Which life course theoretical models best explain the relationship between childhood adversity and depressive symptoms in adolescence?

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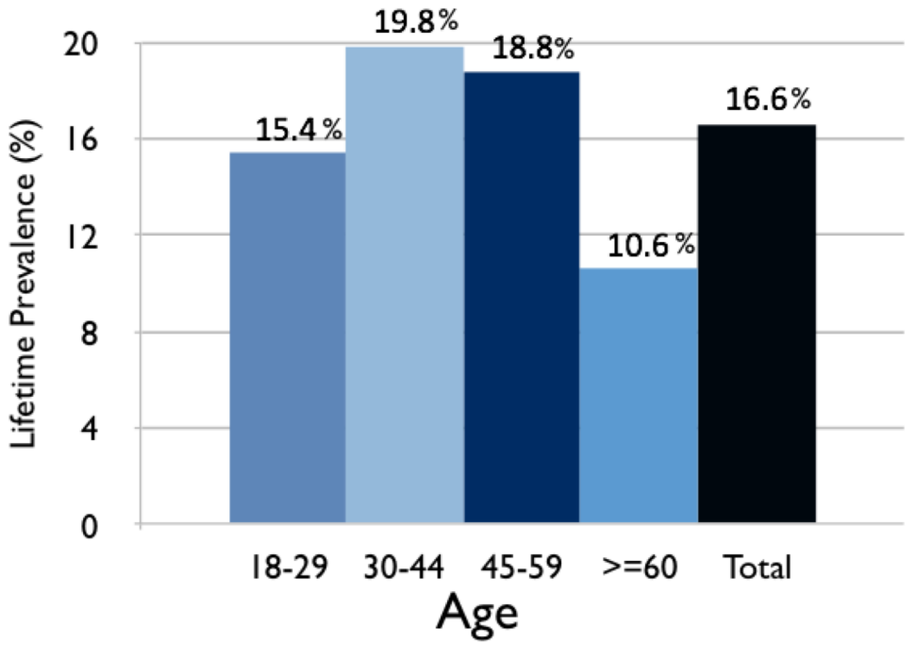
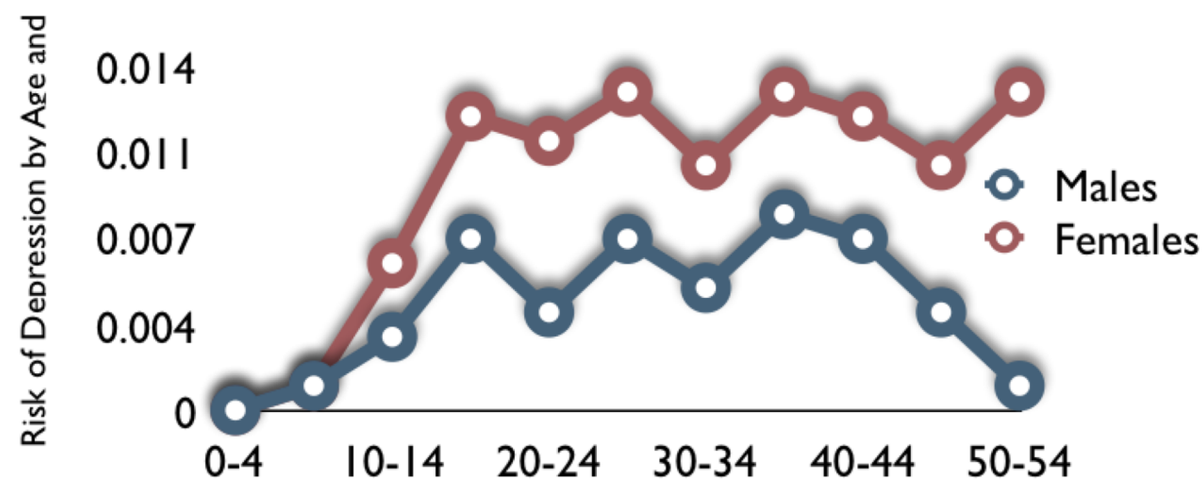
Depression: a major public health issue

It is common throughout the lifespan,



disproportionally affects women,



is associated with many consequences,

and is the leading cause of disability worldwide.

Kessler RC, et al. (2005). *Archives of General Psychiatry*.

Kessler RC & Bromet E (2013). *Annual Review of Public Health*.

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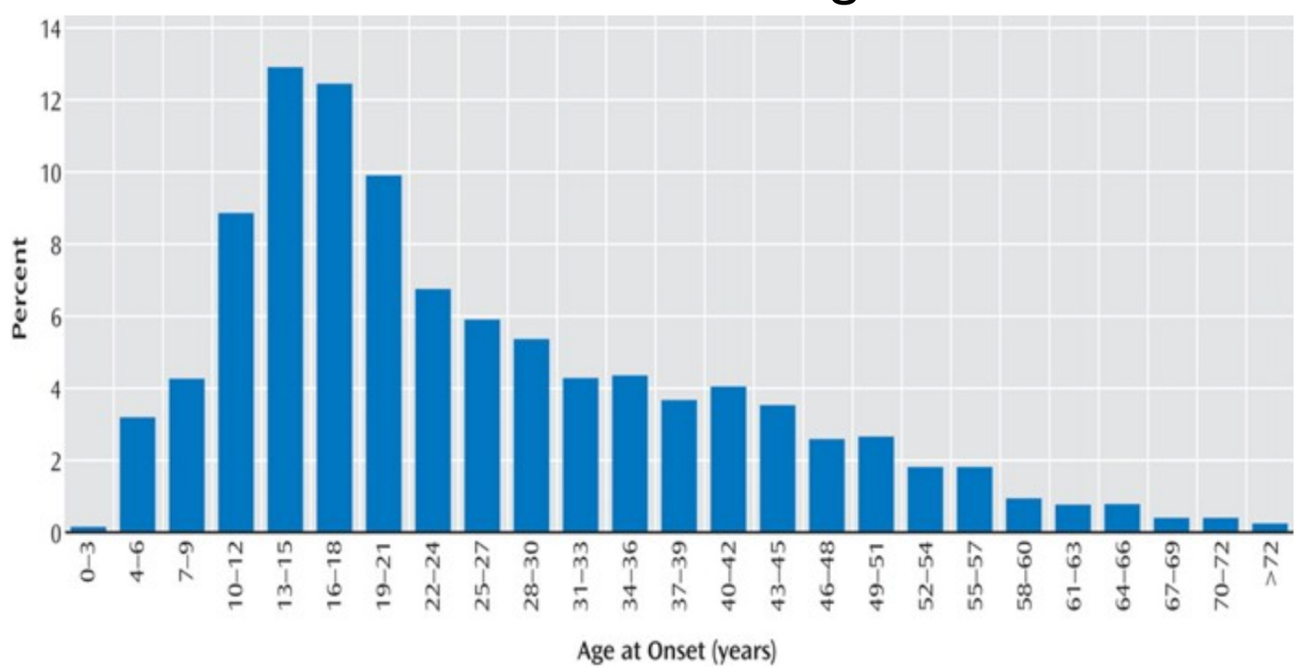
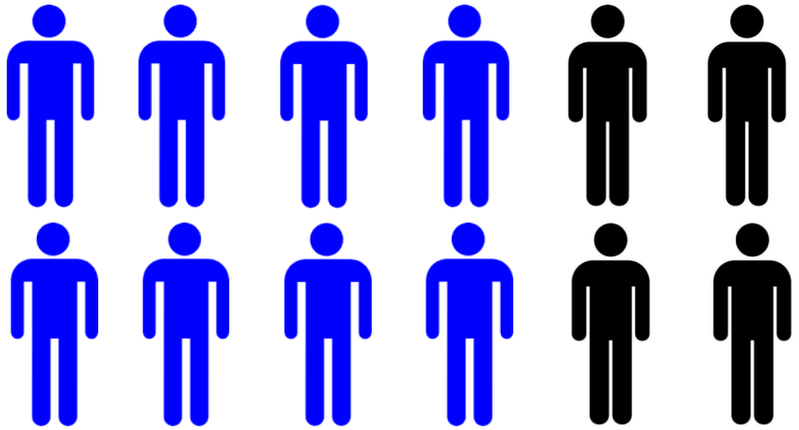
Preventing depression is key

...because it strikes when people are young and once it emerges, it is highly recurrent.

1/3 of people with major depressive disorder had their first onset between ages 13-21.



3/4 of people with depression will experience a relapse at some point in their lives.



Conclusion: We need to better understand the etiology of depression in order to prevent its occurrence as early on in the lifespan as possible.

Zisook et al. (2007) American Journal of Psychiatry,1539:1546

Warden D, et al. (2007). Current Psychiatry Reports,

Exposure to stress/adversity is a potent risk factor for depression

Divorce/marital discord

Poverty

Accidents/Injury

Natural disasters

Child abuse/neglect

Death of a loved one

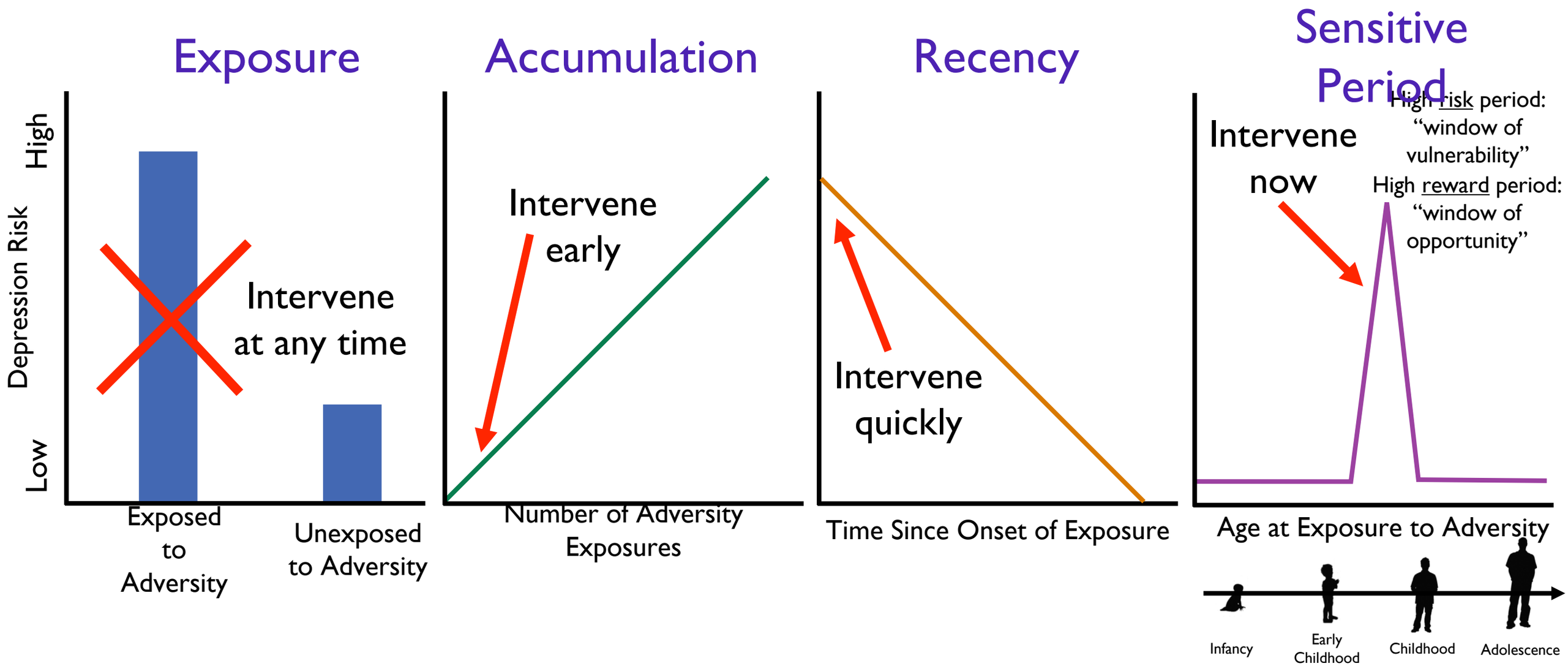
Illness

Witnessing violence

Parent psychopathology

How might childhood adversity increase subsequent risk for depression?

Theoretical Implications for Intervention Models



Goals of the Current Study

- In the current study, we aimed to:
  - Identify sensitive periods in development when exposure to adversity confers a particularly high risk for depression, and
  - Test whether the effects of adversity during sensitive periods are still observable even if we account for other theoretical models.

Sample: ALSPAC

Avon Longitudinal Study of Parents and Children (ALSPAC)
n=~14,000

Challenges
- Children can be exposed repeatedly throughout their lifespan
  Working with repeated, and often correlated, exposures

Two types of caregiver reported adversity

- Caregiver physical or emotional abuse
- Financial stress/poverty

Each assessed repeatedly from birth to age 18

Depression (Short Moods & Feelings)

Relton, C.L., Gaunt, T., McArdle, W., Ho, K., Duggirala, A., Golding, J. Davey Smith, G., et al. (2012). *International Journal of Epidemiology.*

Analytic Approach

- Structured lifecourse modeling approach (SLCMA) to analyze repeated binary exposure data across the lifecourse
- Simultaneously evaluate different pre-specified theoretical models, each describing the association between exposure to adversity and depressive symptoms at age 18
  - Sensitive period model
  - Accumulation model
  - Recency model
- Step 1: Identify best fitting theoretical models (based on r2) *for each adversity type* using least angle regression (LARS)
  - Recorded the best fitting theoretical model(s) chosen by the LARS procedure, (determined by a covariance test p-value threshold of 0.05)
- Step 2: Test best fitting models using standard linear regression to obtain estimates of effect

Smith, A.D.A.C., Heron, J., Mishra, G., Gilthorpe, M.S., Ben-Shlomo-Y., & Tilling, K. (2015). *Epidemiology*

Overview of LARS with LASSO Estimation

Code each theoretical model into an encoded variable: sensitive_3: 0=unexposed ; 1=exposed accumulation=sum of number of time points exposed; recency: accumulation score weighted by time period

→

Enter each encoded variable into least angle regression (LARS) using LASSO as estimation procedure

→

LASSO = Least Absolute Shrinkage and Selection Operator

Imposes an "absolute value penalty" on the parameter estimates, in essence reducing effect estimates with already small effects to zero

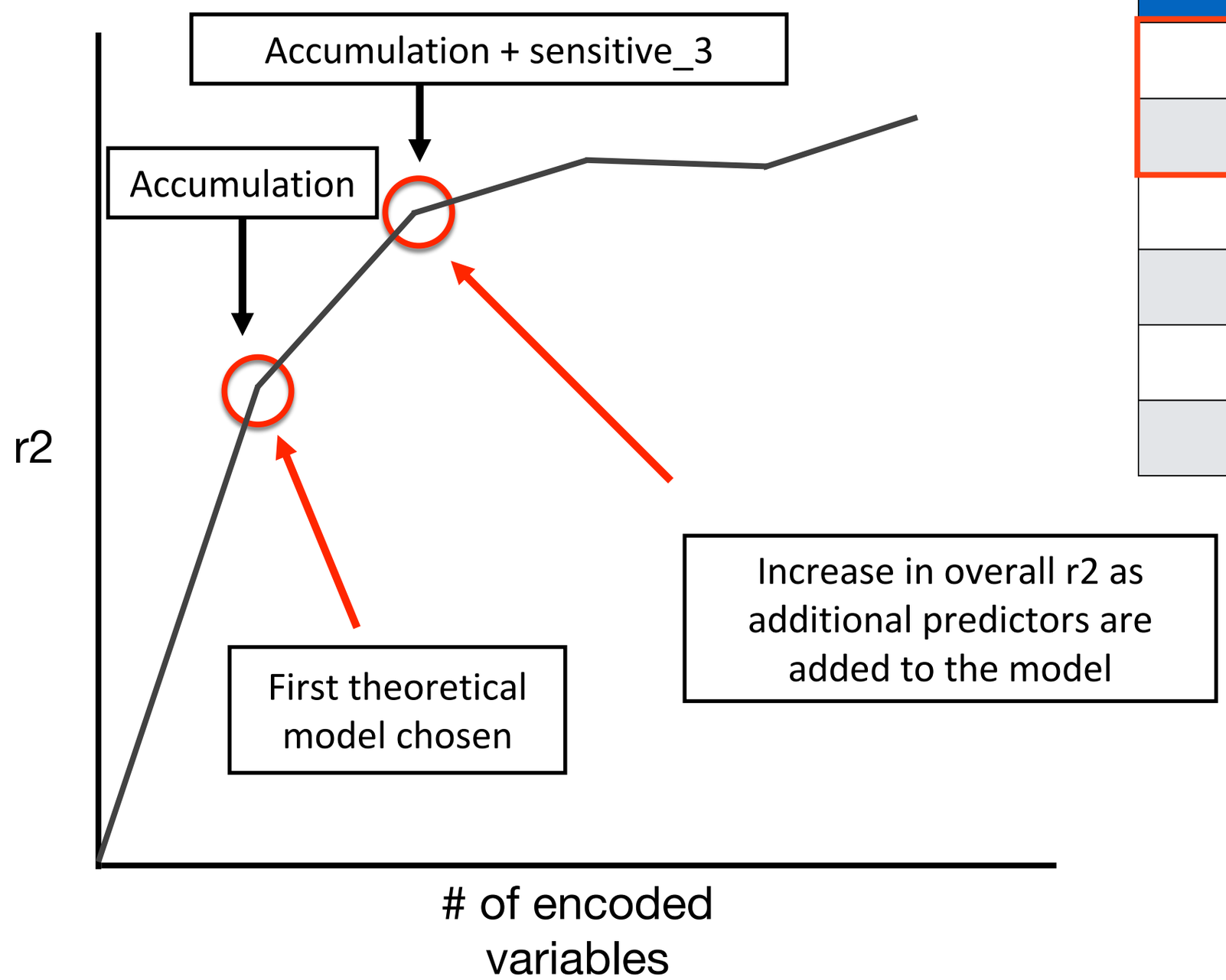
←

LASSO aids in achieving parsimony by identifying the smallest combination of encoded variables that explain the most amount of outcome variation

Smith, A.D.A.C., Heron, J., Mishra, G., Gilthorpe, M.S., Ben-Shlomo-Y., & Tilling, K. (2015). *Epidemiology*

Interpreting LARS Results

Results are summarized in an "elbow plot"



Variable	Drop in covariance	P Value
1	17.396	0.0012
2	1.2234	0.0438
3	0.8836	0.1734
4	0.0023	0.5672
5	0.0001	0.9738
6	0.0020	0.9803

Also evaluate quantitatively through covariance hypothesis test

Smith, A.D.A.C., Heron, J., Mishra, G., Gilthorpe, M.S., Ben-Shlomo-Y., & Tilling, K. (2015). *Epidemiology*

Analysis, cont.

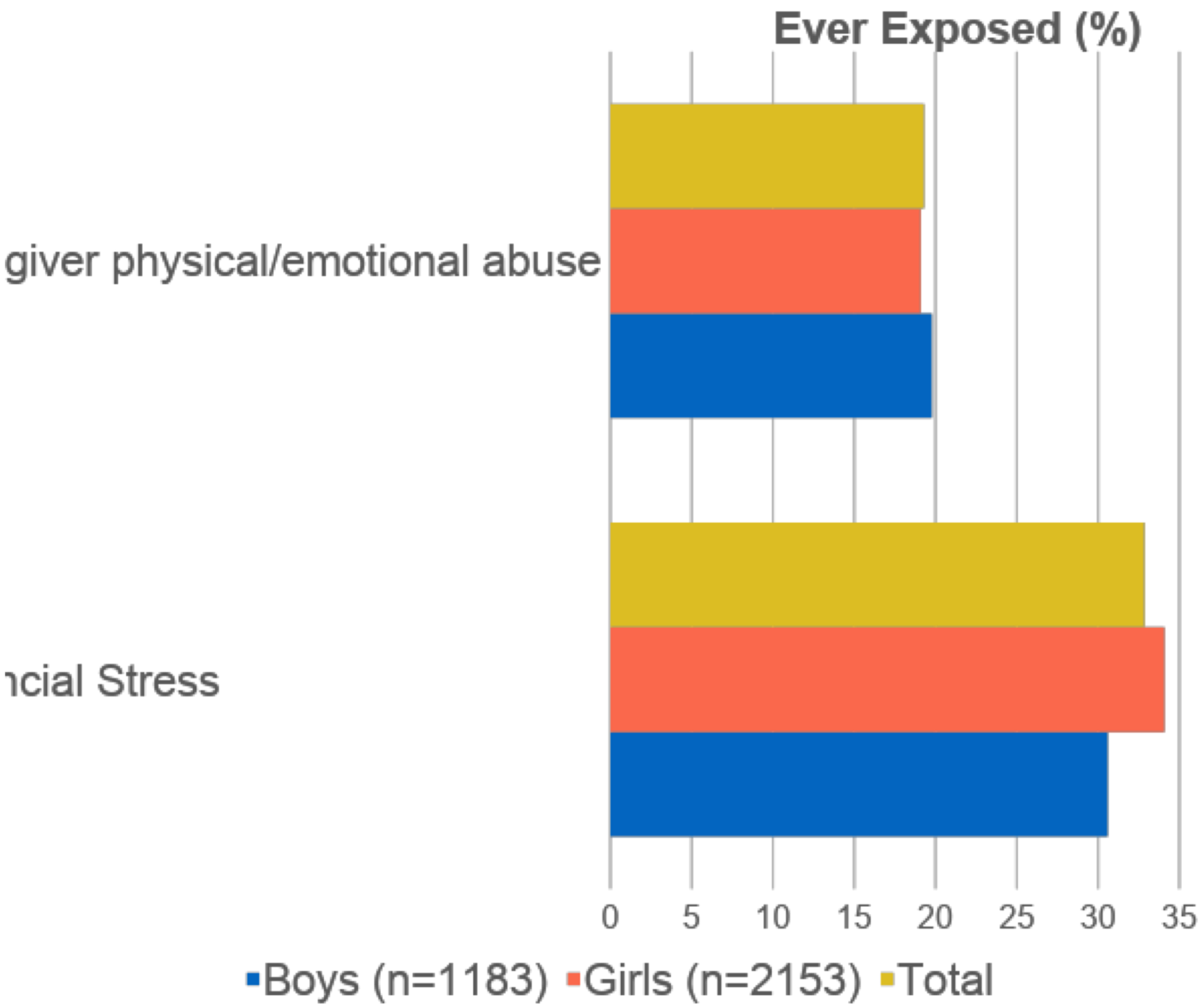
- Ran analyses in two phases to address different questions:
- Phase 1: Are there sensitive periods when exposure to adversity confers a particularly high risk for depression?
  - Testing *only* sensitive periods
- Phase 2: Does these sensitive periods effects persist even after accounting for other theoretical models, like accumulation or recency?
  - Accumulation model
  - Recency model
  - Sensitive periods

Smith, A.D.A.C., Heron, J., Mishra, G., Gilthorpe, M.S., Ben-Shlomo-Y., & Tilling, K. (2015). *Epidemiology*

Analysis, cont.

- To reduce potential bias and minimize loss of power due to attrition, we performed multiple imputation, separately for each exposure, using logistic regression in 20 datasets with 25 iterations each among all children with complete data on the outcome.
- We controlled for the following covariates, measured at child birth:
  - Child race/ethnicity
  - Pregnancy size
  - Number of previous pregnancies
  - Maternal marital status
  - SES-indicators: Highest level of maternal education, Maternal age, Homeownership, and Parent social class
- We also adjusted for maternal psychopathology measured during pregnancy to reduce potential impacts of confounding, as mothers were the primary reporters of their child's exposure to adversity, and maternal mood may influence this.
- All analyses were stratified by sex, given known sex differences in depression risk.

Adversities were common, but not correlated across type



Prevalence ever exposed to either adversity type
44%

Correlation ever exposed between types
r = 0.11

Adversities were correlated across time

Table 1. Tetrachoric correlations for caregiver physical or emotional abuse

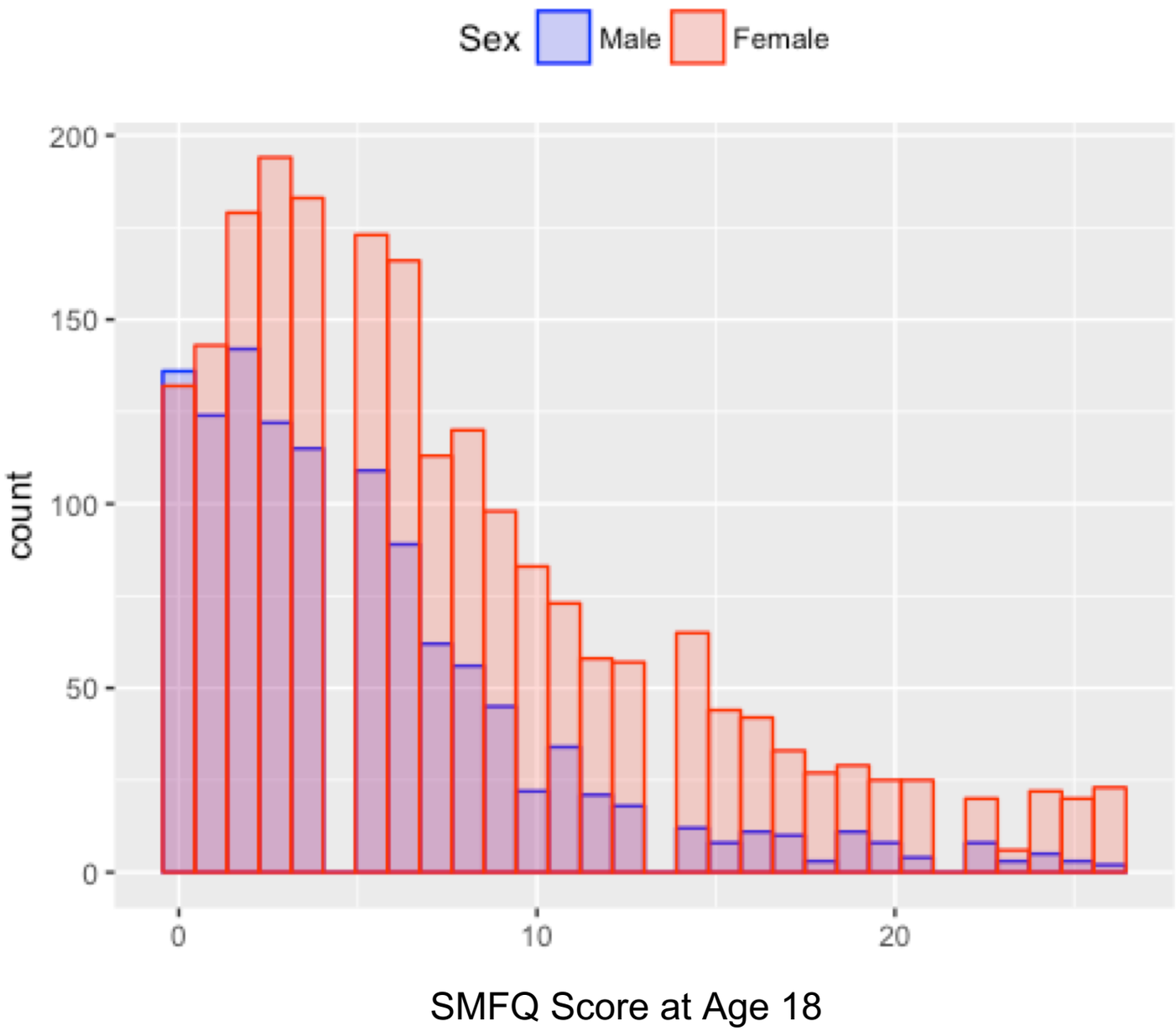
Age	8 mo.	1.75 y	2.75 y	4 y	5 y	6 y	9 y	11 y	18y
8 mo.									
1.75 years	0.76								
2.75 years	0.64	0.75							
4 years	0.59	0.70	0.77						
5 years	0.60	0.57	0.64	0.73					
6 years	0.56	0.55	0.57	0.66	0.77				
9 years	0.50	0.51	0.47	0.63	0.64	0.56			
11 years	0.40	0.37	0.34	0.43	0.47	0.46	0.63		
18 years	0.45	0.34	0.39	0.40	0.42	0.42	0.48	0.6	

Adversities were correlated across time

Table 2. Tetrachoric correlations for financial stress

Age	8 mo.	1.75 y	2.75 y	5 y	7 y	11 y	18y
8 mo.							
1.75 years	0.72						
2.75 years	0.72	0.81					
5 years	0.53	0.60	0.59				
7 years	0.52	0.54	0.46	0.65			
11 years	0.39	0.57	0.54	0.51	0.57		
18 years	0.47	0.44	0.51	0.47	0.51	0.6	

Girls had more depressive symptoms



Average SMFQ score for boys:
5.34

Average SMFQ score for girls:
7.64

Girls on average had significantly more depressive symptoms
($p<.001$)

Phase 1: Identifying sensitive periods

Table 3. Results of LASSO models on multiply imputed data, testing only sensitive periods models

	Model(s) selected	R^2	P Value	β	S.E.	Lower CI	Upper CI
Girls (n=2153)							
Parental Cruelty	Sensitive period at 11 years	0.18%	0.12				
Financial Stress	**Sensitive period at 1.75 years**	0.38%	0.01**	1.93	0.49	0.95	2.92
Boys (n=1183)							
Parental Cruelty	Sensitive period at 9 years	0.40%	0.07				
Financial Stress	**Sensitive period at 2.75 years**	0.42%	0.03*	1.16	0.50	0.12	2.19

Models significant at *p < .05 in bold

Phase 2: Comparing theoretical models

Table 4. Results of LASSO models on multiply imputed data, testing accumulation, recency, and sensitive periods models

	Model(s) selected	R^2	P Value	β	S.E.	Lower CI	Upper CI
Girls (n=2153)							
Parental Cruelty	Accumulation	0.10%	0.33				
Financial Stress	Accumulation	0.09%	0.35				
Boys (n=1183)							
Parental Cruelty	Sensitive period at 9 years	0.40%	0.07				
Financial Stress	**Sensitive period at 2.75 years**	0.42%	0.03	1.16	0.50	0.12	2.19

Models significant at *p < .05 in bold

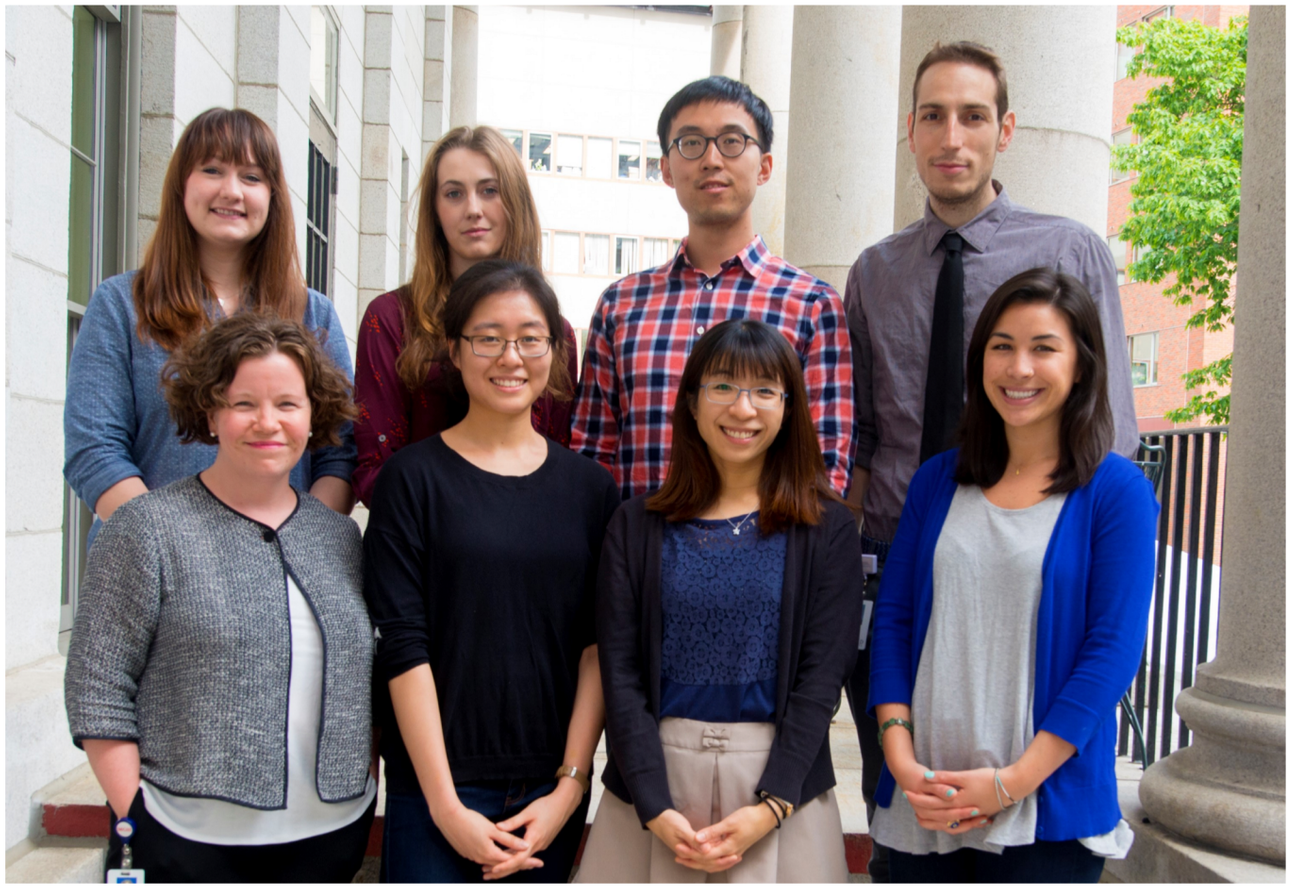
Conclusions

- Very early childhood (age 0-3) seems to be a sensitive period when exposure to financial stress has a particularly strong effect on depressive symptoms in adolescence for both boys and girls.

- For boys, the effect of this sensitive period persists even after accounting for other theoretical models.
    - In other words, the developmental timing of exposure to financial stress explains more variability in depression at age 18 than the number of time points exposed or the recency of exposure.

- Although these results should be replicated, they suggest the need to move beyond crude comparisons of those exposed vs. unexposed to "early life" adversity.

Lab Members and Funding Support



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Yiwen Zhu

Funding Support

Behavioral Research Award for Innovative New Scientists, NIMH (BRAINS; R01MH113930)

Career Development Award, NIMH (K01MH102403)

Harvard Mind, Brain, and Behavior Initiative

Bezos Foundation

Russell Sage Foundation

Thank you!

Questions?:

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Prospective Study of Young Children

Avon Longitudinal Study of Parents and Children (ALSPAC) n=~6,000

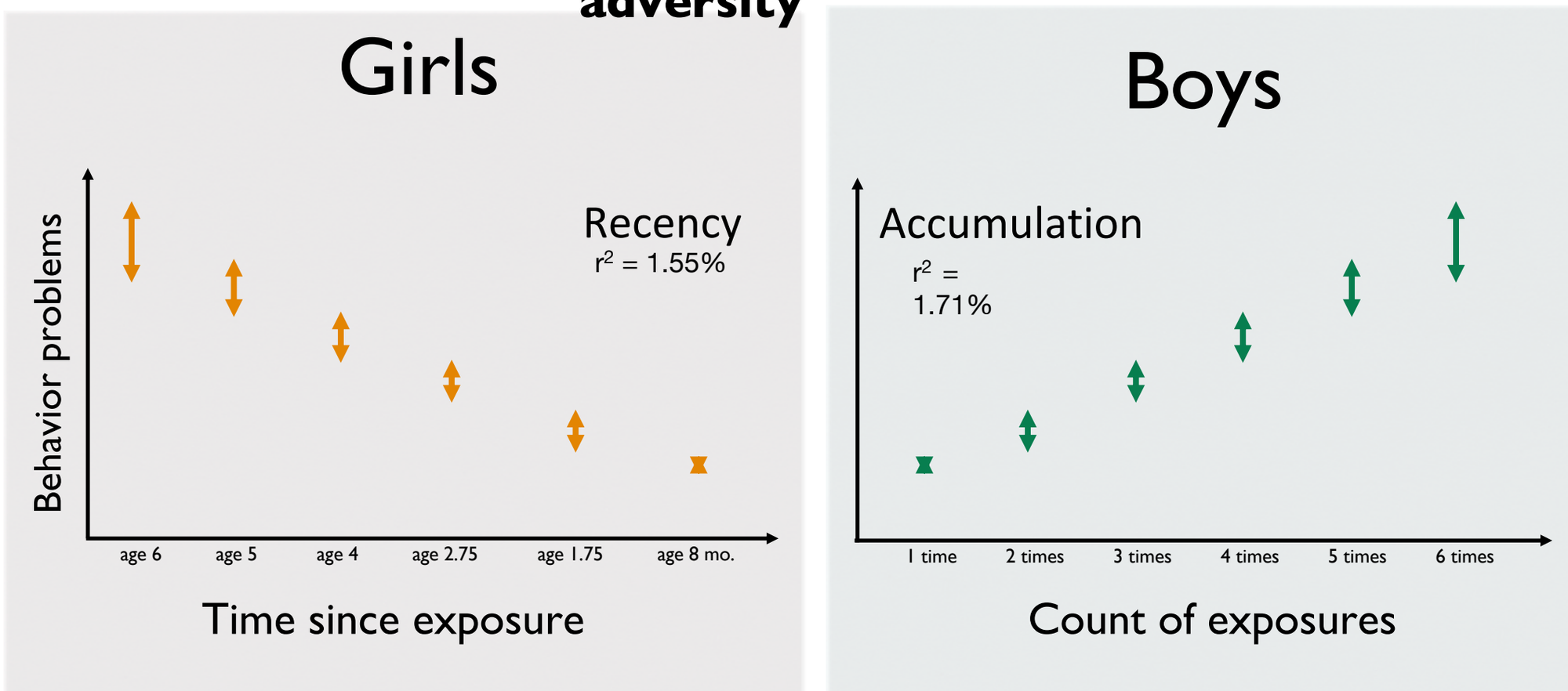
What theoretical model best explains variation: Accumulation, recency, or sensitive period?

Behavior problems

1.5 years | 2.5 years | 3.5 years | 4.75 years | 5.75 years | 6.75 years | 8 years

Exposure to adversity

Caregiver physical or emotional abuse



Dunn, E.C., Soare, T., Raffeld, M., Busso, D.S., Crawford., K., Davis, K., Fisher, V., Slopen, N., Smith, A.D.A.C., Tiemeier, H., & Susser, E.S. (2018) *Psych Med*

Measures

	Construct	Measurement Tool	Sample Items
Exposures	Caregiver physical or emotional abuse	Mother-completed questionnaire	Mother's partner was physically cruel to child in past year
	Financial stress	Mother-completed questionnaire	Mother finds it difficult to afford rent/mortgage
Outcome	Depressive symptoms	Child-completed Short Moods and Feelings Questionnaire (SMFQ) (ranges from 0-26)	In the past two weeks, respondent felt miserable or unhappy