

Self-regulation: Conceptualization and Relations to Adjustment and Maladjustment in Childhood

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Self-regulation

- the *intrinsic* processes aimed at adjusting mental and physiological state adaptively to context. Encompasses cognitive control, emotion regulation, and top-down and bottom-up processes that alter emotion, behavior, or cognition to attempt to enhance adaptation (or to achieve an explicit or implicit goal or goal state). Also involves physiological systems ...encompasses strategic/deliberative as well as reactive/automatized processes and their reciprocal influences (Nigg, 2017)

Important to differentiate between top-down & bottom up processes

- **top-down processes: slow, capacity-limited, and sequential**
- **they respond to mental representations (such as a goal or a rule) rather than sensory stimuli**
- **imaging and single cell recording data link them to “feed backward” neural signaling (i.e., cortical to subcortical or anterior to posterior cortical) (Depue & Lenzenweger, 2006; Miller & Buschman, 2012; see Nigg, 2017)**

- top-down self-regulation is built on what Rothbart has labeled as temperamental (dispositional) *effortful control*
- "the efficiency of executive attention, including the ability to inhibit a dominant response and/or to activate a subdominant response, to plan, and to detect errors" (Rothbart & Bates, 2006)
- "a dispositional trait-level representation that represents the tendency to be able to employ top-down control to self-regulate. It is seen as emerging from one aspect of executive functioning, executive attention, but also, with development, including other capabilities" (Nigg, 2017)

- **includes effortful control of attention (shifting & focusing) & behavior (inhibiting & activating) & planning**
- **effortful, willful, and voluntary (although can be in a semi-automatic mode at times)**
- **overlaps with executive functioning**

Bottom-Up Self-regulation

- generally automatic, stimulus driven, rapid, and/or does not require mental resources
- elicited by sensory stimuli
- human brain imaging animal single cell recording studies link them with “feed-forward” neural signaling (e.g., subcortical to cortical, or posterior to anterior cortical signaling) (Depue & Lenzenweger, 2006; Miller & Buschman, 2012)

- **includes reactive behavioral aspects of control (called reactive control by Eisenberg)**
- **the distinction between effortful & reactive control systems is similar to distinctions discussed by Carver (impulse vs. constraint) & Hofmann (impulse vs. self-control) (also recent work by Zelazo, Blair, Bunge, etc.)**

Types of reactive control

- ***reactive undercontrol***: impulsivity, pulled by environmental rewards/cues; spontaneous attentional capture by salient stimuli without much thought
- ***reactive overcontrol***: rigid, constrained behavior, typically inflexible, such as behavioral inhibition (e.g., Kagan; note this is not inhibitory control)
 - anxious interruption of behavior in response to novelty
 - children who are timid, constrained, and lack flexibility in novel situations

▪ well-regulated people have the ability to respond to the ongoing demands of experience with a range of responses that are socially acceptable and sufficiently flexible to allow for spontaneity as well as for the delay of spontaneous reactions as needed (Cole et al., 1994)

- top-down self-regulation usually (not always) is adaptive
- reactive control is sometimes adaptive, often not; high levels of bottom-up control often are not adaptive

Neurological correlates of effortful control and more reactive control (or the lack thereof) likely differ

- **effortful control believed to be based in the anterior cingulate gyrus (Posner) and prefrontal cortex (e.g., right ventrolateral prefrontal cortex)**
- **Gray and others have argued that reactive systems are associated especially with subcortical systems**
- **effortful and reactive control systems are clearly inter-connected**

What is measured to assess emotion-related self-regulation and effortful control in children?

- many constructs and methods....
- typically use others' reports (e.g., parents, teachers) or self-reports on questionnaires
- or behavioral measures of self-regulation, delay of gratification, and/or aspects of executive functioning (especially executive attention)

Sample items/measures

Executive attentional control – the ability to voluntarily focus and shift attention as needed

“Becomes very absorbed in what s/he is doing, and works for long periods”

“Has an easy time leaving play to come to dinner”

Rothbart's Child Behavior Questionnaire

Behavioral tasks: Stroop or computer tasks involving focusing & shifting attention, ignoring distractors

Inhibitory control – the capacity to effortfully suppress inappropriate responses

“Can lower his/her voice when asked to do so”

“Can wait before entering new activities if s/he is asked to” (Rothbart et al., 2001)

Or tasks such as Simon Says; also “don’t look” and delay of gratification tasks, and some executive functioning tasks (e.g., knock/tap task)

Activation control – the capacity to perform an action when there is a tendency to avoid it

“When asked to do something, does it right away, even if s/he doesn’t want to”

Behavioral tasks? Tasks that assess persistence on boring task





Can we differentiate between effortful & reactive control?

- in 3 studies, we have found separate latent constructs for the two constructs for preschoolers or school-aged children (e.g., Eisenberg et al., 2004, *CD*, 2013, *DP*; Valiente et al., 2003, *J. of Personality*)
- at 30 months, cannot differentiate reactive overcontrol from undercontrol, but could at 42 and 54 months (Eisenberg et al., 2013, *DP*)

How might one think about individual differences in emotion-related self-regulation, including various types of effortful control, and their implications for (mal)adjustment?

Heuristic Styles of Control: Highly Inhibited

- high in less voluntary reactive overcontrol (e.g., behavioral inhibition)
- average or slightly low in the ability to effortfully inhibit behavior (i.e., inhibitory control)
- relatively low in effortful attentional control (which is used to modulate negative emotion)

- low in the ability to effortfully activate behavior as needed (activational control) and in planful active coping
- prone to internalizing problems (e.g., anxiety, depression, social withdrawal), especially if predisposed to negative emotionality (Eisenberg & Morris, 2002)



Undercontrolled

- low in all types of effortful control (e.g., attentional, inhibitory, activational, planning)
- low in reactive overcontrol & high in reactive approach tendencies (impulsivity)
- relatively low in social competence and prone to externalizing problems such as reactive aggression



Optimally Regulated

- high in various modes of effortful control
- in regard to reactive control, neither overcontrolled nor undercontrolled
- well adjusted, socially competent, and resilient to stress



Hypothesized Relations of Effortful and Reactive Control To Adjustment

- externalizing problems are linked to *low* effortful control (of all types) and high reactive undercontrol/impulsivity
- internalizing problems associated with *low* attentional and activation effortful control and *high* reactive overcontrol (or low impulsivity)

Empirical findings

- **effortful control (EC) has been associated with a wide range of positive child outcomes:**
 - **low externalizing & internalizing problems (somewhat mixed findings for the latter)**
 - **higher social competence**
 - **higher conscience, prosocial development, and sympathy**
 - **school performance/engagement**

Need to look at

- different components of EC/self-regulation
- unique effects of EC and reactive control
- interactions of EC and reactive control
- mediators of the relation of EC→outcome
- relations of EC with co-occurring externalizing/internalizing versus pure externalizing or pure internalizing
- also important to use multiple reporters/methods and longitudinal data

Relations with different types of effortful control (Eisenberg et al., 2001, *CD*)

- 4.5- to 7-year-olds with externalizing &/or internalizing problems or nondisordered**
- mothers', fathers', and teachers' reports of externalizing & internalizing problems**
- parents' and teachers' report of EC**
- observed measures of EC (sitting still when hooked to physiological equipment and left alone, facial/behavioral reactions to a disappointing prize, persisting at a difficult task)**





Constructed 4 groups of children

- **Externalizing: high in externalizing but not internalizing problems**
- **Internalizing: high in internalizing but not externalizing problems**
- **Co-occurring: high in both externalizing & internalizing problems**
- **Control/nondisordered: below borderline clinical levels in both externalizing & internalizing**

Pure externalizing or co-occurring children (compared to non-disordered children) at age 5-7 years

- **lower in attention shifting & attention focusing**
- **lower in inhibitory control**
- **higher in impulsivity**
- **less regulated on observed tasks**
 - **had more difficulty than controls sitting still when asked and in persisting on puzzle task**
- **strong pattern found across reporters & measures**

Internalizing children as compared to non-disordered children.....

- somewhat lower in attention shifting and attention focusing
- much lower in impulsivity
- about the same in reported inhibitory control
- not less regulated on observed tasks

- **EXTs low in attentional *and* inhibitory control and high in impulsivity (reactive undercontrol)**
- **INTs low in reactive undercontrol (i.e., low impulsivity) and low in effortful attentional control (but not inhibitory control)**

Externalizing: 2- and 4-year follow-up

- **externalizing problems still clearly linked to low effortful control and high impulsivity**
 - **change in externalizing status related to change in effortful control and impulsivity (in predictable ways)**

Internalizing: 2- and 4-year follow-up

- pure internalizing no longer associated with problems in attentional regulation (and still not associated with deficits in inhibitory control)
- internalizers still low in impulsivity
 - change in internalizing status linked to change in impulsivity and, 4 years later, attentional control

(Eisenberg et al., 2005, 2009, *DP*)

6-year follow-up (early adolescence)

- **computed bifactor models (which provide unique, continuous factors for pure and co-occurring internalizing and externalizing problems)**
- **both pure externalizing & co-occurring problems were predicted by low EC & high impulsivity in childhood and adolescence (controlling initial symptoms)**
- **pure internalizing related to low childhood & early-adolescent impulsivity (but not EC)**

- **lower early effortful control predicted changes in externalizing (pure and co-occurring) over six years, but only when parental positive expressivity was low (Wang, Eisenberg, et al., 2016, *D & P*)**

- in a high-risk adolescent sample (including children of alcoholics & a bi-factor model),
- assessed 5- to 10-year-olds' EC & impulsivity and, 5–6 years later, their aggressive-antisocial behavior (AAB) and depressive symptoms (DEP)
 - low EC → pure AAB
 - low EC & low impulsivity --> pure DEP & co-occurring AAB/DEP
 - for older adolescents, lower EC predicted pure AAB & co-occurring AAB-DEP only at average and high impulsivity

(Wang, Chassin, Eisenberg, et al., 2015, *CD*)

so perhaps low EC is related to pure internalizing problems in mid adolescence, is related to only certain kinds of internalizing problems (e.g., depression), or relates more in higher risk samples

Same patterns in other countries?

...there are some findings similar to those reported in other US labs and in Europe (e.g., Oldehinkel's and Muris' research), although pure internalizing more often related to low EC

EC related to low aggression/externalizing in Indonesia (Eisenberg et al, 2001, *CD*, 2004, *DP*; French et al., submitted)

In China: both internalizing & externalizing symptoms related to low attention focusing & low inhibitory control (Eisenberg et al., 2007, *D & P*; Zhou et al, 2004, *DP*; Zhou et al., 2008, *CD*)

- **internalizing group lower than controls & externalizers in impulsivity (Eisenberg, Chang, et al., 2007, *D & P*)**

Additive & mediated relations

Hypothesized and found:

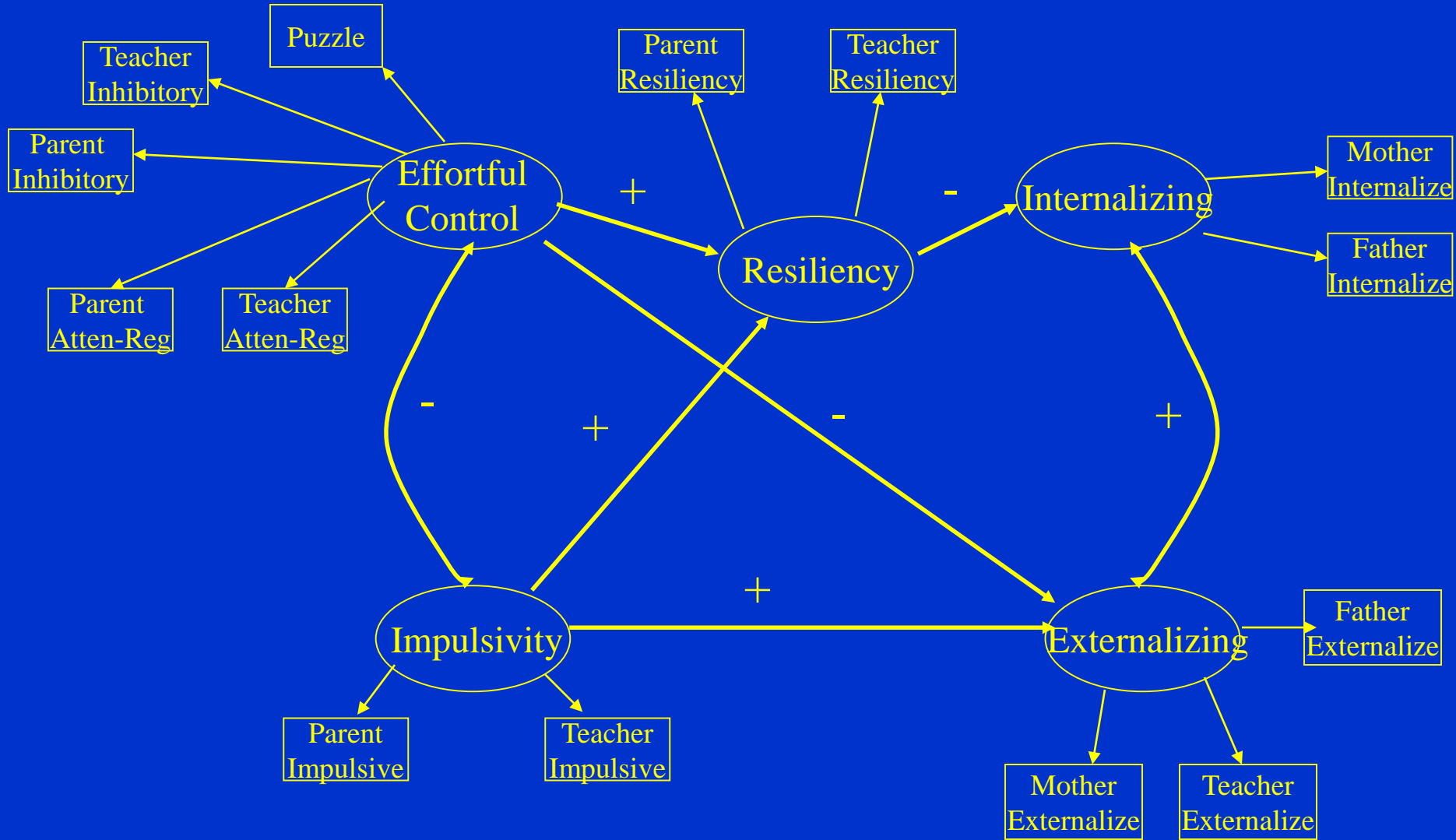
- **at some ages, prediction of socioemotional outcomes is greater when both effortful and reactive control are predictors (unique effects)**
- **personality resiliency--the ability to cope with and rebound from stress--mediates some relations between effortful control and socioemotional functioning**

Prediction of maladjustment from EC and reactive control

- in structural equation models (SEMs) predicting maladjustment, resiliency was treated as a mediator between impulsivity or effortful control and internalizing (or externalizing) problems

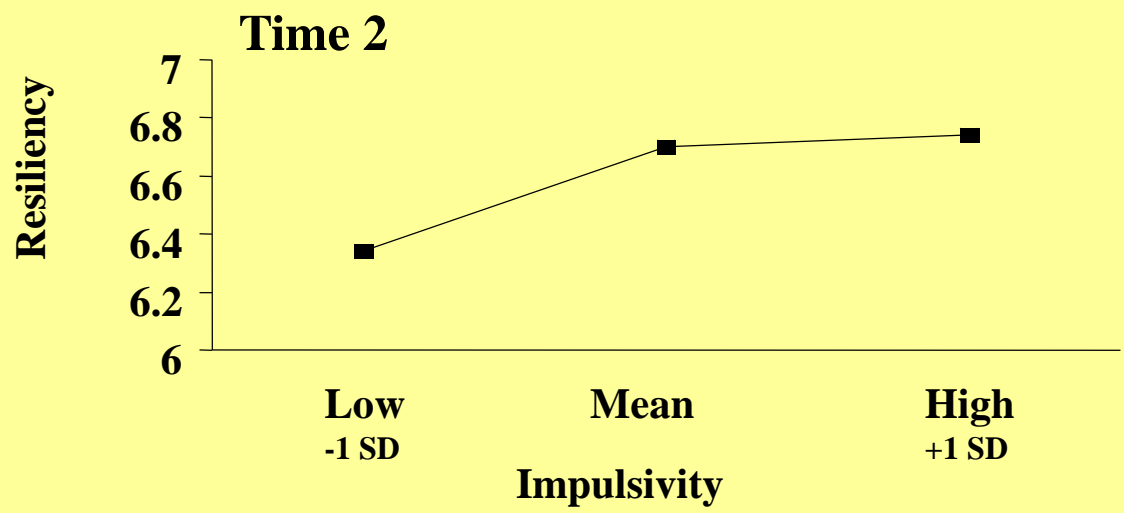
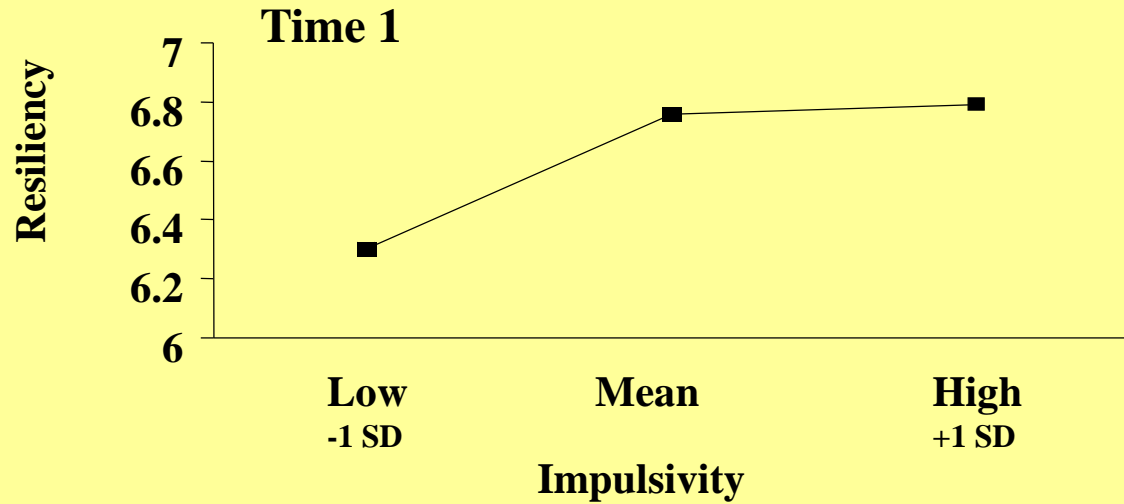
(Eisenberg, Spinrad et al., 2004, *Child Development*)

Time 1



Chisq (52, N=214)=60.017, $p > .208$, CFI= .994;
RMSEA=.027; Eisenberg et al., 2004, *CD*

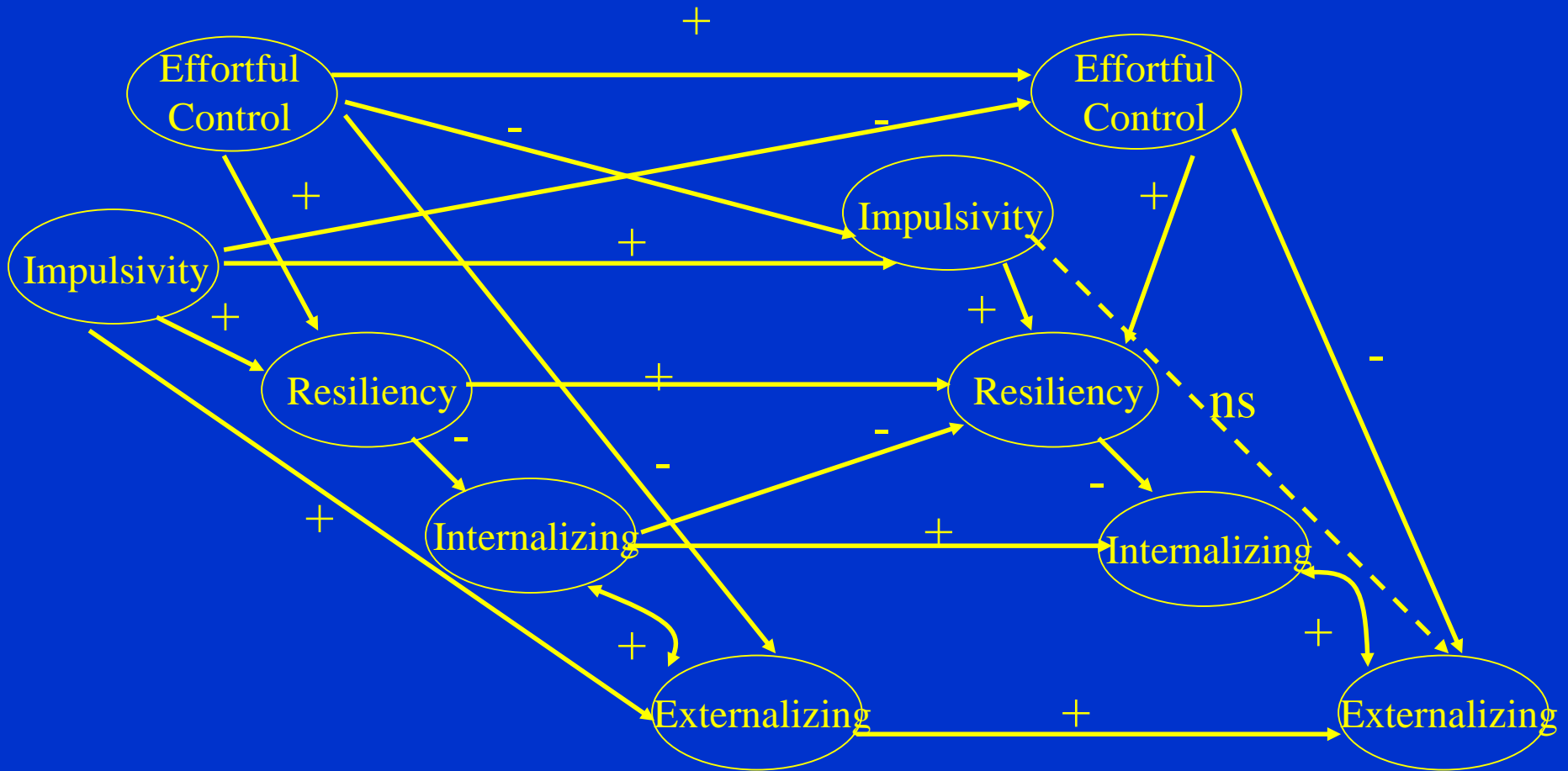
- **the relation of impulsivity to resiliency was positive because children very low in impulsivity were low in resiliency**
- **high impulsive children were not higher in resiliency than children at a mean level of impulsivity**



Longitudinal Model

Time 1

Time 2



Chisq (24, n=214)=23.70. $p < .48$; CFI= .1.0; RMSEA = .00.

- predicted relations held at T2 even when controlling for levels of the various constructs at T1 except the path from impulsivity to externalizing became nonsignificant
 - so EC may increasingly modulate the expression of reactivity tendencies
- most relations at T2 not due merely to the consistency of relations and variables over time
- replicated this pattern for externalizing (Valiente, Eisenberg, et al., 2003, *J. of Personality*)

Similar findings for social competence?

- pattern found at each age (5-7, 9-11) and across 2 years in elementary school

EC → resiliency → popularity

- impulsivity was uniquely associated with less popularity over time (Spinrad, Eisenberg, et al., 2006, *Emotion*)
- in preschool years
 - EC → committed compliance (Spinrad, Eisenberg, et al., 2012, *DP*)
 - EC → sympathy (Taylor, Eisenberg, et al., 2015, *DP*)

- EC→ resiliency→ preschoolers' agreeableness (Cumberland-Li et al., 2004, *SD*)
- however, across kindergarten, peer acceptance predicted EC rather than vice versa (Hernández, Eisenberg et al., 2017, *IJBD*)
 - relations are likely bi-directional

In other countries?

- Chinese children high in EC perceived as socially skilled & leaders at school (Zhou et al., 2004, *DP*)
- Indonesia: EC related to low externalizing/high social competence (Eisenberg et al., 2001, *CD*, 2004, *DP*)

- in an Italian longitudinal sample, teacher-reported EC at age 13 predicted higher prosocial behavior at age 13 and a later normative decline in prosocial behavior
 - (Kanacri, Pastorelli, Eisenberg, et al. 2013, *Journal of Personality*)
- and from 16 to 26 years, the relation of EC to prosocial behavior was mediated by ego-resiliency (Alessandri, Kanacri, Eisenberg, et al., *PSPB*, 2014)

Relations with school functioning?

- EC related to greater school liking, better behavior at school, and higher academic performance/GPA (e.g., Diaz et al., 2017, *IJBD*; Eisenberg et al., 2010, *EE&D*; Kopystynska et al., 2016, *DP*; Valiente et al., 2013, *EE&D*)
- the relation of regulation with these outcomes sometimes was mediated

In preschool years:

**EC → better relationships → school liking
with preschool teachers (Silva et
al., 2011)**

In elementary school:

**EC → social competence/ → better grades
low externalizing
(e.g., Valiente et al., 2011)**

Do self-regulation & emotionality interact when predicting developmental outcomes?

- **in several studies, interactions of EC with negative or general emotional intensity or anger when predicting social competence or externalizing problems**
 - **EC → outcomes: stronger for children high in negative emotion**
 - **OR emotion → outcomes stronger for children low in EC**
 - **intense and/or negative emotion was not a problem for regulated children**
 - **(Eisenberg et al., 1995, 1996, 1997, 2004)**

- in more recent studies, evidence of EC X emotion interactions when predicting outcomes at school

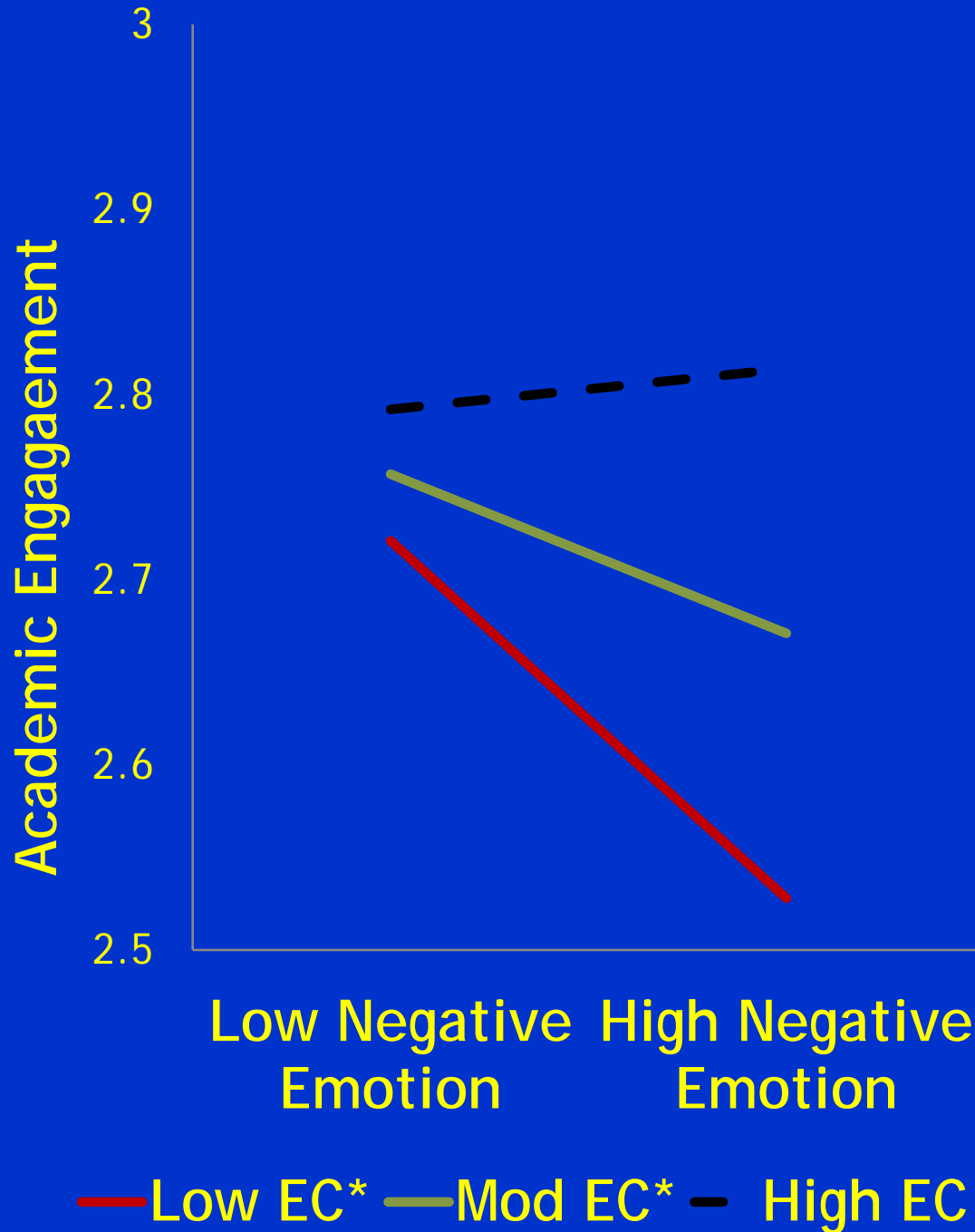
(Diaz, Eisenberg et al., 2017, *JRP*)

- 301 kindergartners are being followed for 3 years, with multiple measures of school outcomes in spring:
 - teachers' reports of student-teacher conflict
 - teachers' reports of problem behavior at school
 - observed engagement in class

- **observed real-life positive and negative emotional expressivity at school in autumn for 9-12 weeks**
- **measured EC in the autumn**
 - **parents, teachers, & observers rated children's EC (CBQ; Rothbart et al., 2001)**
 - **attention focusing, inhibitory control, attention shifting**
 - **a computer-based continuous performance task (CPT; adapted from NICHD, 2003)**

- **direct effects: EC predicted better school outcomes whereas negative emotionality (but not positive emotionality) predicted worse school outcomes**
- **multiple EC X emotion interactions when predicting school outcomes, especially for negative emotion**

- **children high in EC tended to be low in conflict with teacher and in problem behaviors & high in school engagement regardless of their level of negative expressivity**
- **for children with low and/or average EC, observed negative emotion predicted student-teacher conflict, problem behaviors at school, and low engagement**



The negative relation between negative expressivity and academic engagement was significant at low and moderate levels of EC, $ps < .01$

Children high in EC were high in engagement regardless of their level of negative emotion

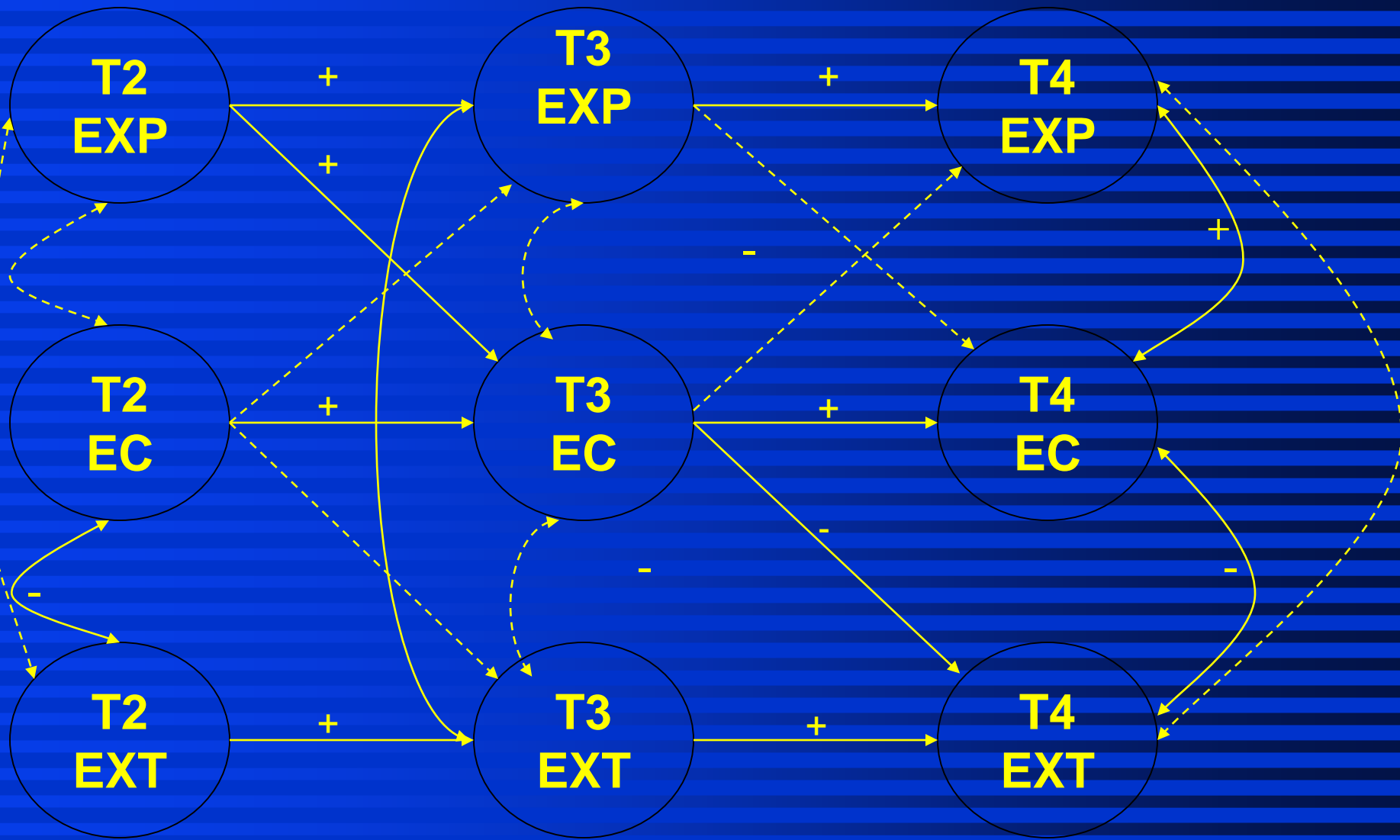
Conclusions

- **individual differences in effortful regulation and less voluntary types of control are predictors of (mal)adjustment, social competence, and academic outcomes and sometimes provide unique additive (and interactive) prediction**
- **EC becomes the stronger unique predictor (vs. impulsivity) of externalizing with age**
- **personality resiliency and quality of relationships may be important mediators of relations of EC to child outcomes**

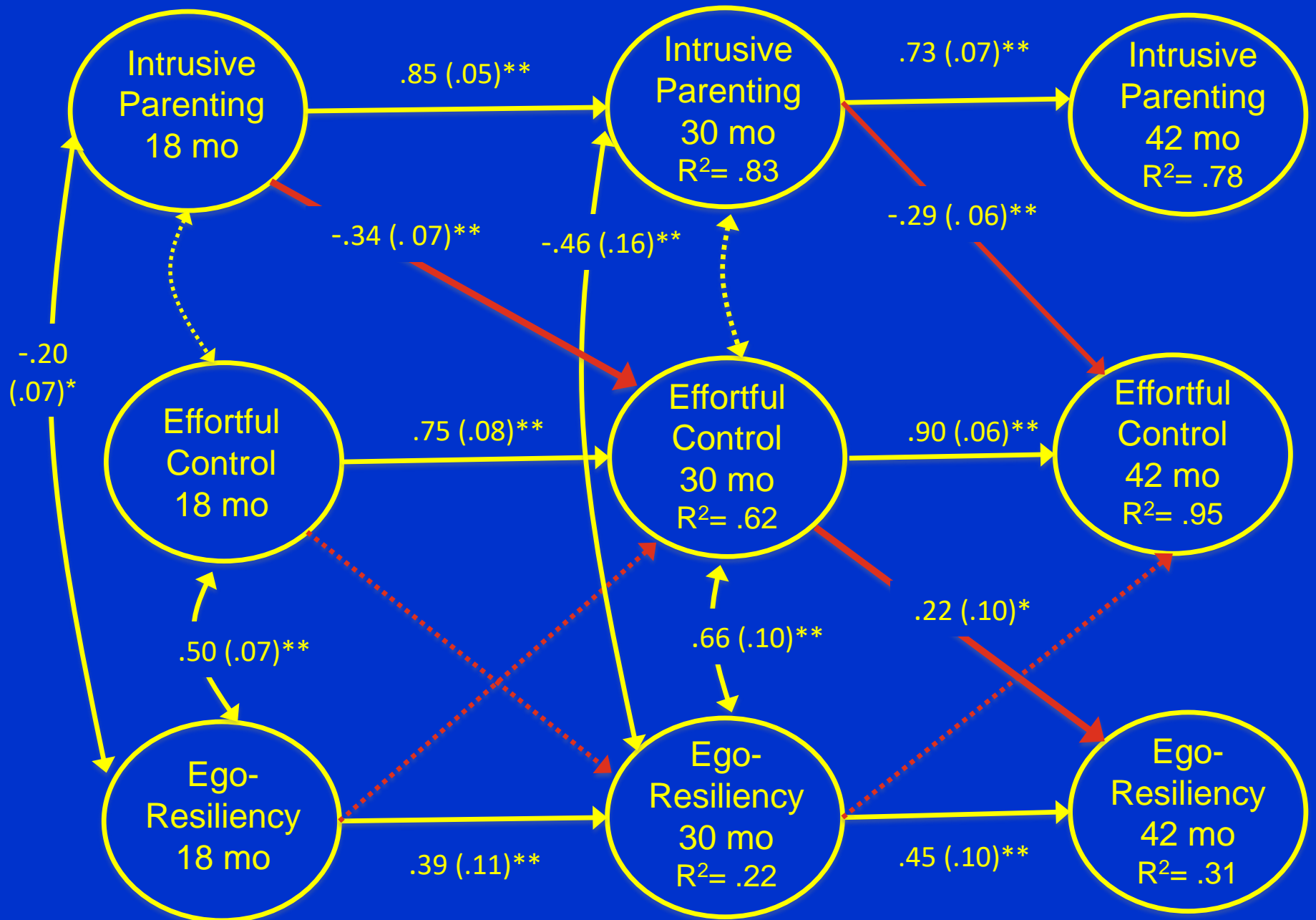
- **EC & impulsivity or negative emotionality sometimes interact when predicting many outcomes for children**

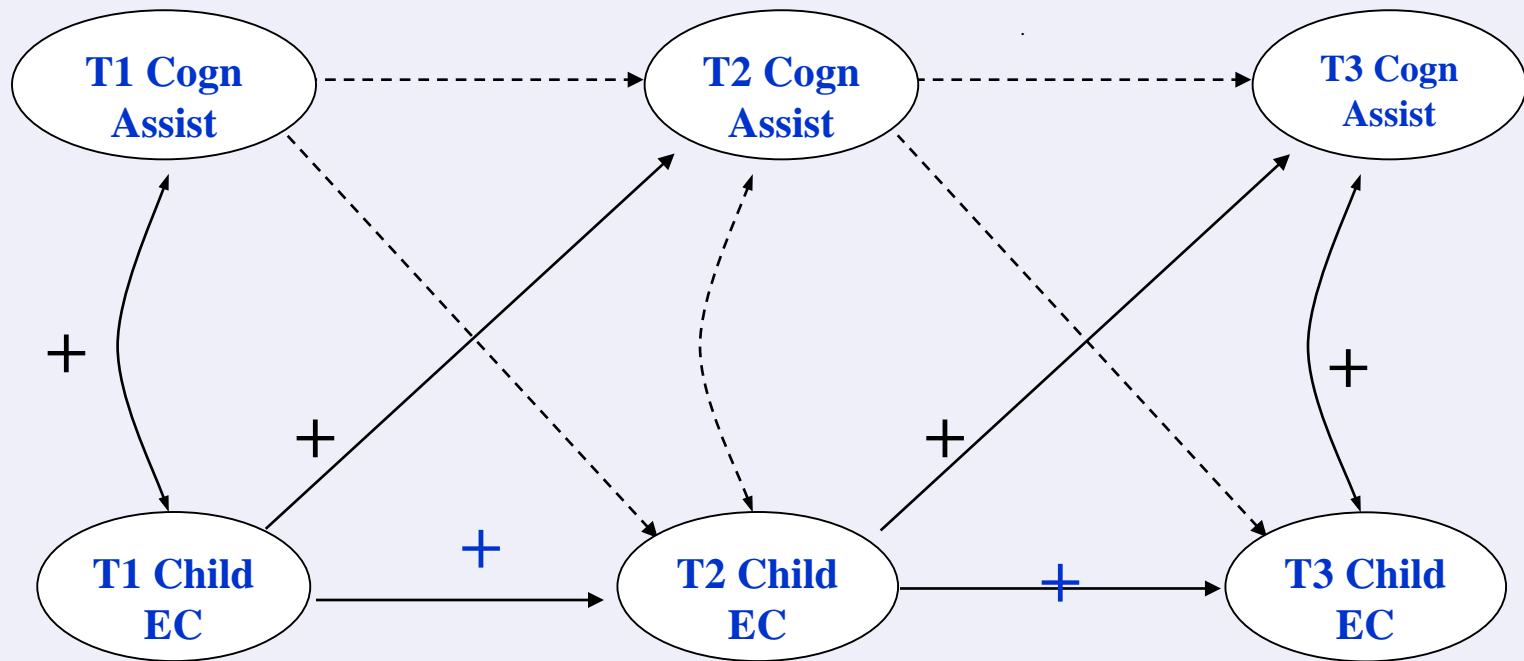
Other directions

- **parental behavior often predicts EC, which in turn predicts maladjustment & other developmental outcomes**
- **but EC sometimes also predicts parenting behavior**



EXT = externalizing; EXP = parent expressivity; EC = effortful control.
 Obtained similar findings for parent-rated internalizing problems





Simplified model for cognitive assistance

Eisenberg et al., 2010, *Developmental Psychology*

- **evidence of bidirectional relations between parenting & EC (Eisenberg et al., 1999, *CD*, 2015, *D & P*)**
- **these relations vary somewhat depending on age of child, type of parenting examined, & developmental outcome**

Collaborators

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- Elizabeth Gershoff
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- Ivanna Guthrie
- Jeffrey Liew
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- Steve West
- Natalie Eggum
- Michael Sulik
- Anjolie Diaz
- Rebecca Berger

Thanks for your effortful attention!

Why is resiliency related to high impulsivity?

Block & Kremen (1996) noted,
"the human goal is to be as undercontrolled as possible and as overcontrolled as necessary. When one is more undercontrolled than is adaptively effective or more overcontrolled than is adaptively required, one is not resilient."

- **effortful control would be expected to relate positively to resiliency (and has been)**
- **high reactive control (overcontrol) expected to predict rigidity & low resiliency**
- **moderate reactive undercontrol (i.e., a bit impulsive & spontaneous) might be expected to relate positively to resiliency, especially for young children**

- **positive linear relations between reactive undercontrol and resiliency in several samples of young children and quadratic relations in 2 samples (Eisenberg et al., *Self & Identity*, 2002; Cumberland et al., 2004, *Social Development*; Taylor, Eisenberg, et al., 2013)**
- **children low in impulsivity are especially low in resiliency**

- **by mid- to late-elementary school, only the quadratic relation between impulsivity and resiliency remains**
- **by early adolescence, impulsivity is modestly negatively related to resiliency**
 - **but if the overlapping variance in resiliency predicted by effortful control is controlled, and then the relation becomes positive (Valiente, Eisenberg, et al., 2003, *Journal of Personality*)**

Origins of Self-Regulation

- **strong genetic component to effortful control**
- **however, despite the role of heredity in self-regulation, socialization seems to be important**

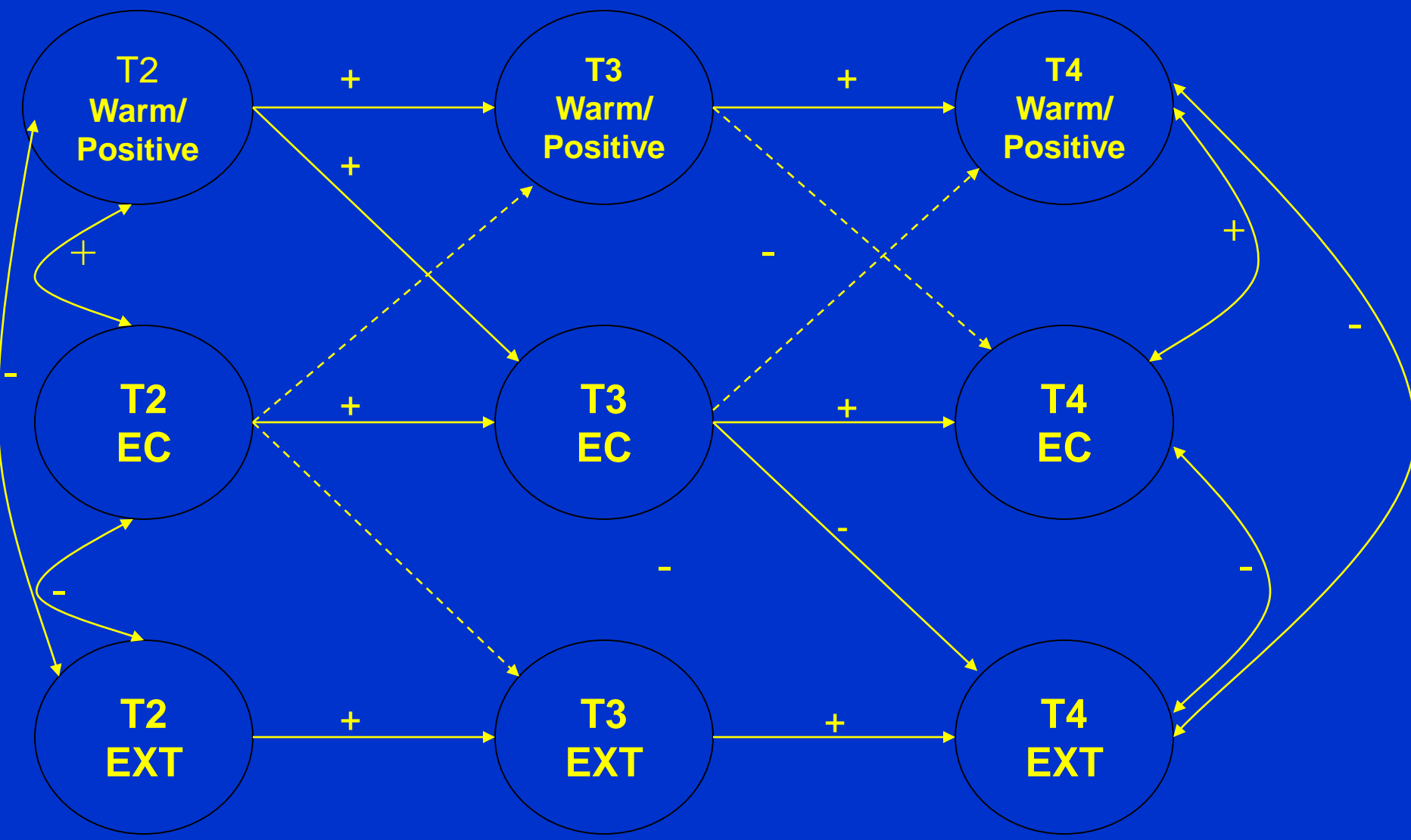
Hypothesized

Optimal socialization → regulation →
adjustment

Longitudinal model

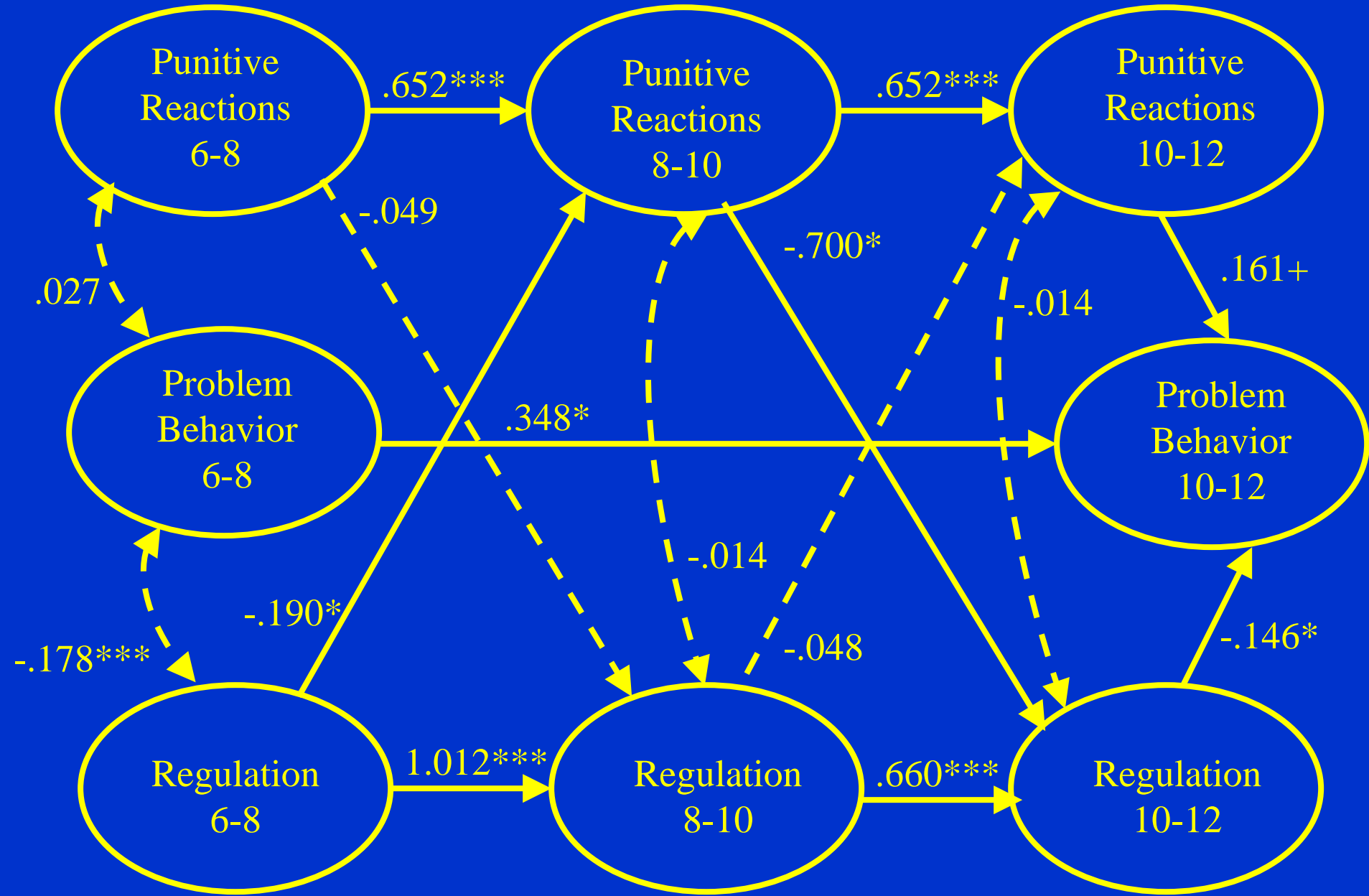
- tested mediation using 3 times (2 years apart; starting at 7-9 years)
- high parental positive vs. negative expressivity at T2 predicted high EC at T3, which predicted low externalizing at T4
- EC did not predict parenting across time (Valiente et al., 2006, *Emotion*)





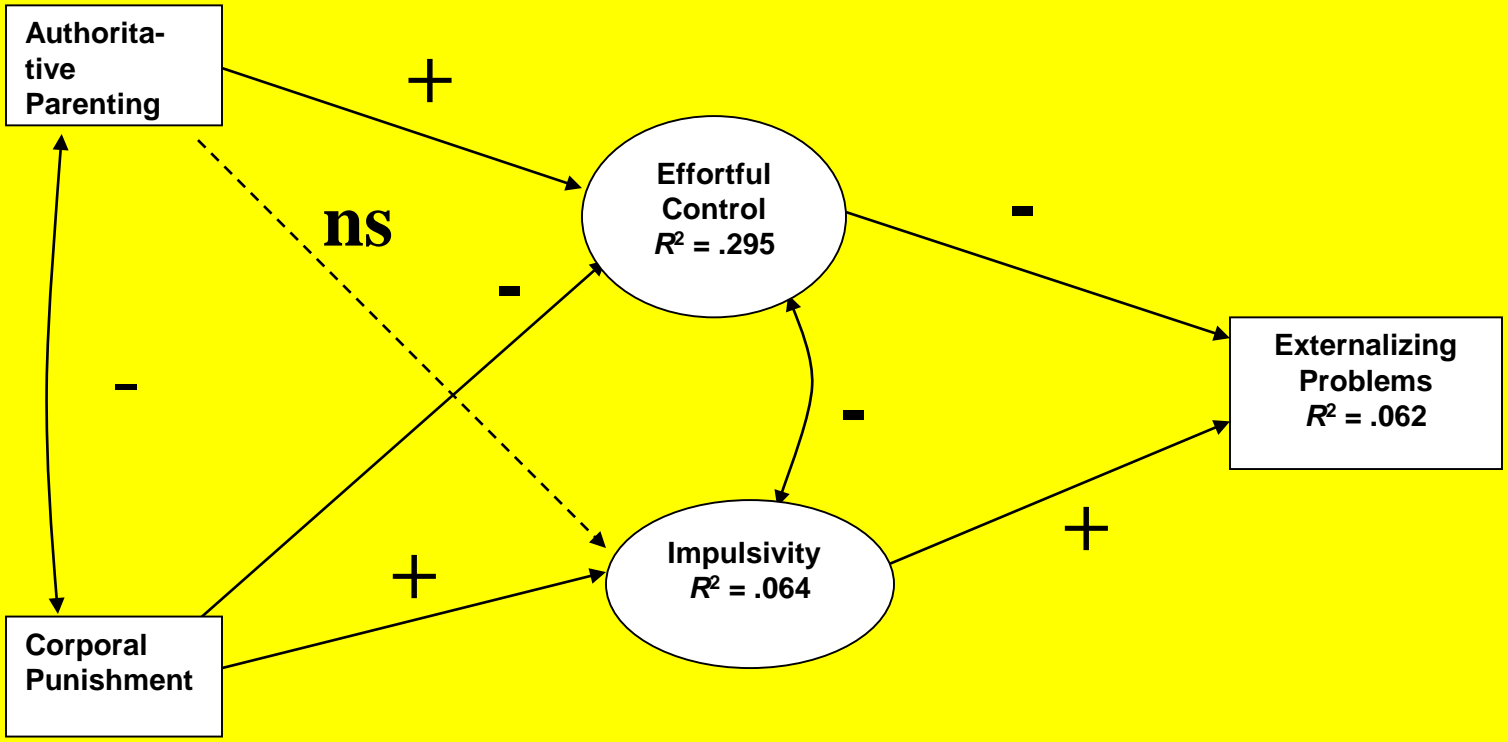
Similar model with unselected school sample and observed parental warmth & positive expressivity (Eisenberg et al., 2005, *CD*)

Bidirectional Relations: Early U.S. Longitudinal Study



- findings from China for school-aged children consistent with findings in Western countries
- in first study,
 - high authoritative parenting (supportive but with reasoned control) and low authoritarian parenting (cold, overly controlling) related to high EC, which in turn predicted low aggression/high socially appropriate behavior (Zhou, Eisenberg, et al., 2004)

- **in a different Chinese sample:**
 - **authoritative parenting and low corporal parenting predicted children's high EC, which in turn predicted low externalizing problems**
 - **corporal punishment predicted impulsivity, which in turn predicted externalizing problems**

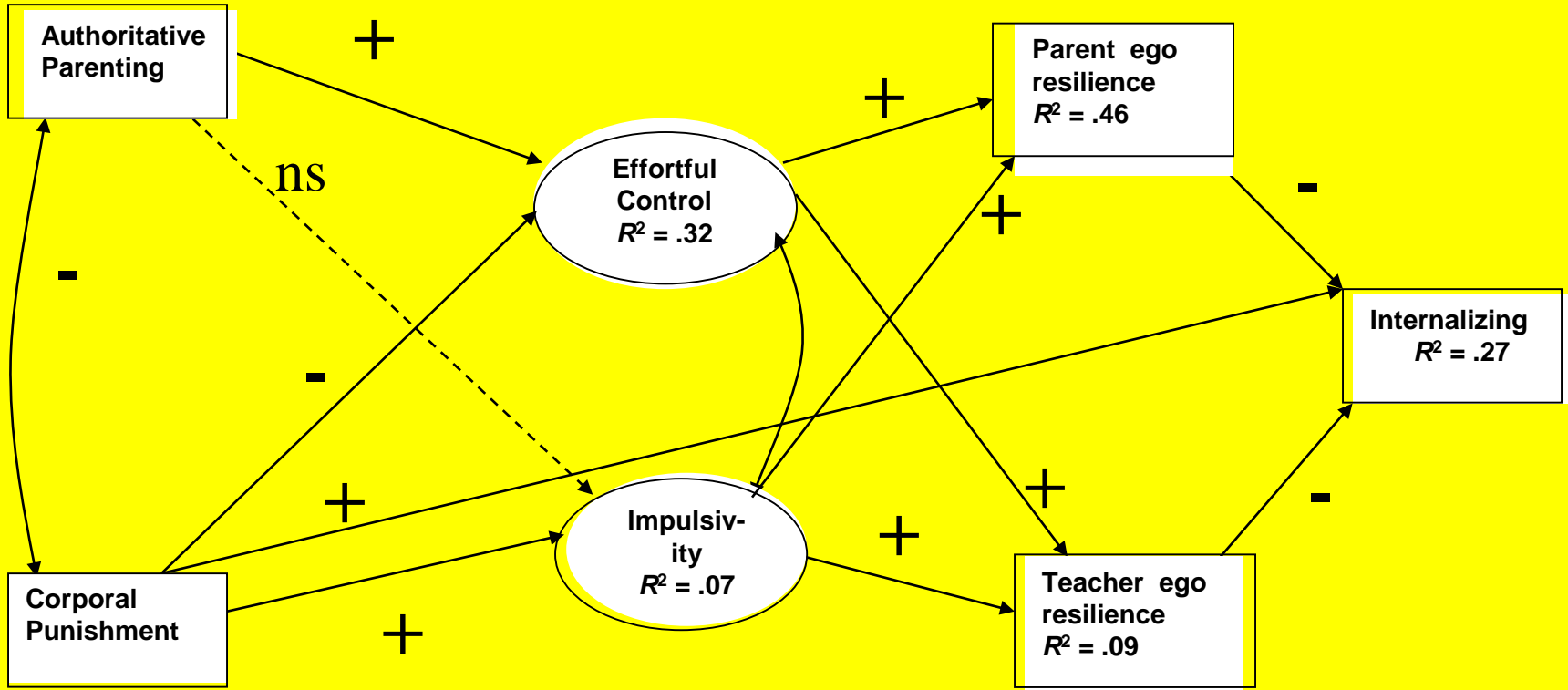


Eisenberg, Chang, et al., 2009

Chi-Square = 11.364 ($df=6$), $p=0.0778$, SRMR for within = .005, SRMR for between=0.027, RMSEA=0.038, CFI = 0.993, TLI = 0.974.

Examples of relevant work from other labs

- Kochanska--observed effortful control & reported child inhibitory control in the early years predict internalized compliance, moral behavior and moral reasoning, lower anger, and better adjustment
- Mischel--ability to delay gratification (often through attentional mechanisms) predicted positive outcomes a decade or two later (e.g., academic & social competence, coping with frustration/stress, drug issues)



$\chi^2(13) = 22.336, p = 0.0504, CFI = 0.992, TLI = 0.976, RMSEA = 0.034, SRMR \text{ for within} = 0.028, SRMR \text{ for between} = 0.002$

Study with 18- & 30-month olds

- **parenting: mothers' reports of supportive and unsupportive reactions to their children's negative emotions & observed maternal sensitivity and/or warmth during free-play and teaching interactions**
- **EC: mothers' & caregivers' reports & children's snack delay behavior**
- **adjustment & social competence: mothers', fathers', and caregivers' reports**

- in both 18- and 30-month within-time models,

supportive → EC → low externalizing, low parenting separation distress, & high social competence

(Spinrad, Eisenberg et al., 2007, *Developmental Psychology*)

- **across one year, supportive parenting predicted high EC when controlling stability and earlier EC**
- **but EC did not predict maladjustment a year later when controlling for initial levels of the variables at 18 months; the relation was there early and was stable across time (Spinrad, Eisenberg, et al., 2007, *DP*)**
- **and there were no additional effects of supportive parenting on EC from 30 to 42 months (Eisenberg et al., 2010, *D & P*)**

- however, 18-month nonsupportive, intrusive parenting did predict lower EC at 30 months and again from 30 to 42 months (Taylor et al., 2013, *CD*)
- and EC also predicted intrusive parenting from 30 to 54 months (Eisenberg et al., in press, *D & P*)
- EC, predicted by intrusive parenting, in turn predicted ego resiliency across time (Taylor, Eisenberg, et al., 2013, *CD*)

- **children's EC also predicted mothers' use of effective teaching strategies (e.g., cognitive assistance, use of questions, and fewer directives) from 18 to 42 months (Eisenberg et al., 2010, *DP*)**

Socialization Summary

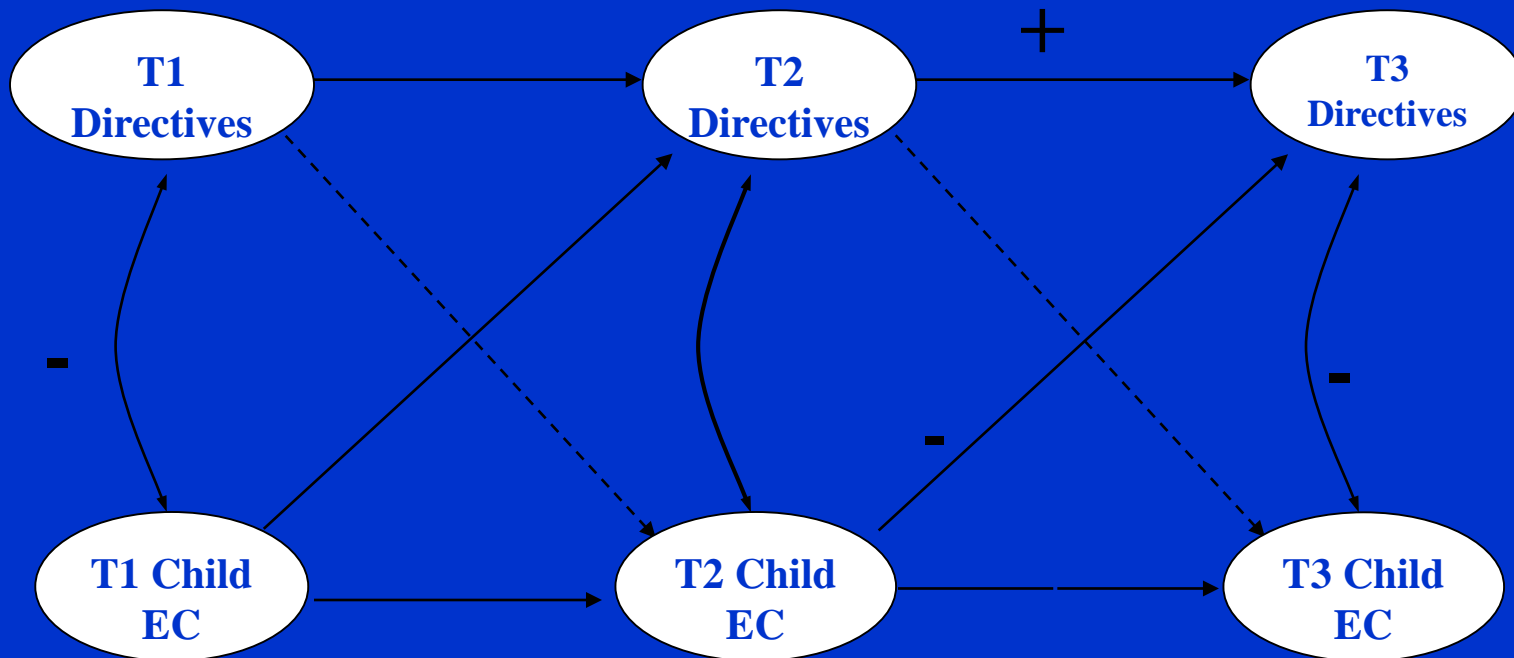
- the quality of parenting is related to EC at many ages and seems to predict EC over time, at least for some types of parenting
- sometimes children's EC may affect the quality of parenting; may depend on the measures of parenting and EC, as well as age
- there seems to be considerable stability across time in the early relation between parenting quality and children's regulation

Our new directions

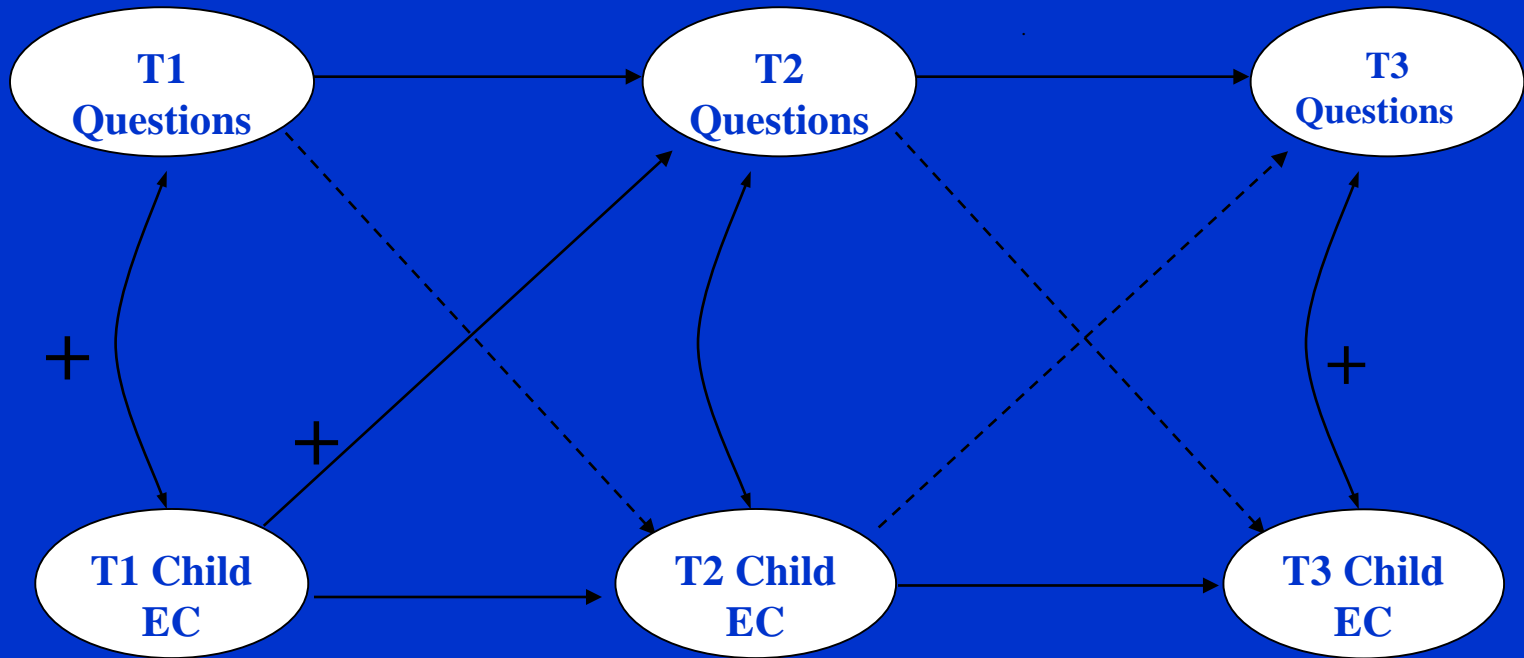
- looking at gene X environment interactions predicting effortful control and related constructs (e.g., DAT1 X observed parenting quality → observed effortful control in toddler/preschool years; Yi et al., in press, *D & P*)
- examining role of regulation & observed emotion at school in school outcomes and how these relations are moderated by the regulation and emotion of peers children associate with at school

Child effects

- during a teaching interaction at ages 18, 30, and 42 months, coded observed maternal teaching strategies (cognitive assistance, being directive, using questions)
- mothers', nonparental caregivers', and observers' reports of child EC, performance on a delay task
- when controlling for the stability of constructs over time, SES, & child expressive language, child EC predicted higher-quality maternal teaching strategies at 30 months and/or 42 months (Eisenberg et al., 2010, *DP*)



Simplified model for mothers' directives



Simplified model for maternal use of questions

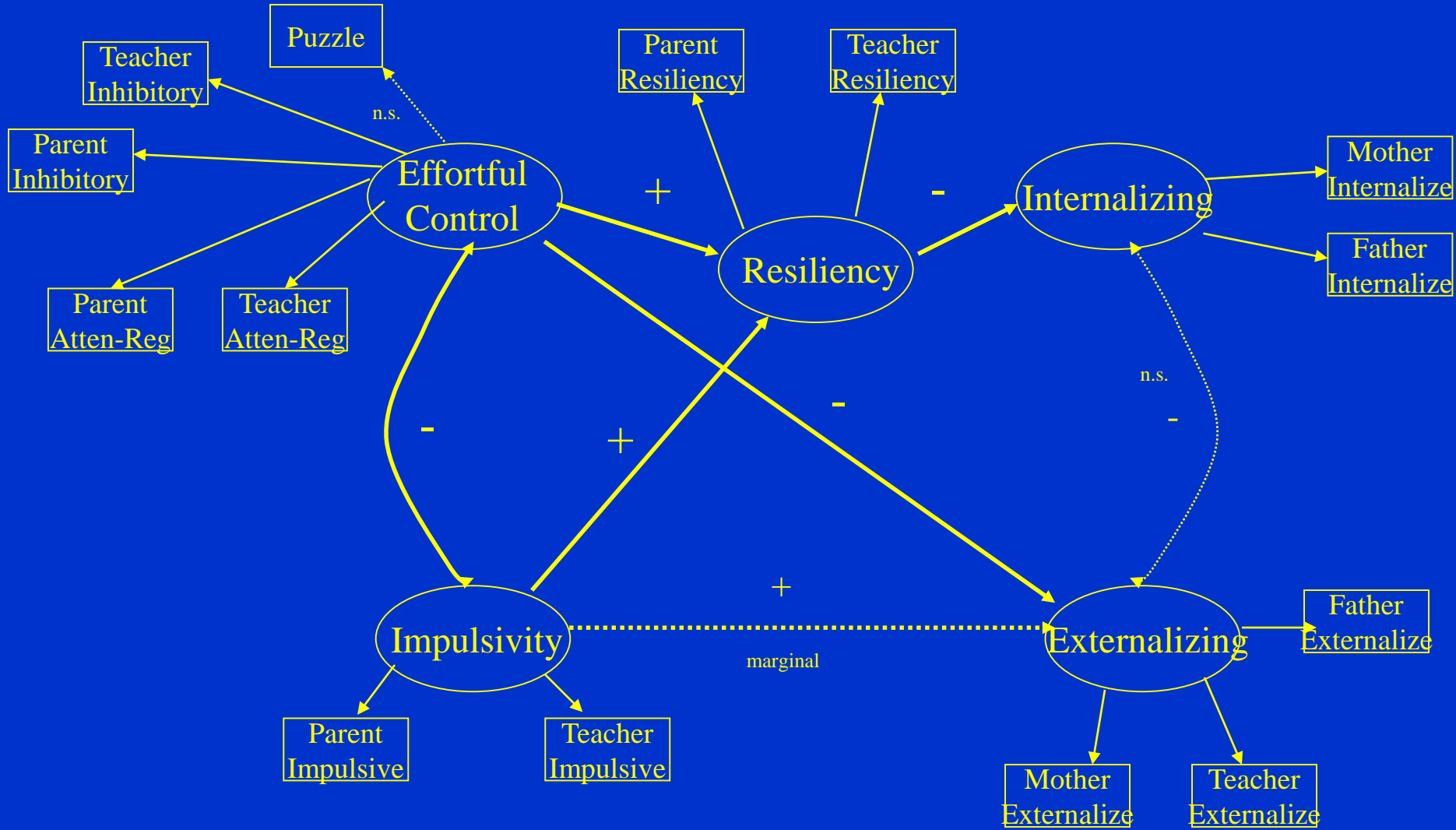
Measures seem to work for diverse groups of children

- **multiple behavioral and reported measures of EC (effortful control or self-regulation) showed factorial, metric, and partial scalar equivalence across groups of low-income Hispanic, European American, and African American children; so measures work similarly for diverse groups of US children (Sulik et al., 2010)**



- **the child has to move plastic figurines (a child, a rabbit, and a turtle) down the path to “home,” while staying on the path**
- **the child first does this with a same-sex figure of a child, then the fastest rabbit in the world (so the child should move fast) and the slowest turtle in the world (so should move slowly)**
- **how well the child stays on the path & also the difference between the fast rabbit time and the slow turtle time are assessed**

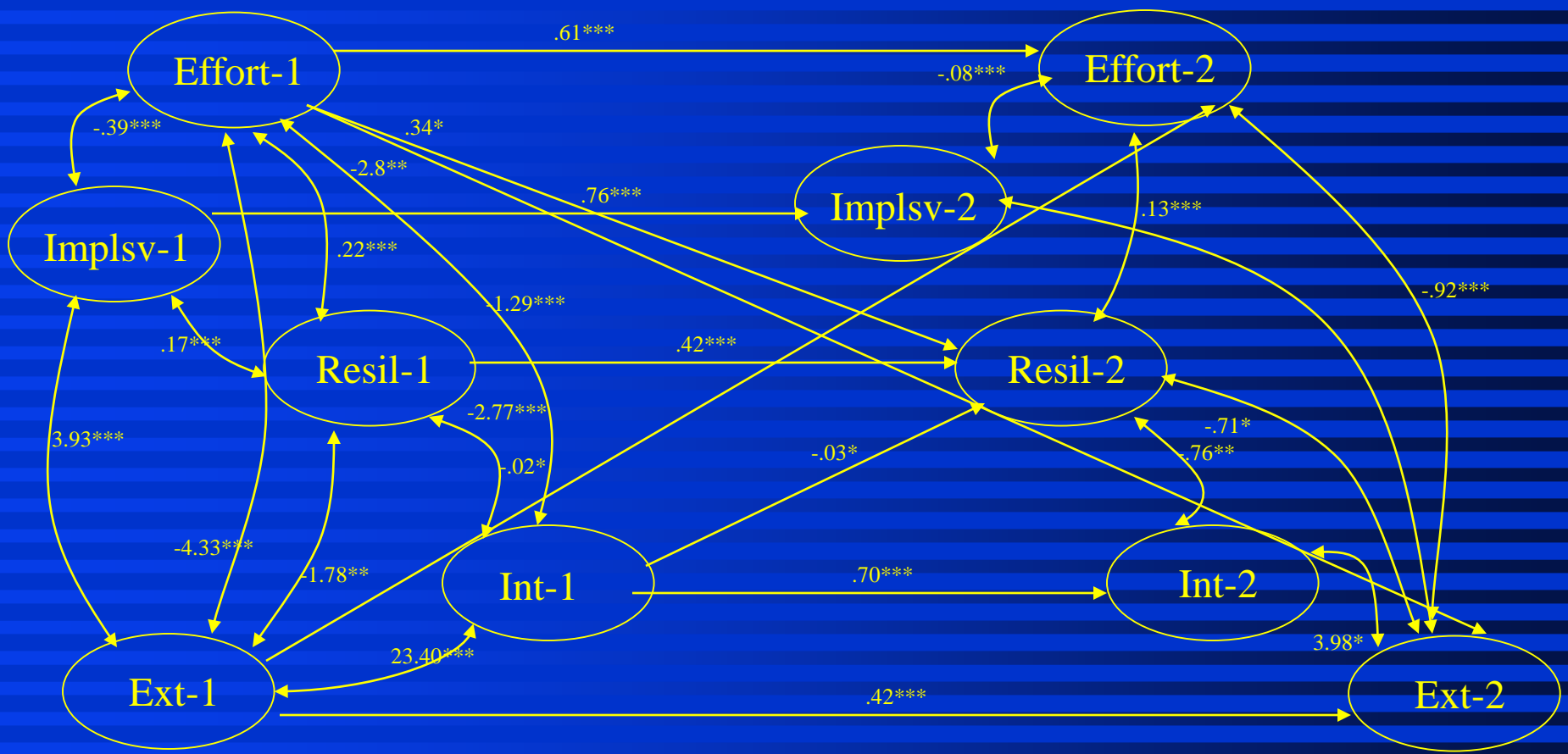
Time 2



Chisq (55, N=193)=86.846, p>.004, CFI= .974' RMSEA=.055

2 years later at Time 2 (T2)

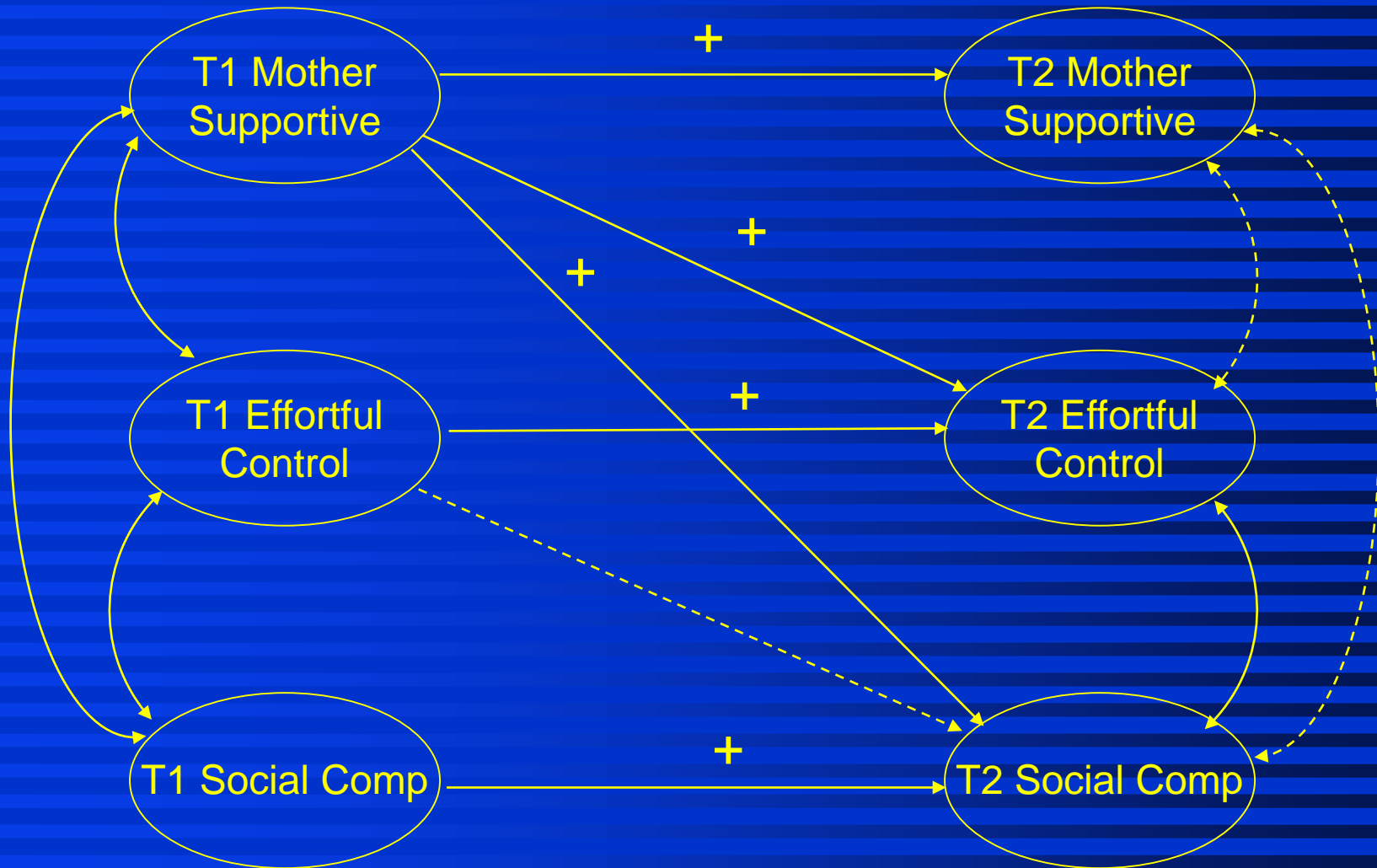
- **same pattern except the relation between impulsivity and externalizing became near significant (although there was a significant zero-order correlation between the two)**



Chisq (9, n=214)=10.59. $p < .30$; CFI= .999; RMSEA = .03.

Evidence of bi-directionality in relations

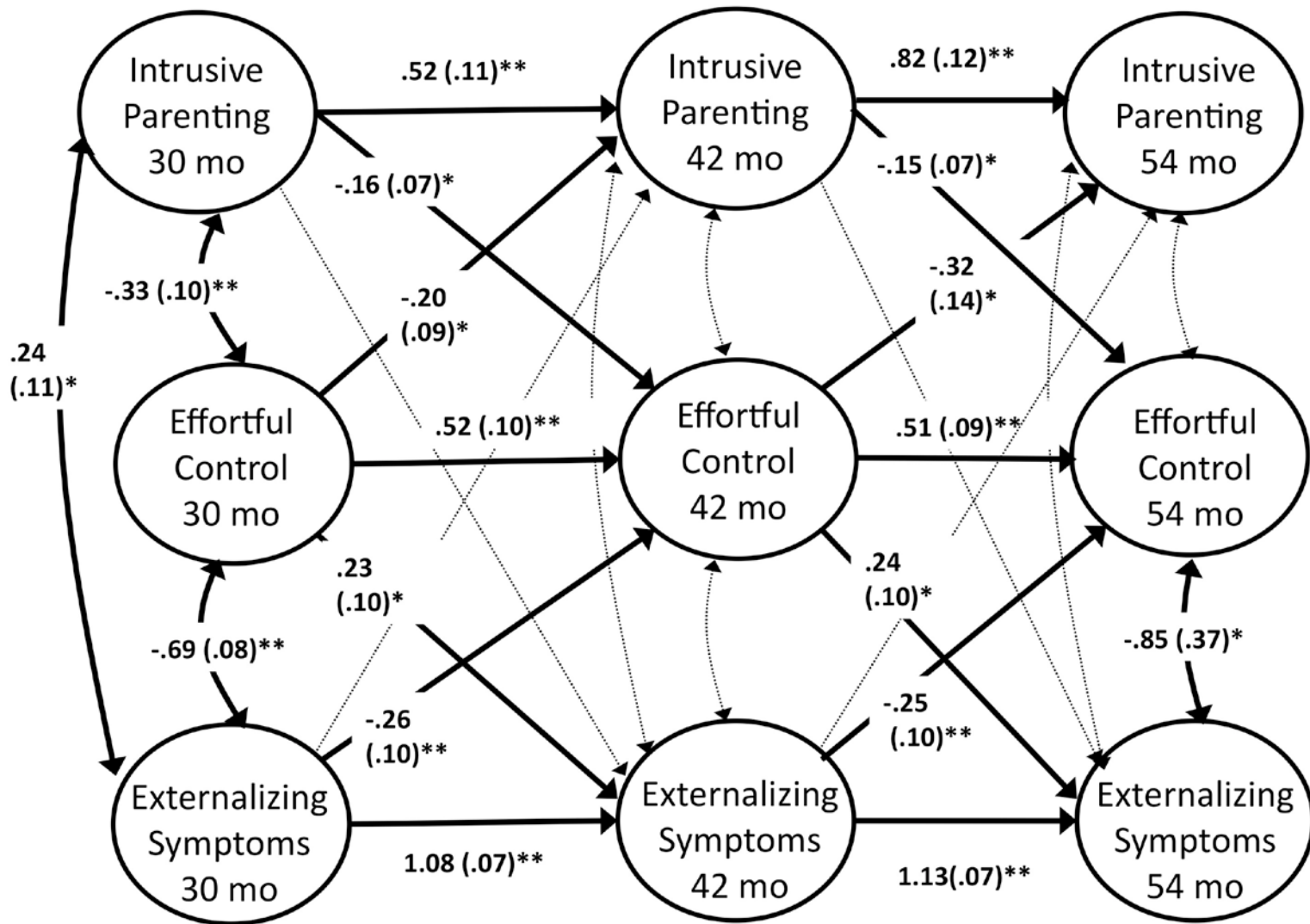
Longitudinal Model for Social Competence



Our New Directions

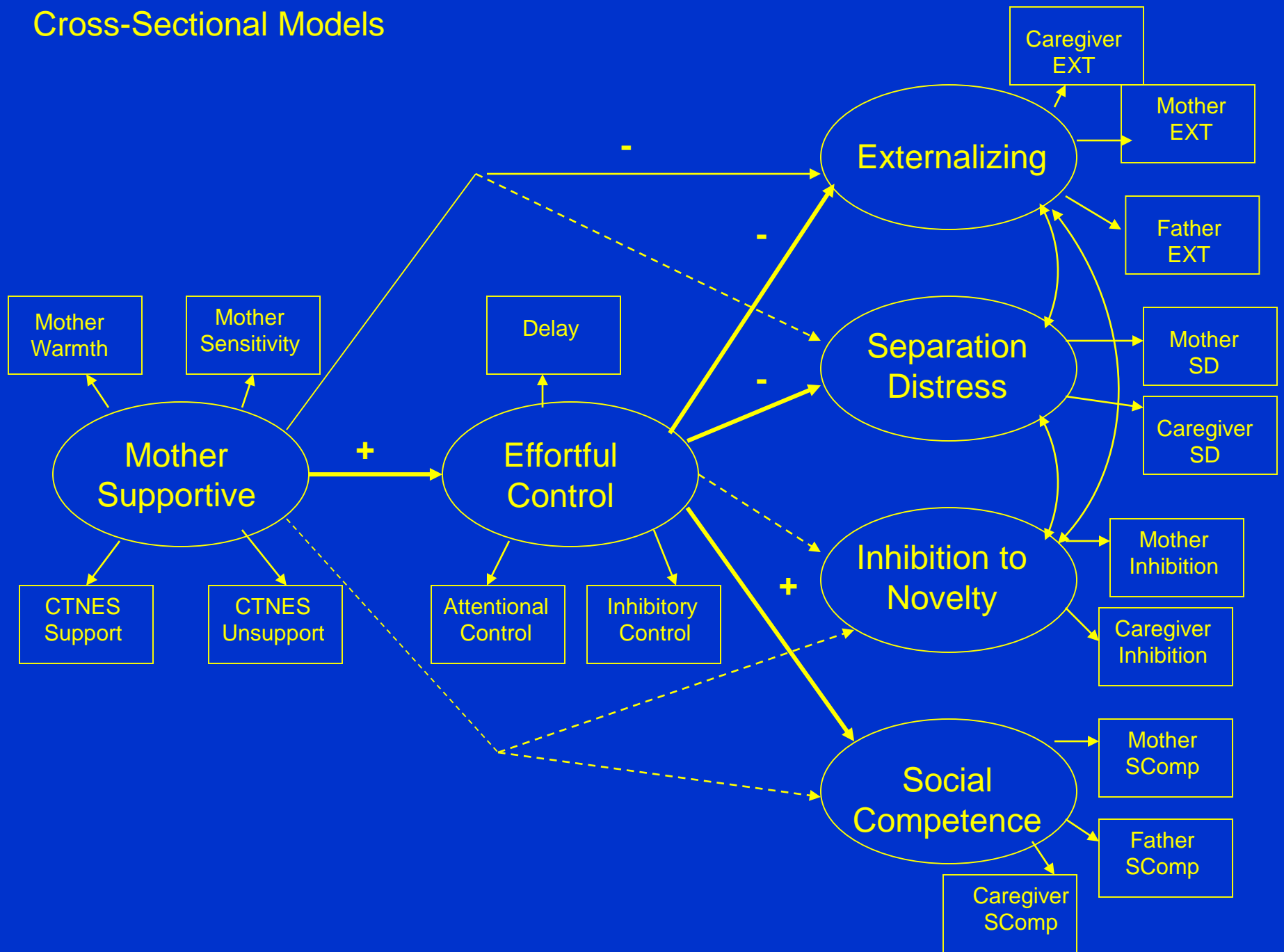
- interventions, e.g., work of Diamond, Greenberg, Bierman, Izard, Domitrovich & others (including using meditation; e.g., Tang)
- which genes relate to effortful control & adjustment (Posner, Rothbart, Fossella)?
- gene X environment interactions
 - Kochanska (2009) found that among children with a short 5-HTTLPR allele (but not those with long alleles), insecurely attached children developed poor effortful control whereas those who were securely attached did not differ

- **child first knocks on the table when the experimenter knocks on the table & taps on the table when the experimenter taps**
- **then the child has to knock on the table when the experimenter taps and tap on the table when the experimenter knocks**
 - **these are the critical trials; this is a common executive functioning task**

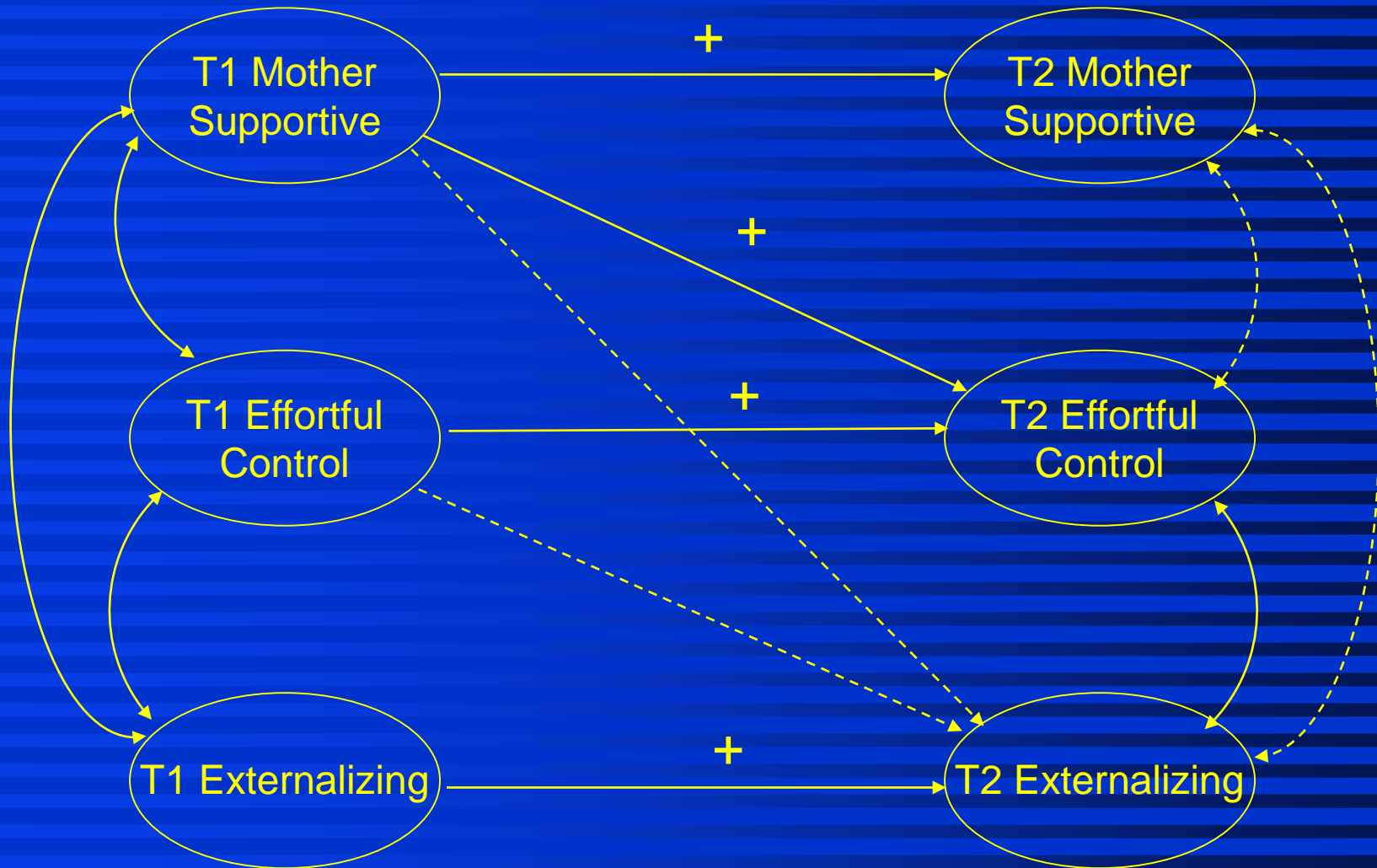


- **child must put her hands on the mat and wait to take candy under a see-through plastic cup until the adult rings a bell; the trials get longer over time**

Cross-Sectional Models



Longitudinal Model for Externalizing Problems: 18 & 30 Months

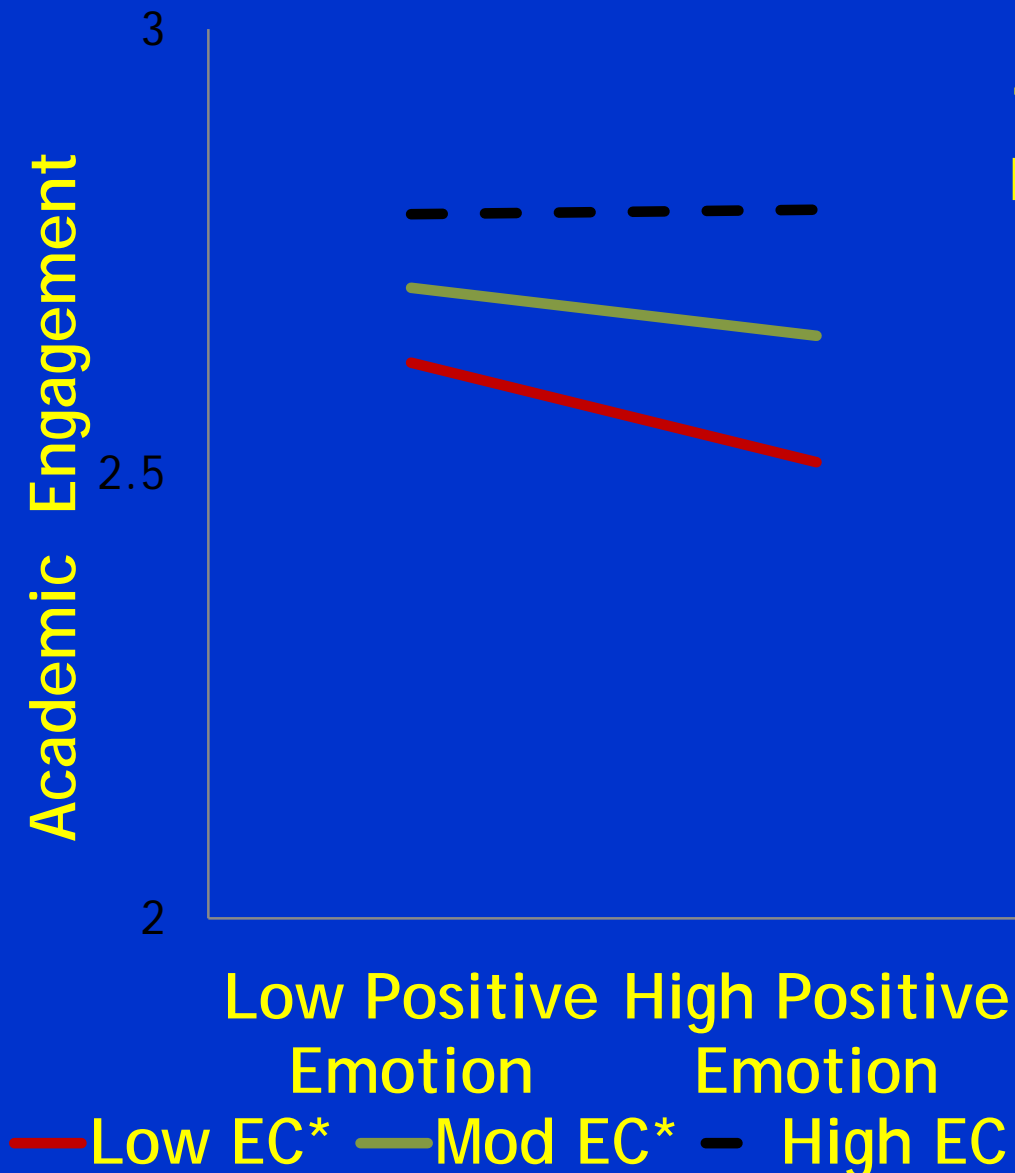


Development of Effortful Control

- the abilities to regulate attention and behavior improve some in infancy but are still immature at 24 months
- there is a dramatic improvement in these abilities in the 3rd year of life
- these skills are fairly well developed by 4 or 5 years but continue to improve across childhood, in adolescence (with continued prefrontal cortex development), and into adulthood

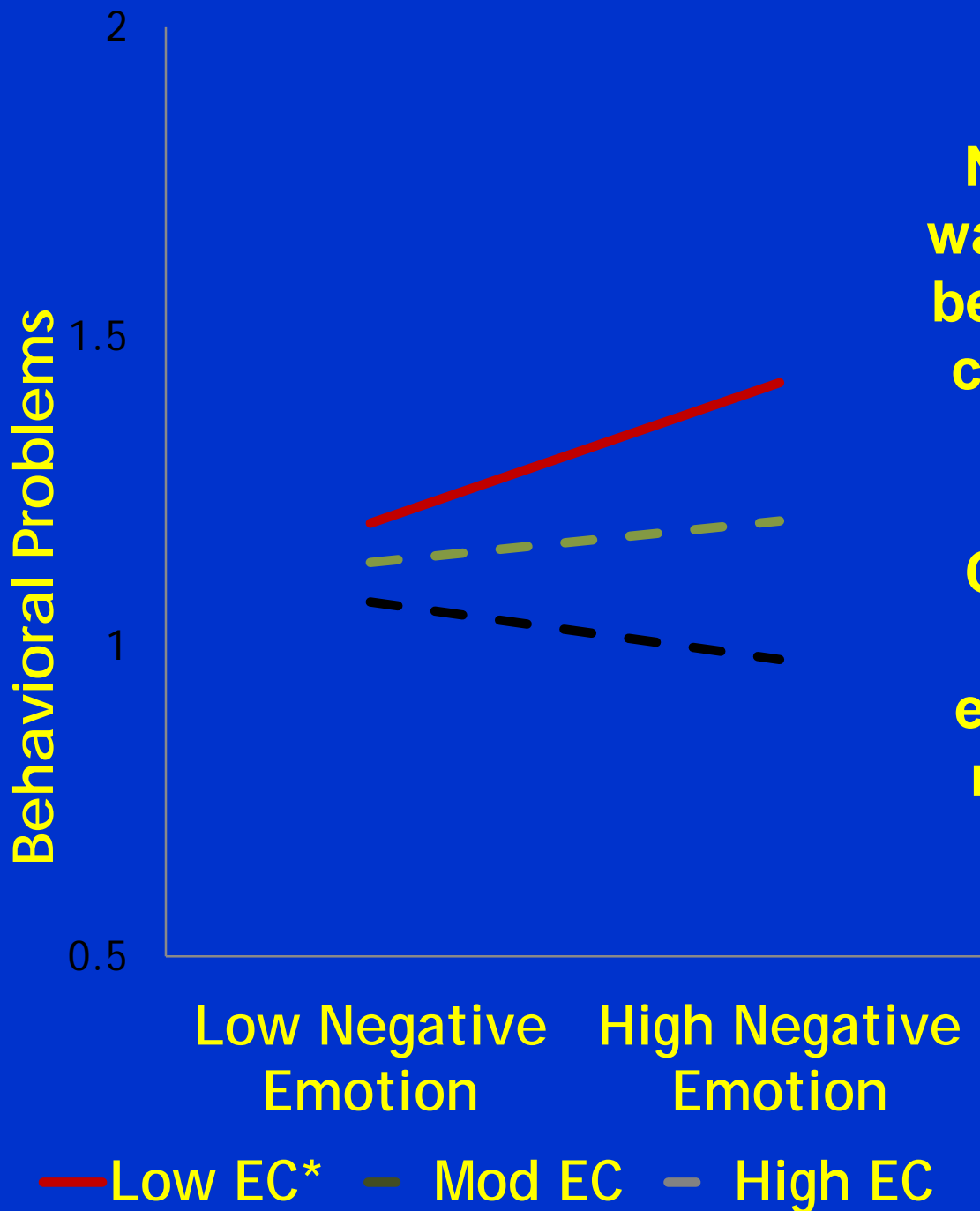
- at Time 1 (T1; about age 5-7), EC predicted higher resiliency, which in turn predicted lower internalizing
- EC predicted fewer externalizing problems
- impulsivity predicted more externalizing problems
- impulsivity predicted more resiliency, which predicted fewer internalizing problems

Interaction Between Positive Emotion Expressivity & Effortful Control



There was a negative relation between positive expressivity and academic engagement at low and moderate levels of EC, $ps < .05$, but not at high EC (where engagement was consistently high)

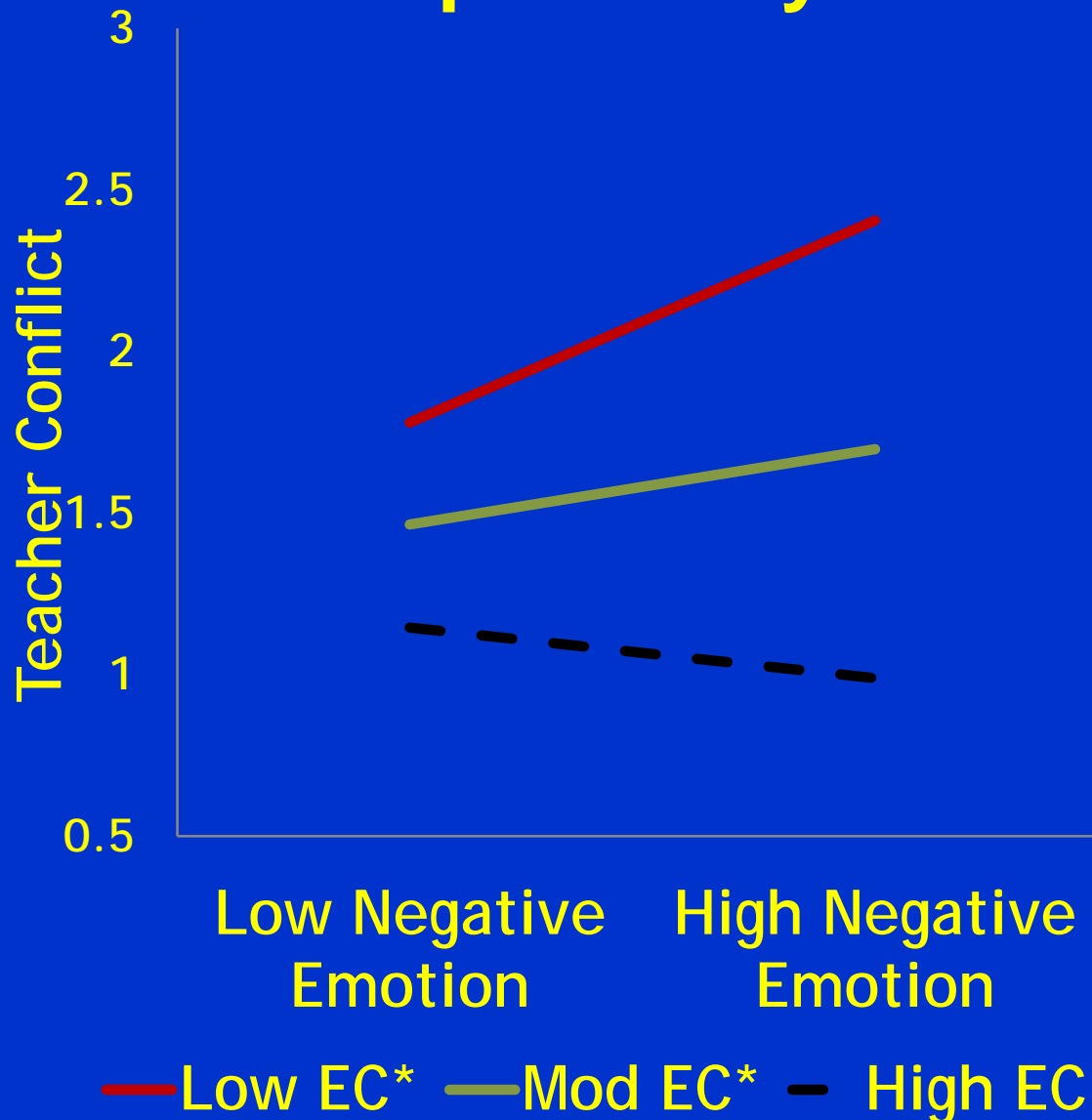
Behaviors such as laughing may make it difficult to focus on lessons and properly engage in classroom activities if not regulated



Negative expressivity was positively related to behavioral problems for children low in EC, $p = .001$

Children higher in EC tended to be low in externalizing behavior regardless of level of observed negative emotion

Interaction Between Negative Emotion Expressivity & Effortful Control



The positive relation between observed negative emotion and student-teacher conflict was significant at low and moderate levels of EC, $ps < .05$, But not high levels of EC

Those high in EC tended to be low in conflict regardless of the level of negative expressivity

Emotion-related self-regulation occurs at several levels:

- ***sensory receptors (input regulation):***
control of perceptual & experiential input through processes such as attention shifting/focusing and selection or modification of contexts that the individual encounters (e.g., turn away from frightening movie or a shy person selecting not to attend a social event)

■ *central level where information is processed and manipulated:*

modifying the meaning and significance of events or experiences in one's mind (e.g., positive cognitive restructuring—when one reinterprets events in a positive light)

- *response selection (output regulation)*

- **changing or selecting behavioral responses (e.g., facial expressions) that stem from, or are associated with, internal emotion-related psychological or physiological states**

- (Campos et al., 1994)**

- Eisenberg & Zhou (2016) argued that top-down self-regulation (TDSR) does not include working memory (although it helps with TDSR & is closely related); Nigg (in press) suggests that it is part of self-regulation
- TDSR includes some aspects of coping (e.g., seeking social support, active coping) traditionally not considered as EF (Eisenberg et al., 1997; Eisenberg & Zhou, 2016), although the construct of higher-level EF can include some of these coping behaviors (Diamond, Nigg)

In a third longitudinal study,

- **found evidence of bidirectional relations between mothers' punitive reactions to children's emotions and children's EC**
 - **and both at least marginally predicted externalizing problems**