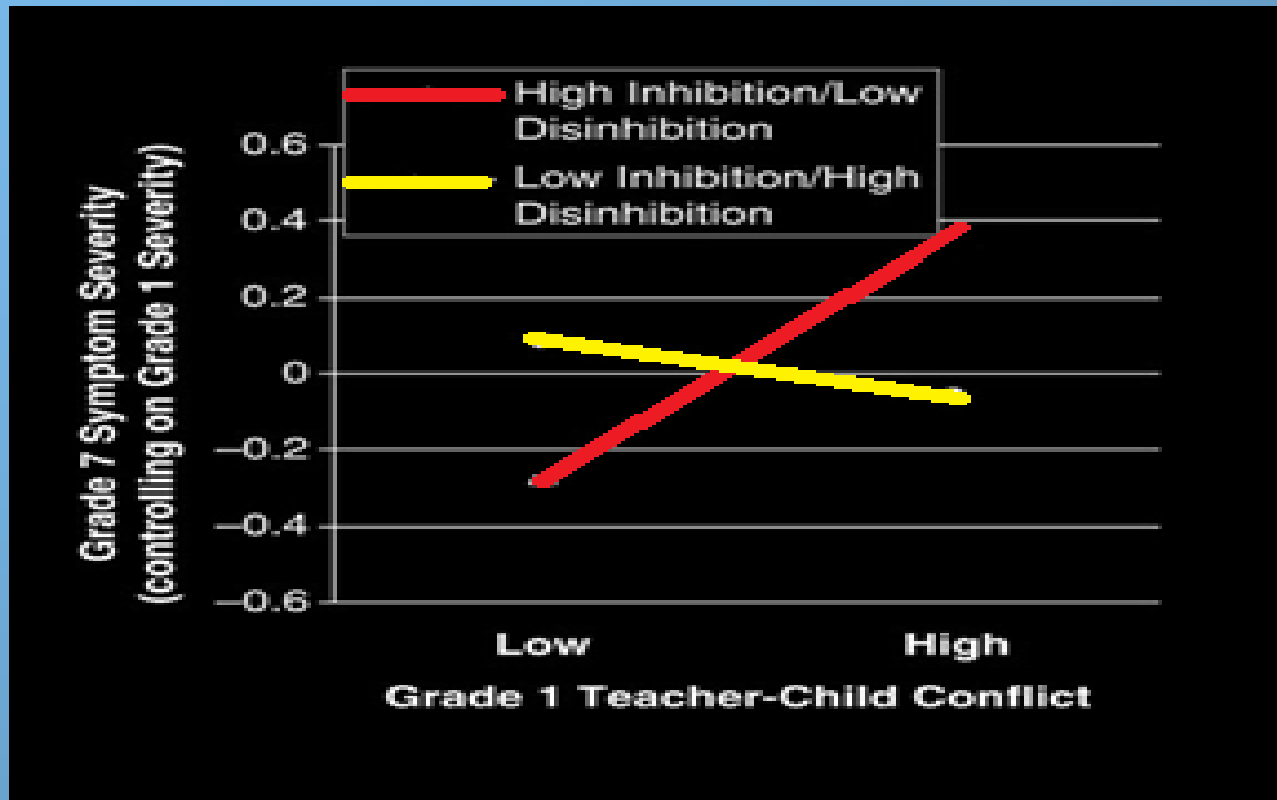
Observed Quality of Child Care and Teacher-Rated Behavior Problems in Kindergarten



Pluess, M., & Belsky, J. (2009). Differential Susceptibility to Rearing Experience: The Case of Childcare. *Journal of Child Psychology and Psychiatry and Allied Disciplines*.



Grade 1 Teacher-Child Conflict and Symptom Severity Change from Grade 1-7 Moderated by Reactive-Inhibited Temperament



Essex, M. et al. (2011). Biological sensitivity to context moderates the effects of the early teacher-child relationship on the development of mental health by adolescence. *Development and Psychopathology*, 23, 149-161.



BEYOND TEMPERAMENT :
*Genes as Moderators of
Environmental Effects
(GXE)*

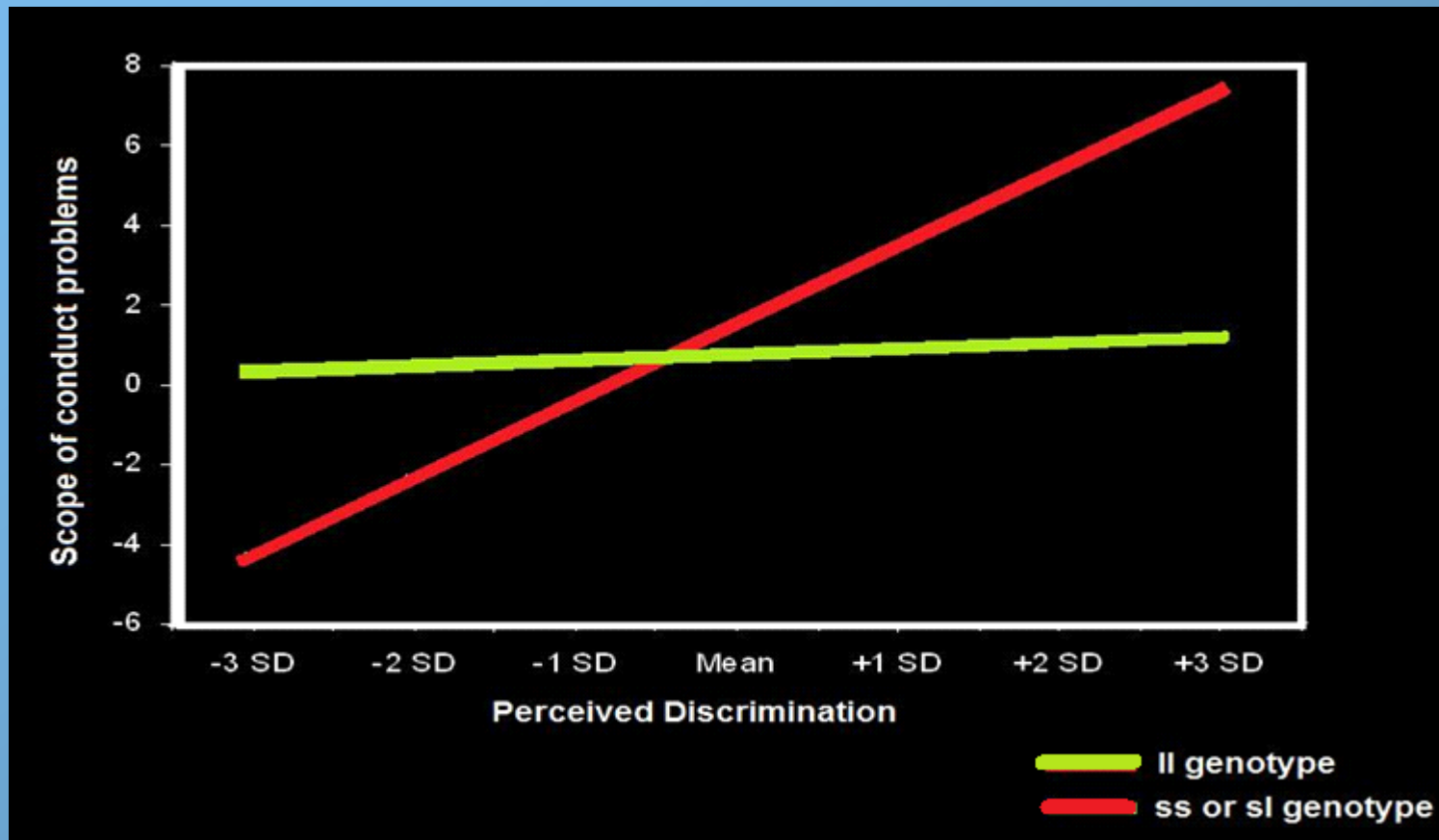


The 5-HTTLPR Gene

The serotonin-transporter gene (5-HTTP) is a good gene to consider because there is some evidence that infants carrying the short (vs. long) allele are more negatively emotional as newborns (Auerbach et al., 2005). Short alleles have also been linked to depression in females and vulnerability to the depression fostering effects of negative life events in adulthood (Caspi et al., 2003).



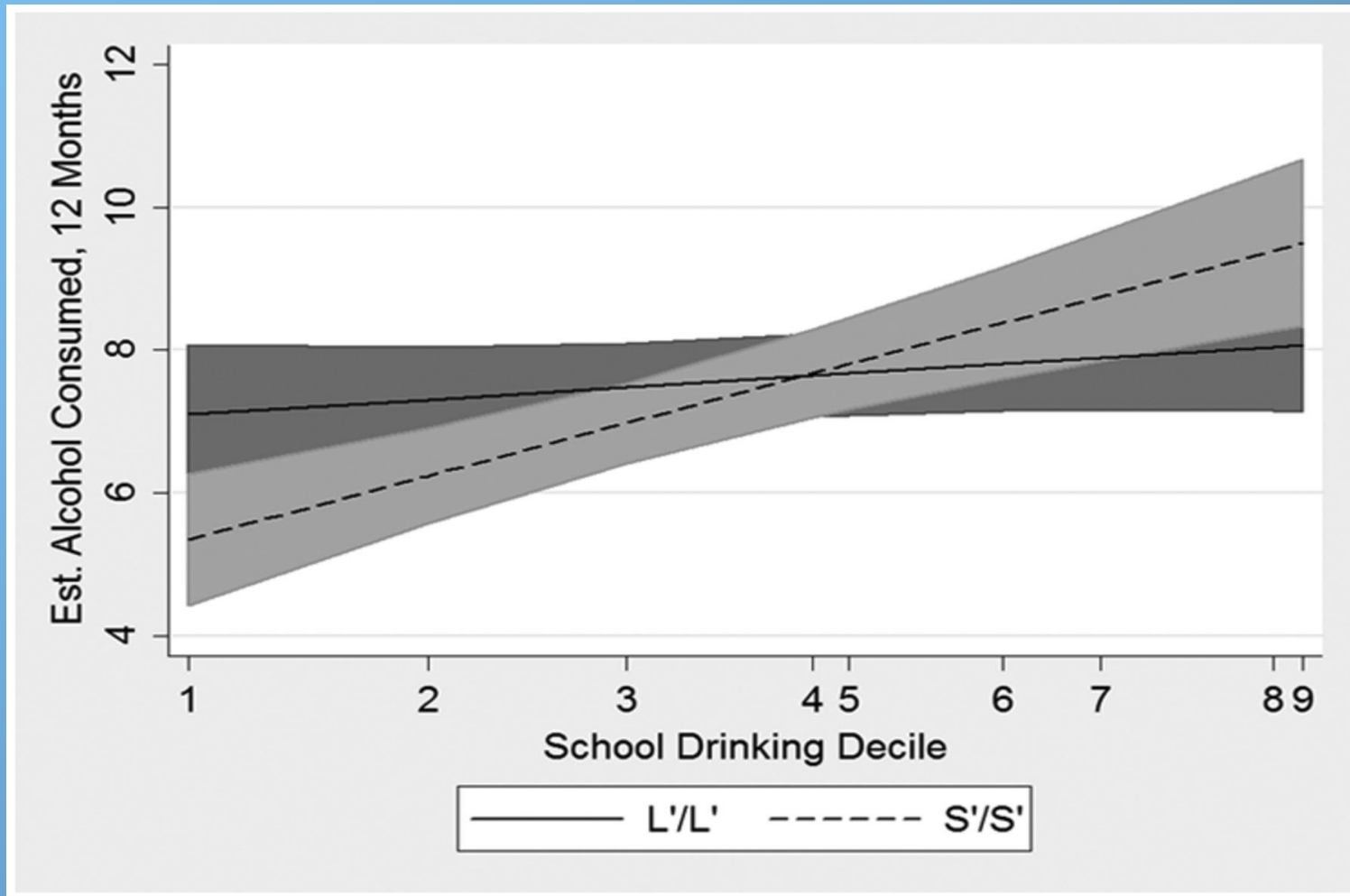
Perceived Racial Discrimination and Adolescent Conduct Problems Moderated by 5-HTTLPR



Brody, G.H., et al. (2011). Perceived discrimination, serotonin transporter linked polymorphic region status, and the development of conduct problems. *Development & Psychopathology*, 23, 617-627.



School-Level Drinking and Adolescent Alcohol Consumption Moderated by 5-HTTLPR



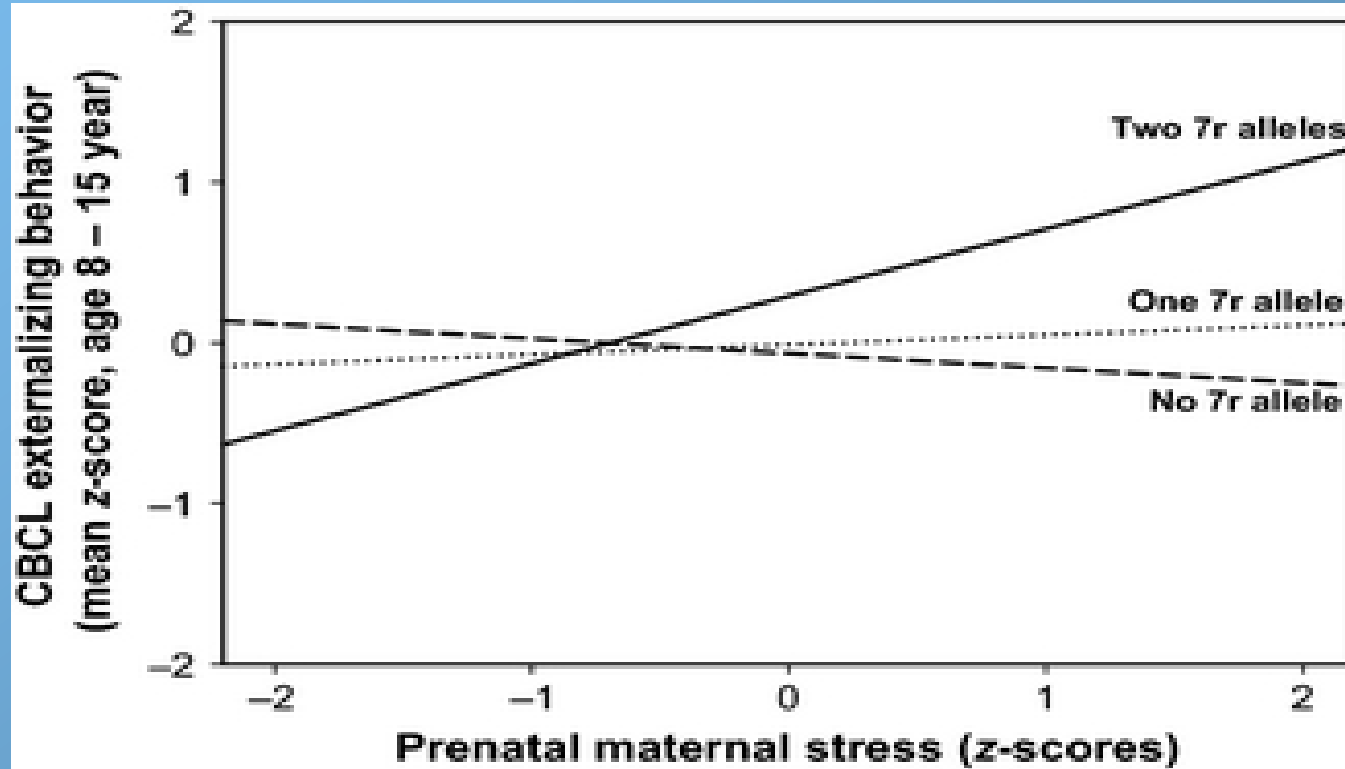
Daw, J. et al. (2013). Genetic sensitivity to peer behaviors: 5HTTLPR, smoking and alcohol consumption. *Journal of Health and Social Behavior*.



GXE: The DRD₄ Gene

The *DRD₄* gene codes for a type of dopamine receptor, with the dopaminergic system involved in attentional, motivational, and reward mechanisms in the brain. One variant of this gene, the 7-repeat *DRD₄* allele, has been linked to lower dopamine reception efficiency, and thus to ADHD and externalizing problems in children, as well as behavioral difficulties, including substance abuse and aggression, in adulthood, .

Prenatal Stress and Child-Adolescent Anti-Social Behavior Moderated by DRD₄

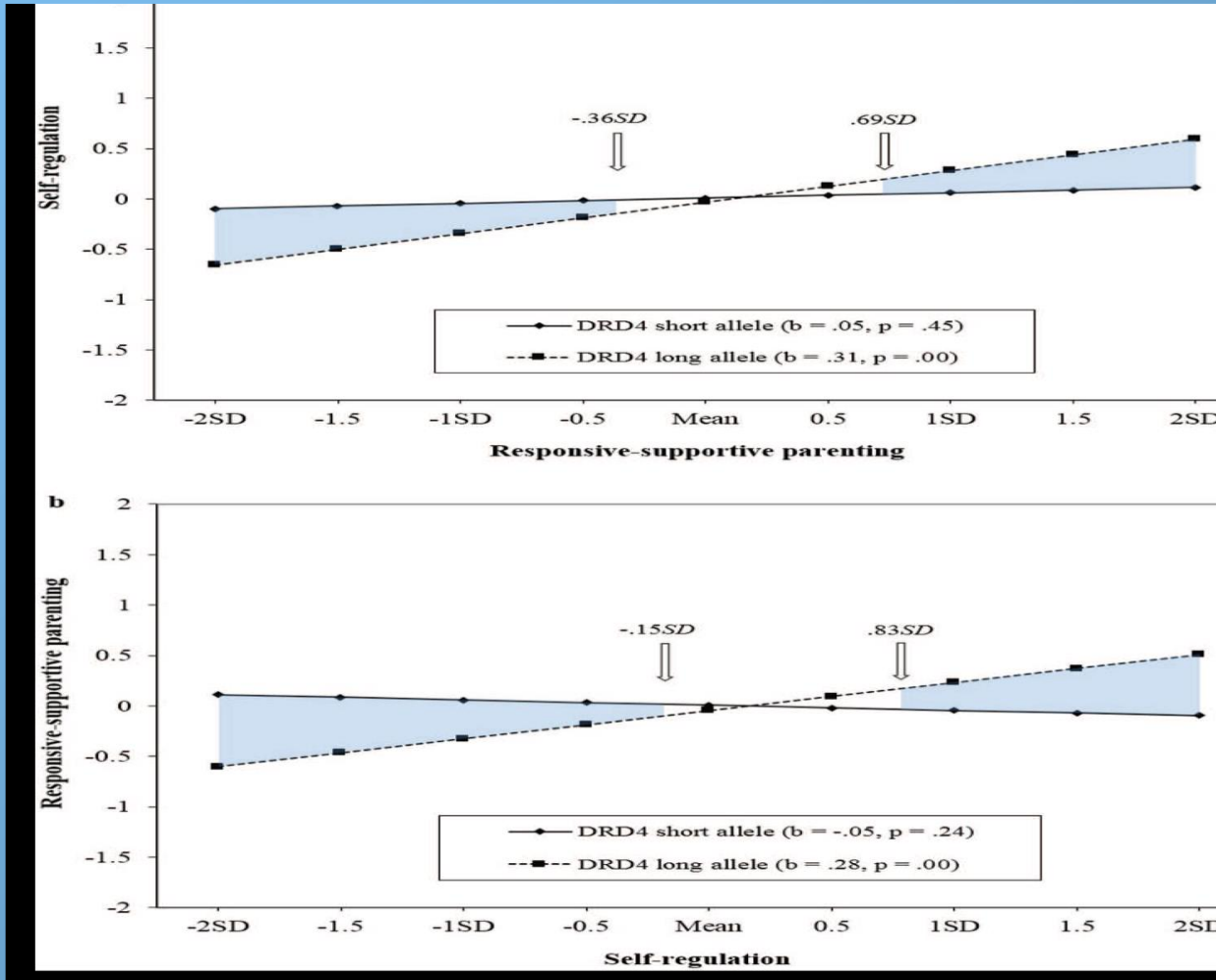


Zohsel, K. et al. (2014). Mothers' prenatal stress and their children's antisocial outcomes—a moderating role for the Dopamine D₄ Receptor (DRD₄) gene. *Journal of Child Psychology and Psychiatry*, 55, 69-76..

Responsive-Supportive Parenting and Adolescent Self Regulation Moderated by DRD4 (TOP GRAPH)

Parenting → Child
Self Regulation

Child Self-
Regulation →
Parenting



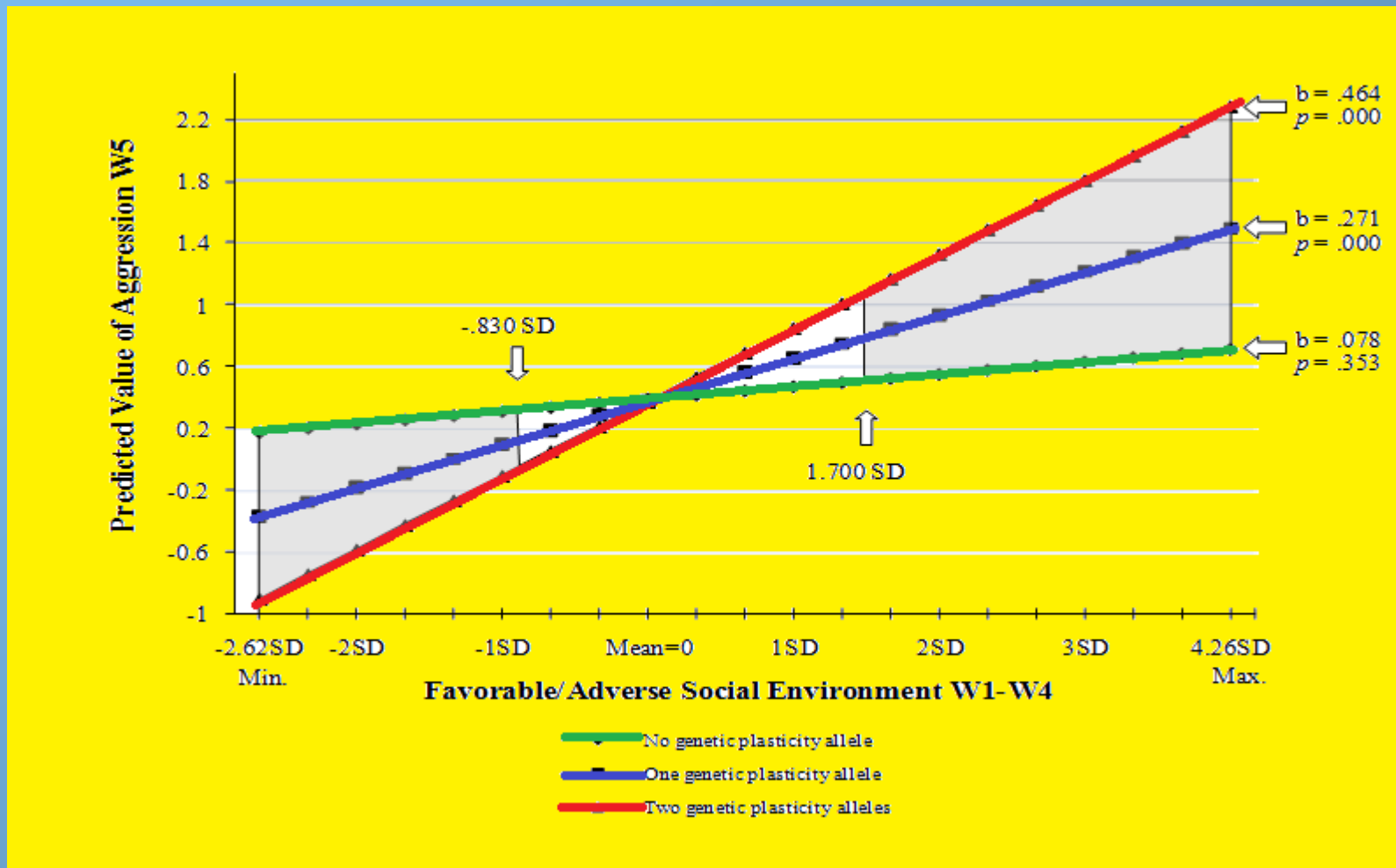


BEYOND SINGLE CANDIDATE GENES:

**MULTIPLE GENES
AS MODERATORS OF
ENVIRONMENTAL INFLUENCE**

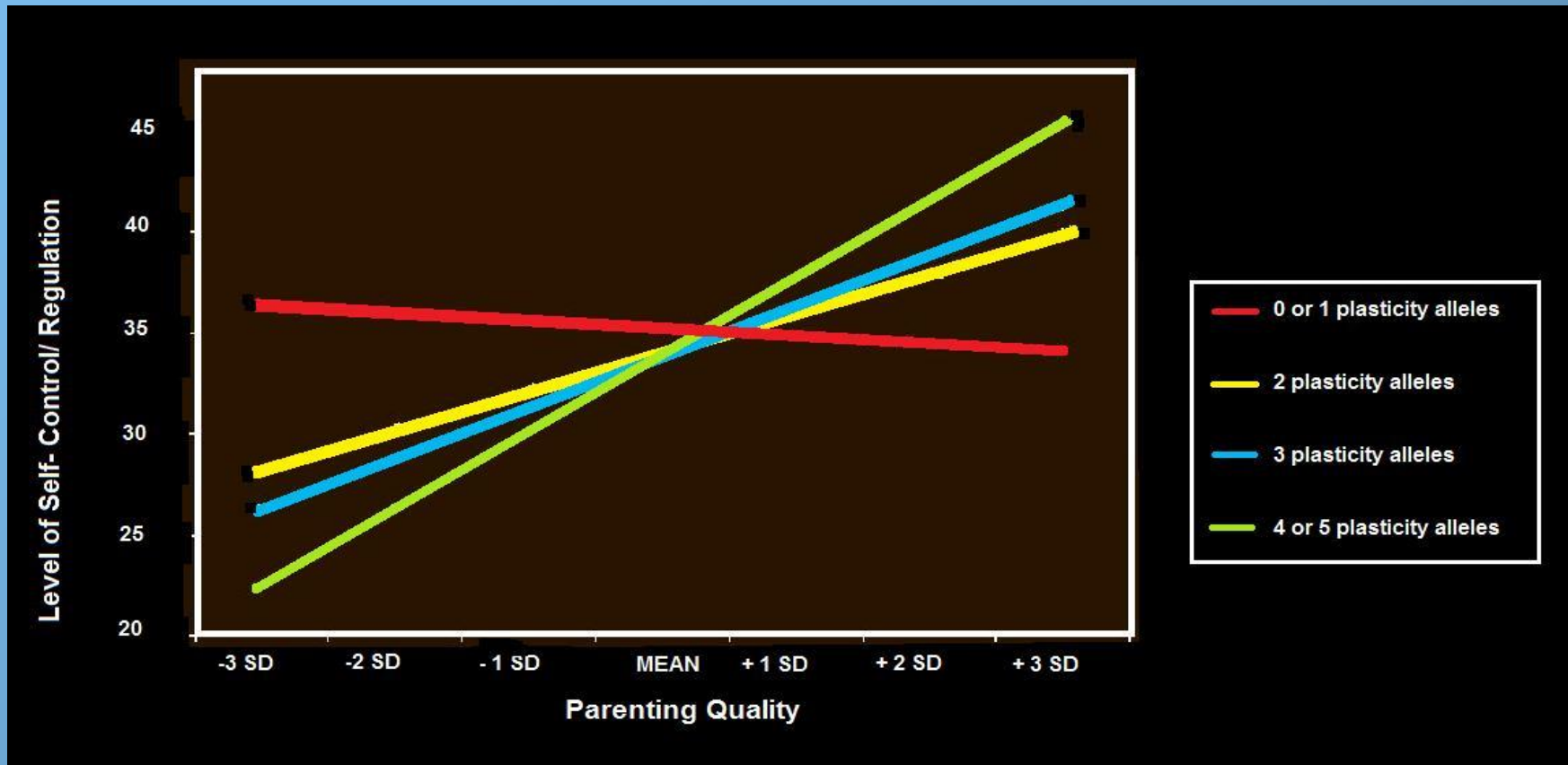


Social Environment and Adolescent Aggression Moderated by Cumulative Genetic Plasticity (5-HTTLPR and DRD4)



Simons, R.L. et al. (2011). Social environmental variation, plasticity genes, and aggression: Evidence for the differential susceptibility hypothesis. *American Sociological Review*, 76, 883-912.

Parenting and Adolescent Boys' Self-Control/Regulation Moderated by Cumulative Genetic Plasticity (DAT₁, DRD₂, DRD₄, 5HTTLPR, and MAOA)

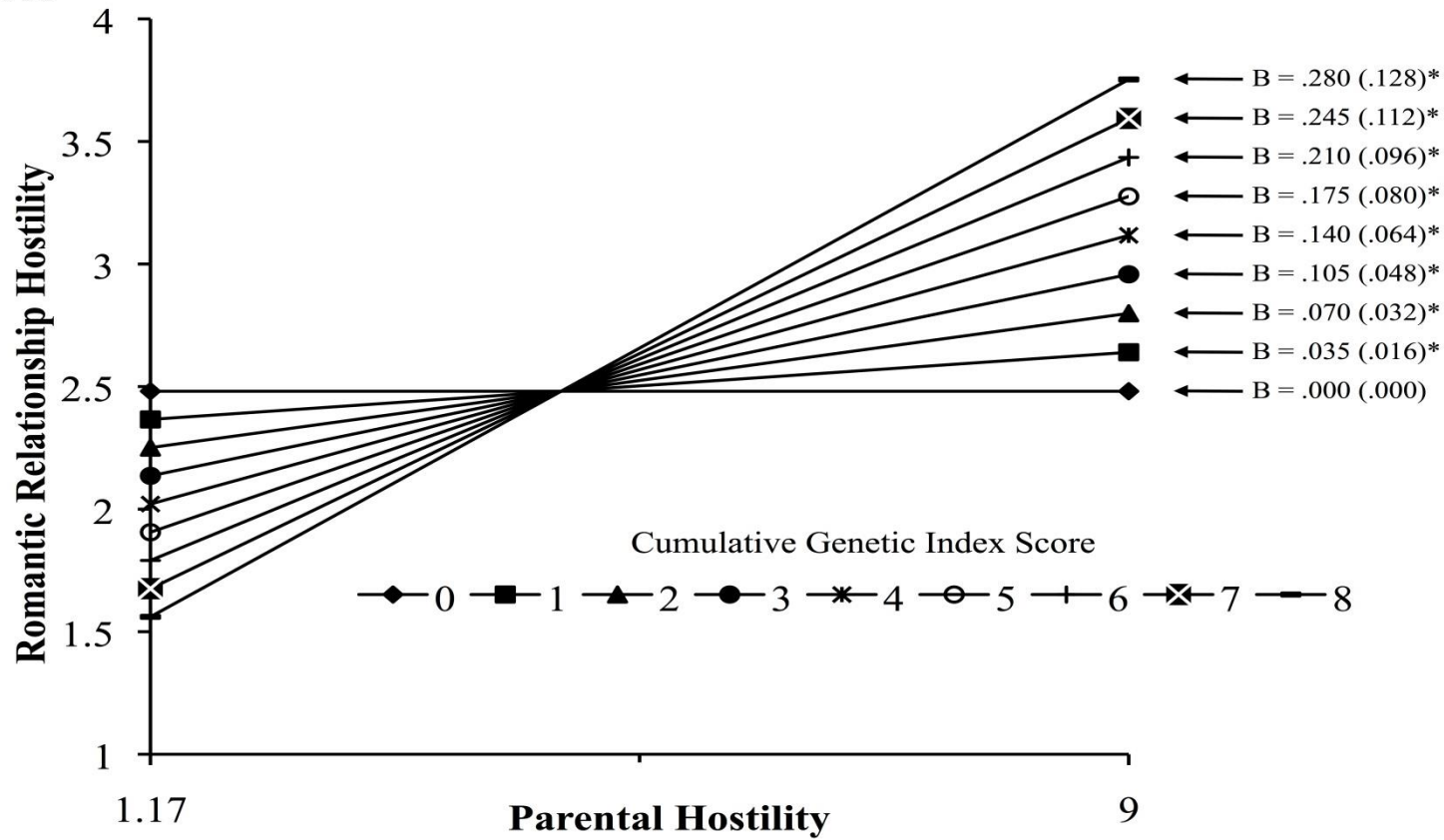


Belsky, J., & Beaver, M. (2011). Cumulative-Genetic Plasticity, Parenting and Adolescent Self-Control/Regulation. *Journal of Child Psychology & Psychiatry*.

Parenting in Adolescence and Hostile Romantic Relations in Young Adulthood Moderated by Cumulative Genetic Plasticity (5HTT, ANKK/DRD2, DRD4, DAT, COMT)



Panel A

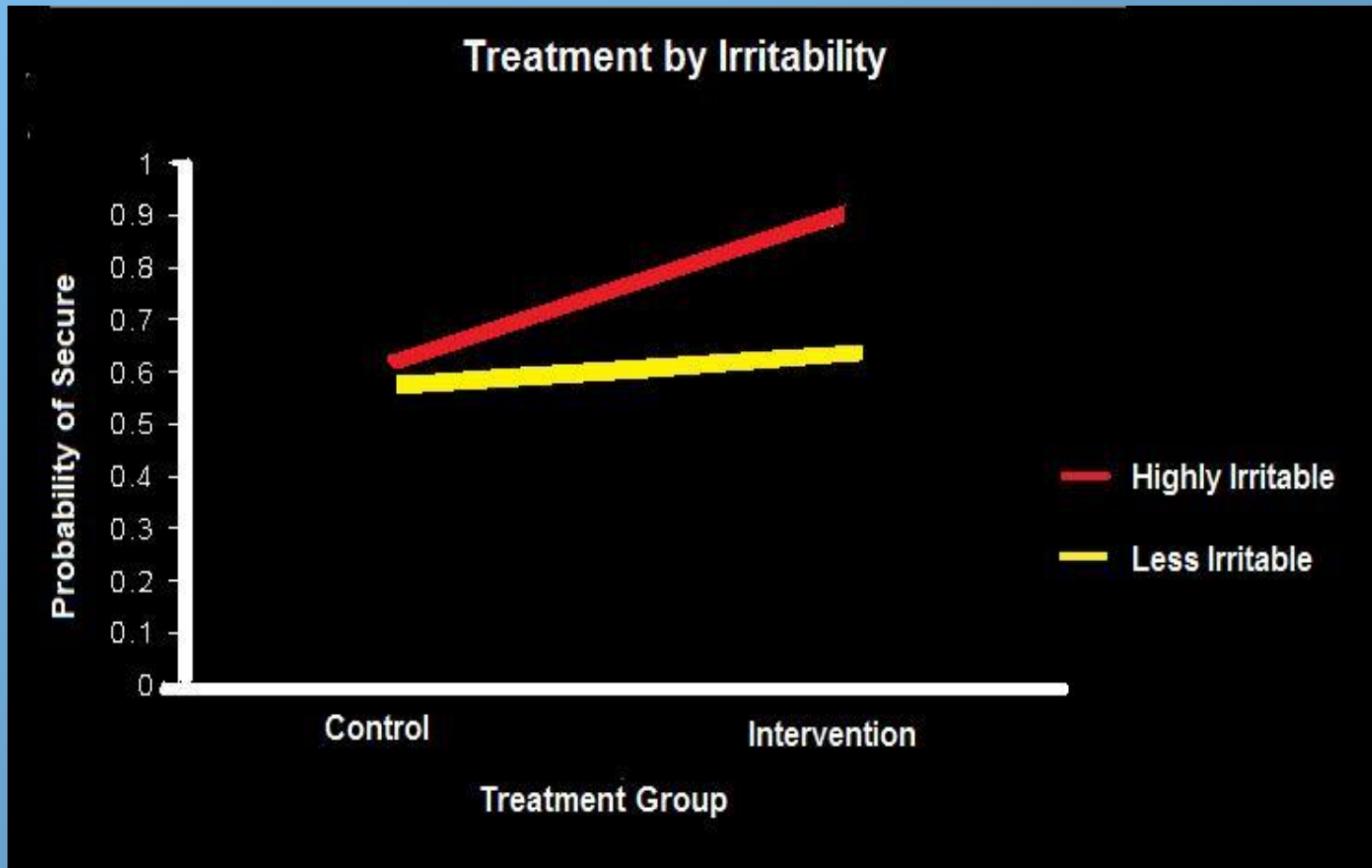




**CAN WE MOVE
BEYOND
CORRELATIONAL EVIDENCE
TO EXPERIMENTAL DATA?**



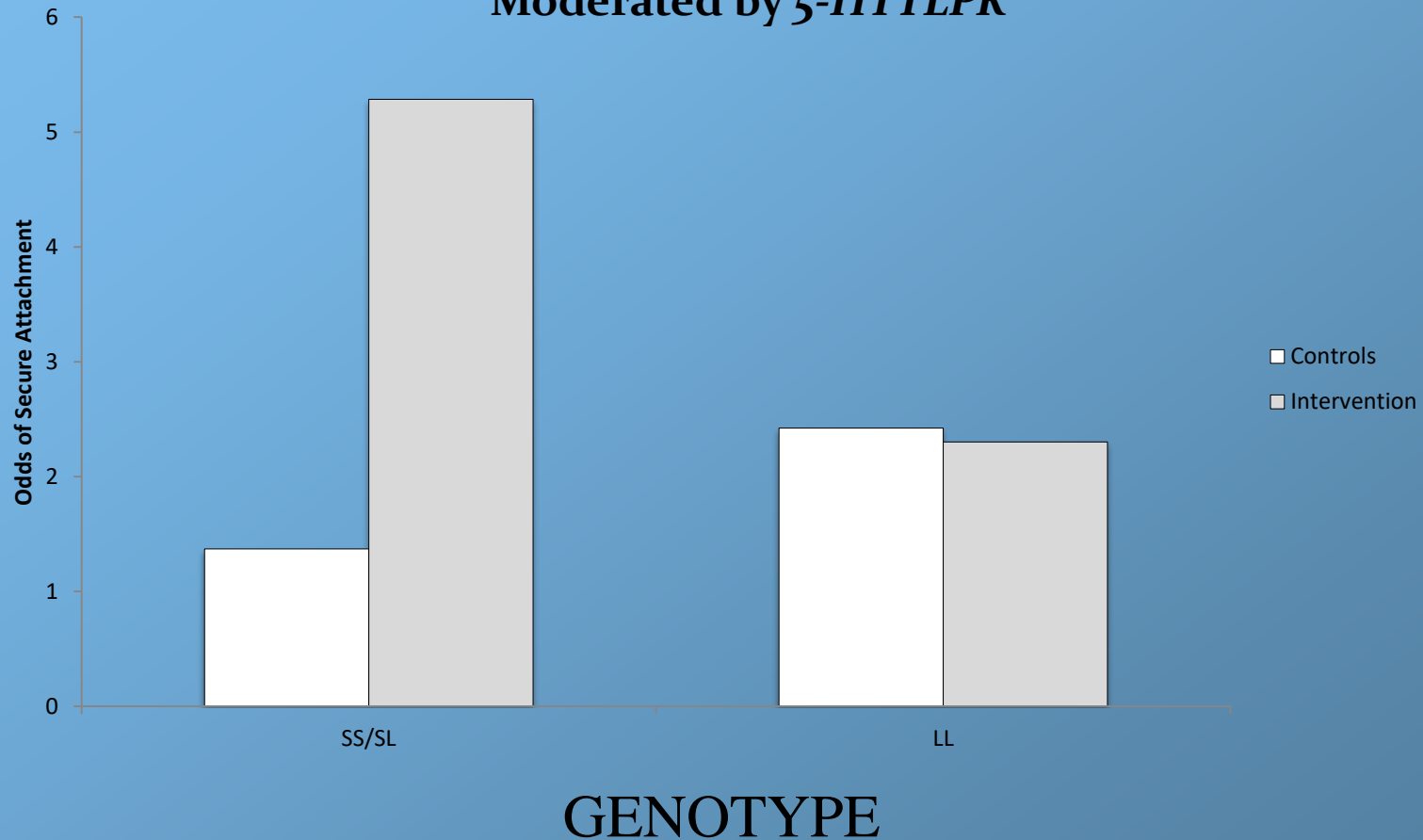
Experimental Enhancement of Maternal Sensitivity via Circle of Security Intervention: Effects on Attachment Security Depend on Newborn Irritability



Cassidy, J., et al. (2011). Enhancing infant attachment security: An examination of treatment efficacy and differential susceptibility. *Development and Psychopathology*.



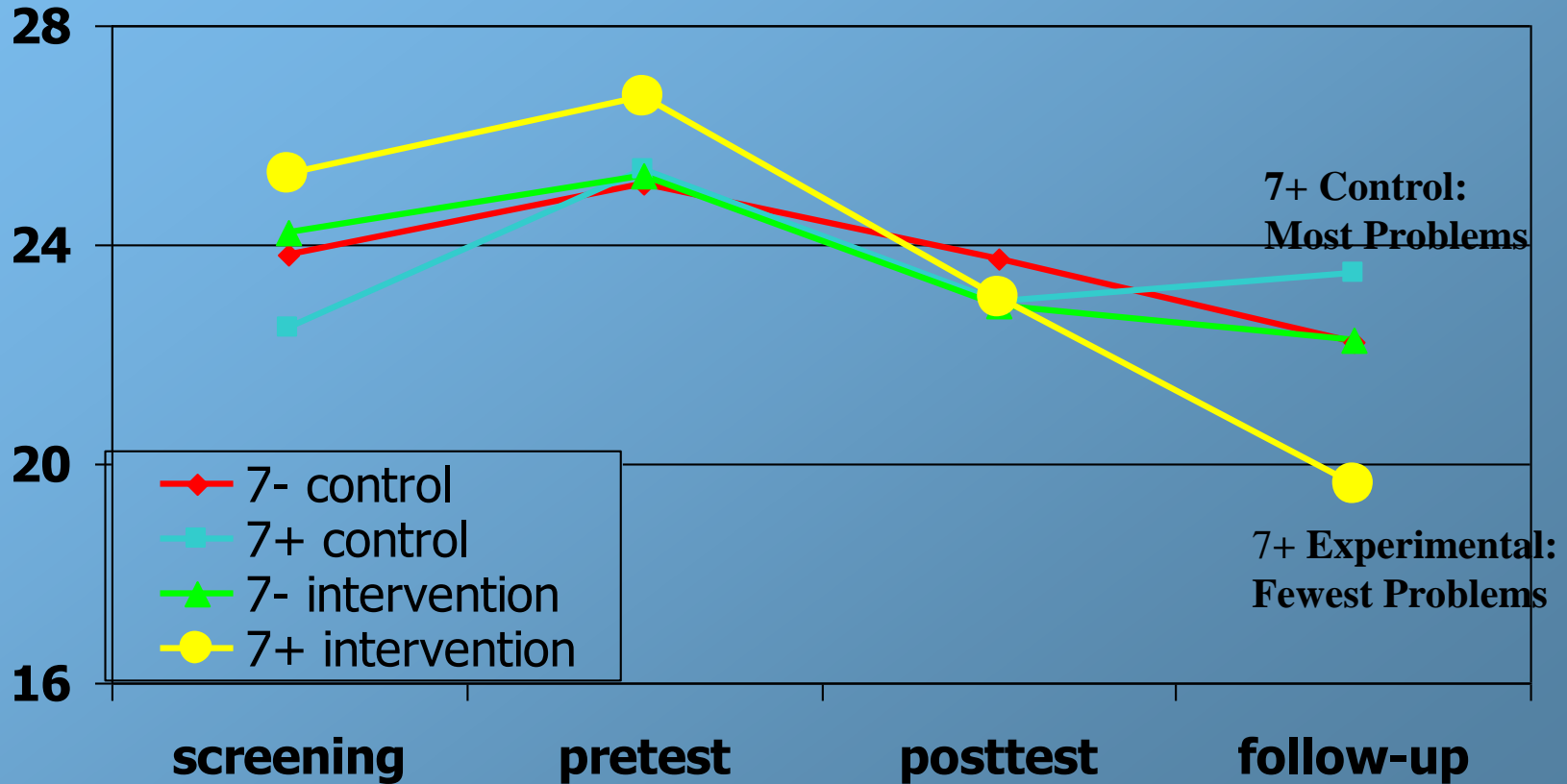
Experimental Enhancement of Maternal Sensitivity Via Home Visiting In South Africa from Pregnancy to 6 mos.: Effects on Attachment Security Moderated by 5-HTTLPR





Development of Externalizing Behavior for Video-Intervention and Control Groups By DRD47-Repeat Allele

CBCL Externalizing



Bakermans-Kranenburg et al. (2008). Experimental evidence for differential susceptibility: Dopamine D4 receptor polymorphism (DRD4 VNTR) moderates intervention effects on toddlers' externalizing behavior in a randomized controlled trial. *Developmental Psychology*, 44, 293-300.

Family Check Up Intervention and Conduct Problems Moderated by Polygenic Score (for aggression based on GWAS)

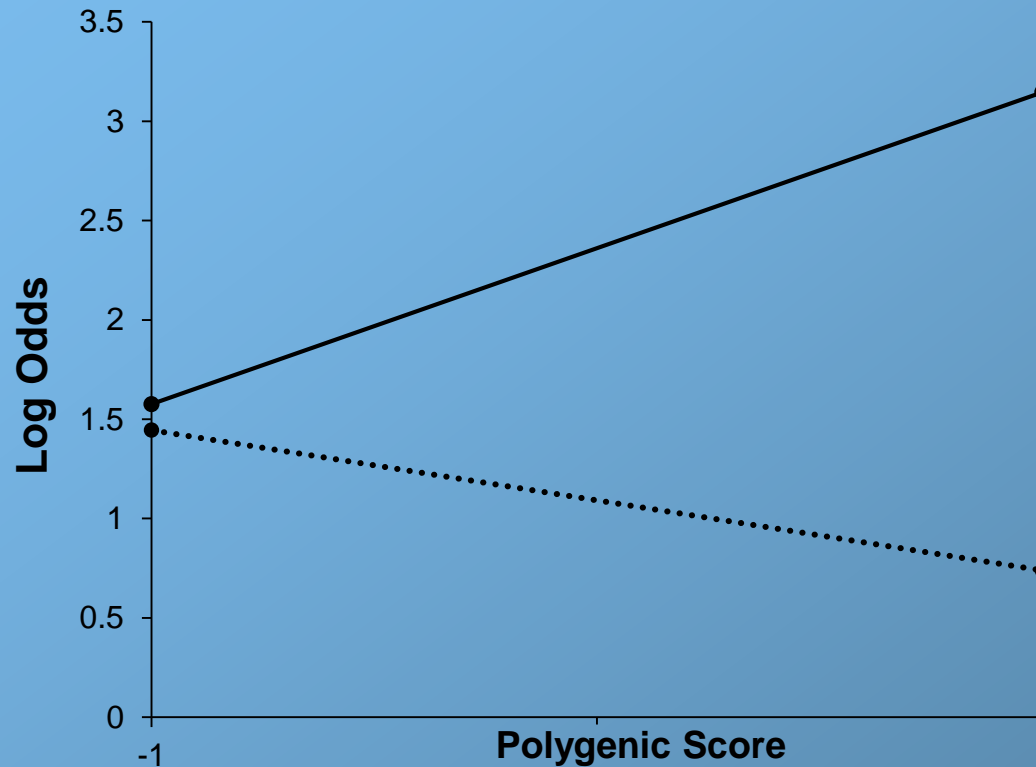


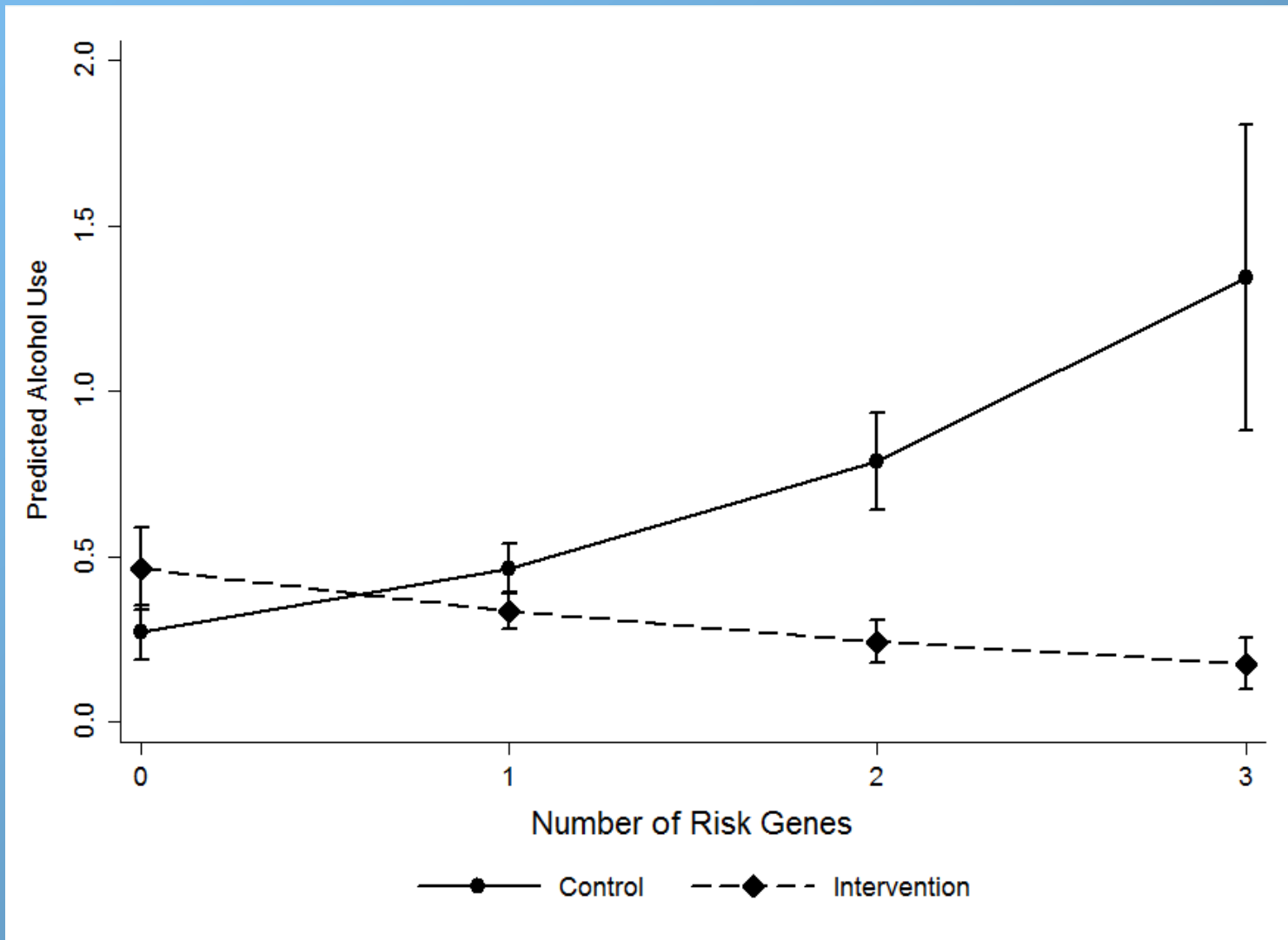
Figure 2. Polygenic score by intervention interaction predicting Conduct Problem (CP) group. The y-axis indicates the likelihood of being in the Persistently Low vs. Persistently High CP group.

Based on data in Shaw, D.S., Galán, C.A., Lemery-Chalfant, K., Dishion, T.J., Wilson, M.N. (2019). Early predictors of children's early-starting conduct problems: Family, genetic, and intervention effects. *Development and Psychopathology*.

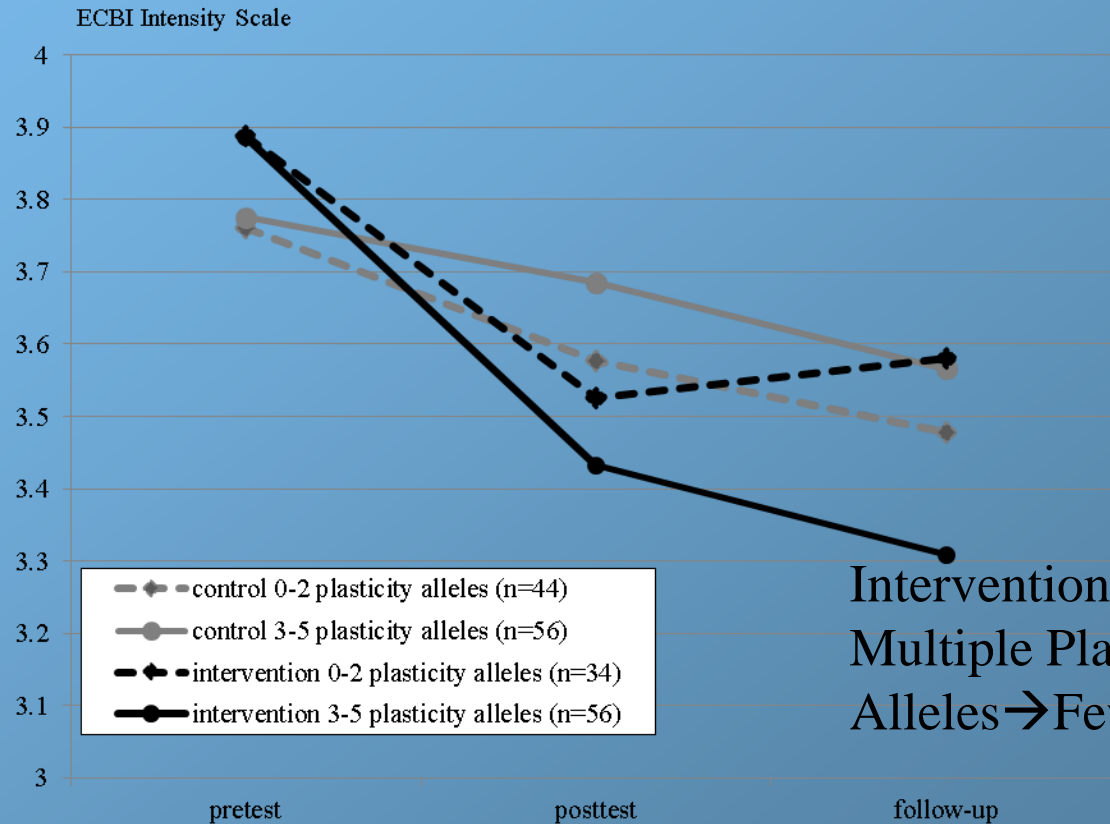


Multiple Genes and Experimental Intervention

Intervention Effects on African-American Teens Alcohol Use Moderated by Multiple GABAergic and Dopaminergic Genes



EFFECTS OF INCREDIBLE YEARS ON REDUCTION IN BOYS' EXTERNALIZING MODERATED BY POLYGENIC DOPAMINERGIC INDEX (*DRD4*, *DRD2*, *DAT1*, *MAOA*, and *COMT*)



**Intervention+
Multiple Plasticity
Alleles → Fewest Problems**

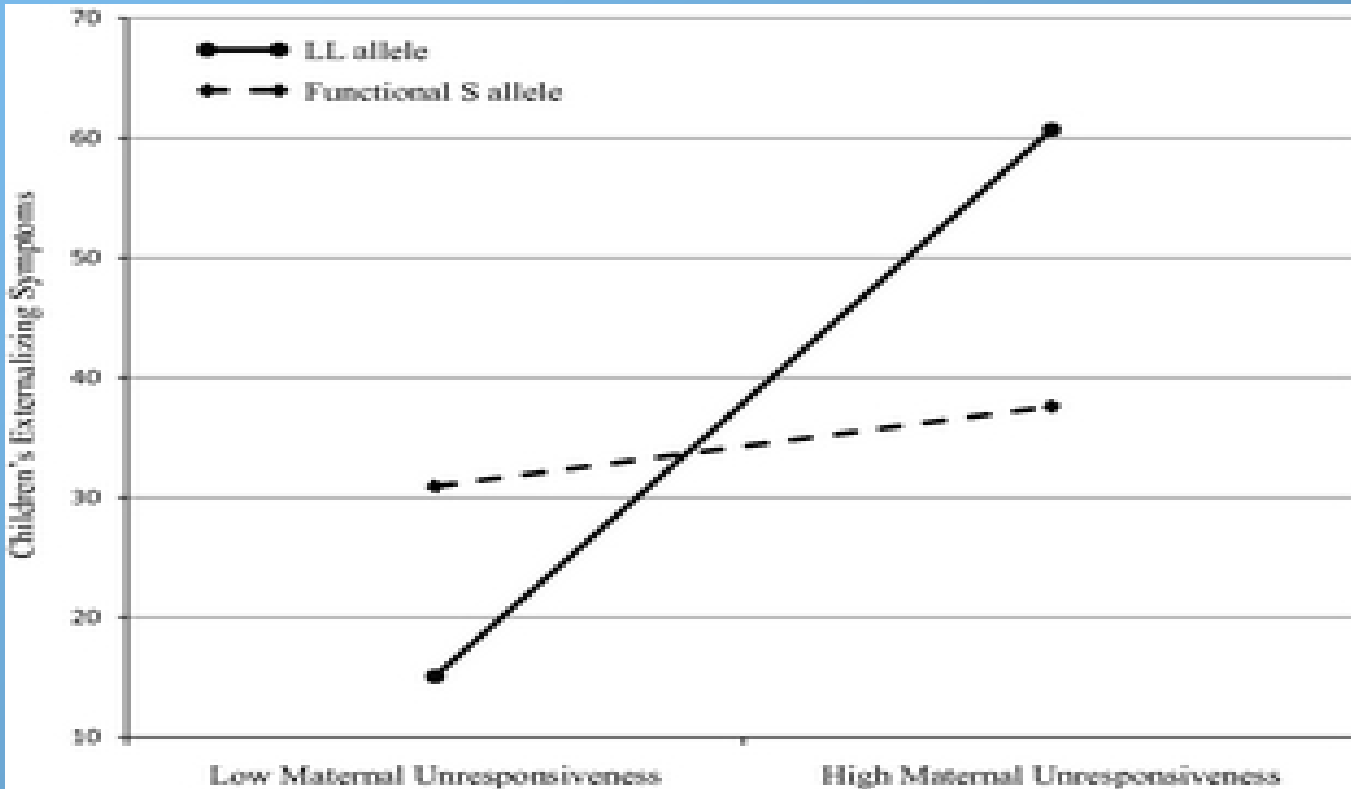


CONCLUSIONS

--There may be racial and ethnic differences in genetic influence, so populations need to be distinguished and glib generalizations should not be made from one population to another.



Unresponsive Parenting and Externalizing Behavior Among African-American Children Moderated by 5-HTTLPR



Note how it is only those with LONG alleles who prove susceptible, for better and for worse, not those with short alleles

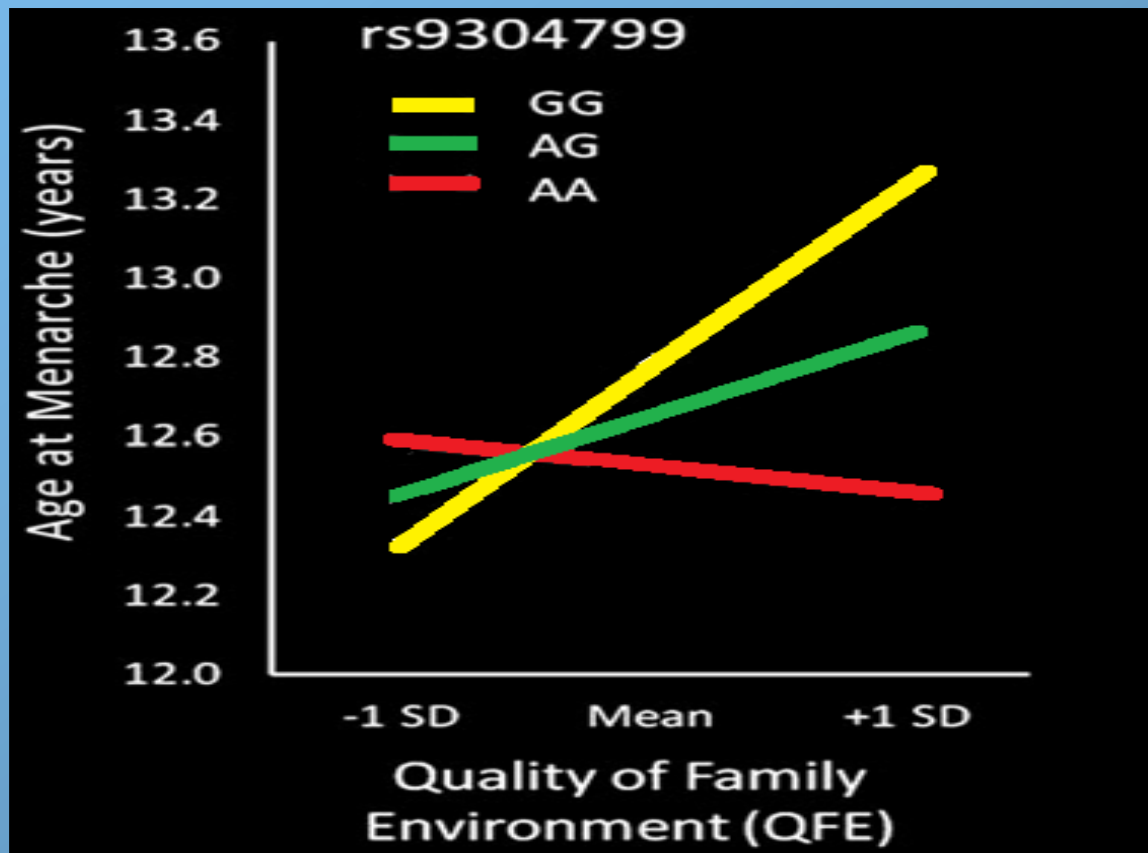


CONCLUSIONS (cont'd)

--Differential susceptibility extends to the evo-devo findings regarding pubertal timing, at least in females, as no differential-susceptibility tests have been made on male puberty .



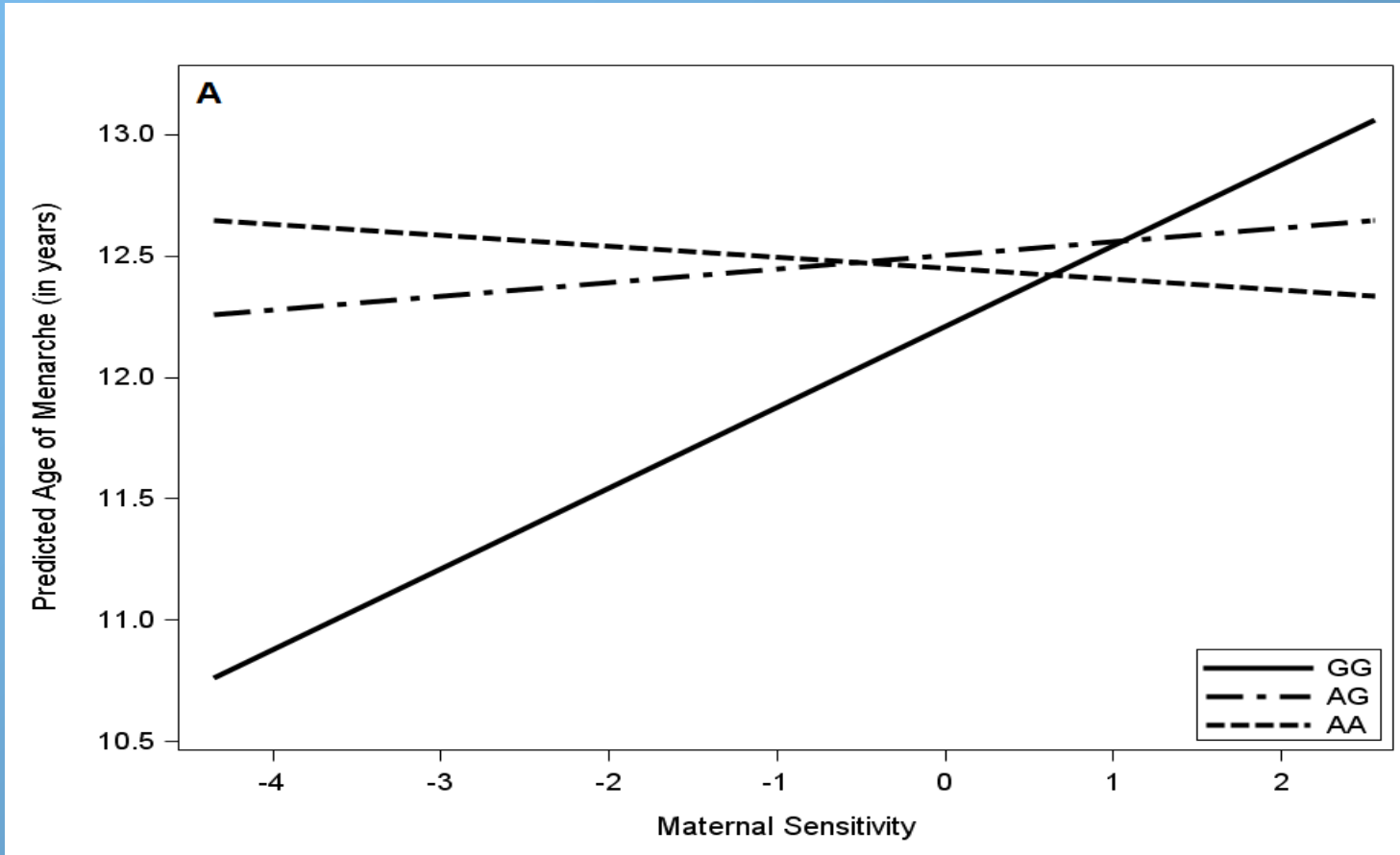
Early Family Environment and Age of Menarche



Manuck, S. et al. (2011). Reported Early Family Environment Covaries with Menarcheal Age as a Function of Polymorphic Variation in Estrogen Receptor- α (ESR1). *Development & Psychopathology*, 23, 69-83.



Replication and Extension: Early Maternal Sensitivity and Age of Menarche Moderated by Same Estrogen Receptor- α (ESR1)



Hartman, S., Widaman, K., & Belsky, J. (2012). Genetic Moderation of Effects of Maternal Sensitivity on Girl's Age of Menarche: Replication and Extension of Manuck et al. (2011)



CONCLUSIONS (cont'd)

- Domain specific or domain general?
- Susceptibility: born or made?
- Implications for Intervention: Efficacy vs. Equity?