Addressing Contamination Bias in Causal Estimates of the Effect of Child Maltreatment on Adolescent Behavior Problems

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Overview

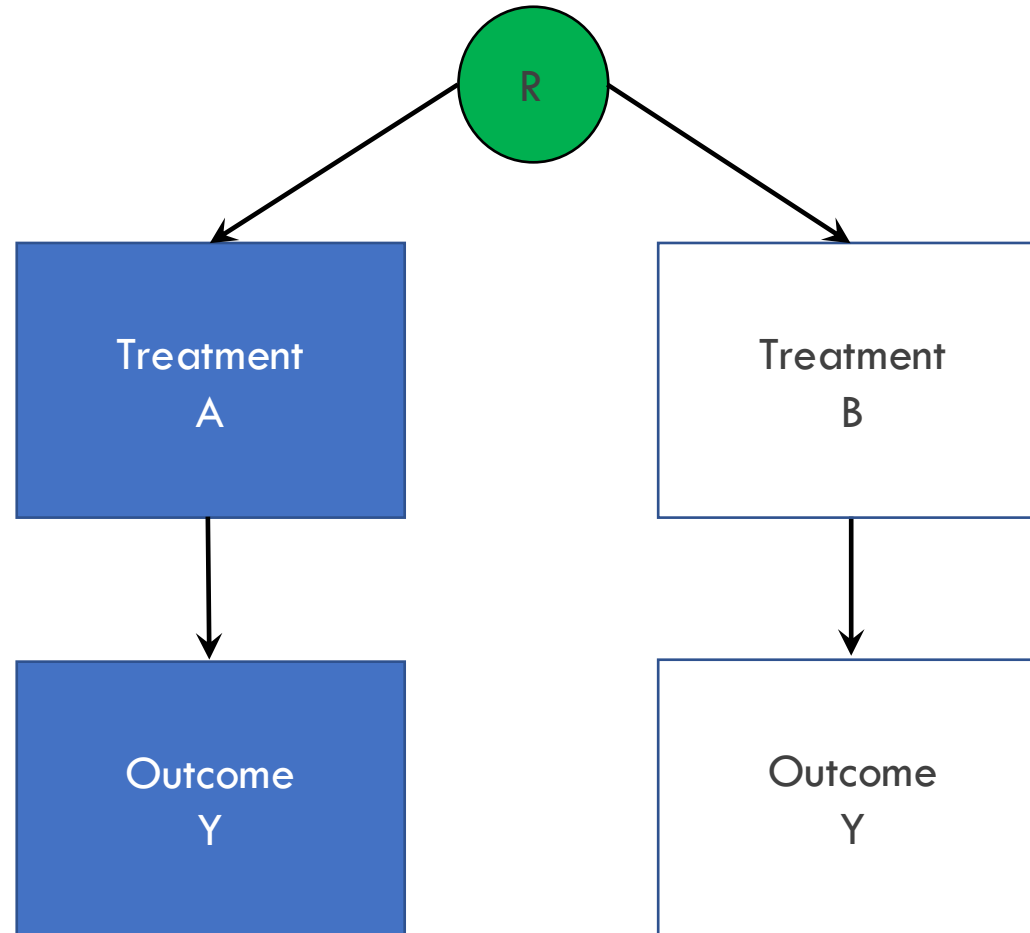Contamination in non-randomized research

- Child maltreatment research as an example

- Prevalence, impact on causal estimates

Causal effect estimation via synthetic control models

- Age vs. time since

- Dual strategy for controlling contamination bias

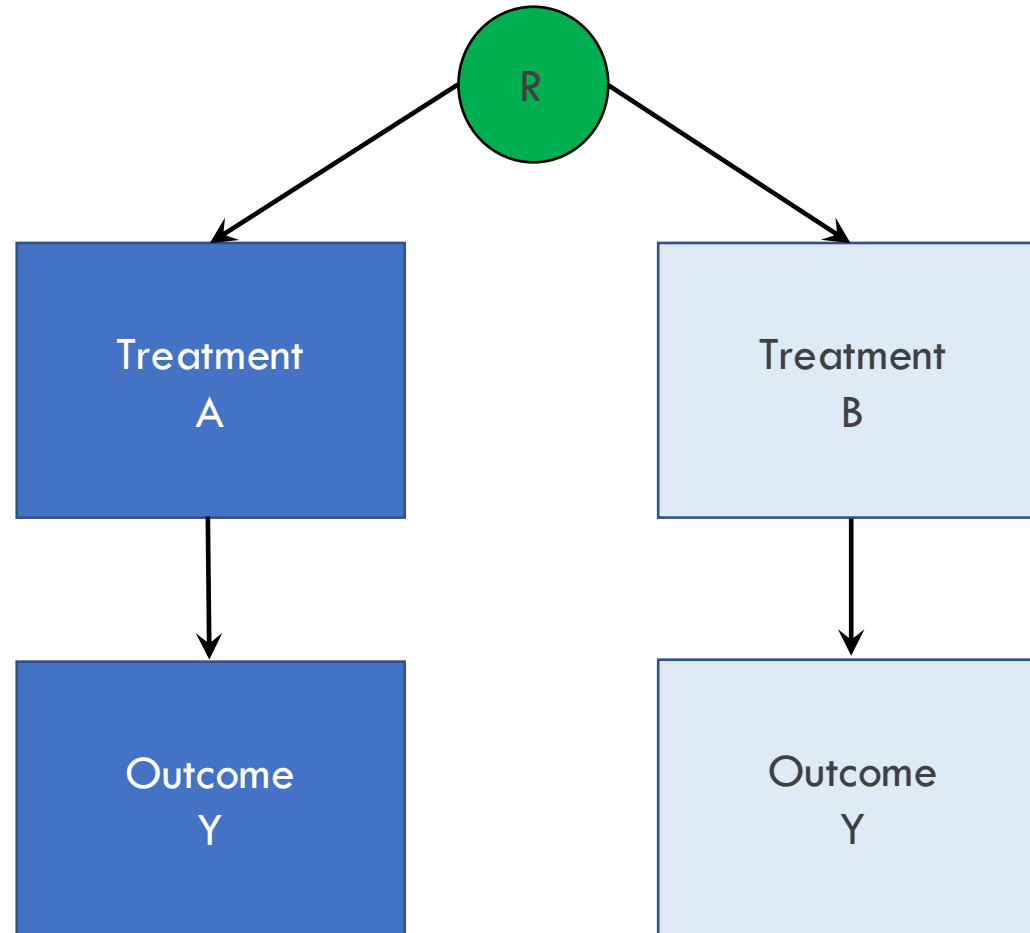- Novel results for internalizing, externalizing behaviors
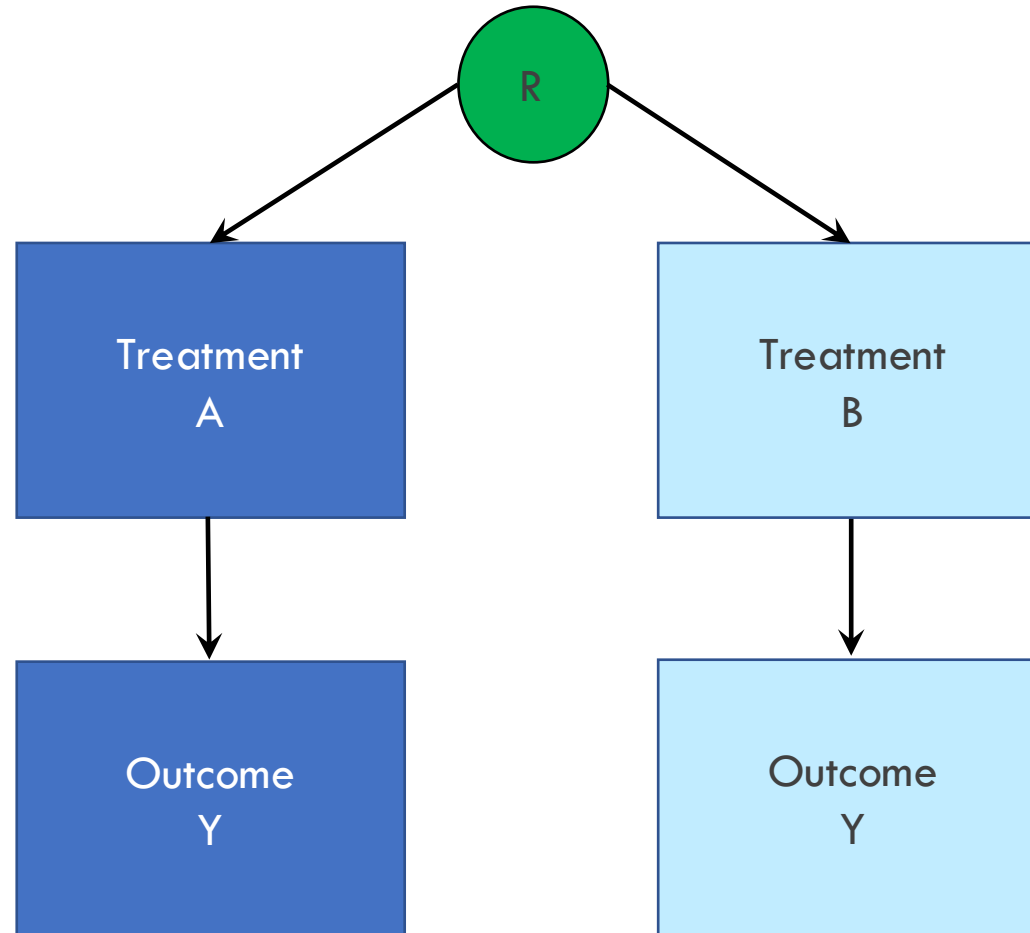
What is Contamination?

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What is Contamination?

Randomized controlled trial

Impact:

Loss of statistical power

Increased probability of Type II errors

Bias in effect size estimates

Jo (2002), *Psychological Methods*; Cuzick, Roberts, & Segnan (1997), *Statistics in Medicine*

What is Contamination?

Prospective cohort study

Treatment — Child Maltreatment

Control — Contamination / Contamination

Maltreatment - Baseline

True Control Group

Maltreatment - Follow-up

Adapted from Cuzick et al. (1997), *Statistics in Medicine*

Prevalence of Contamination

Widom's Longitudinal Cohort: 45%

Rochester Youth Development Study: 18%

Female Adolescent Development Study: 45%

Scott's Longitudinal Cohort: 15%

LONGSCAN: 65%

Widom & Morris (1997), *Psychological Assessment*; Smith et al (2008), *American Journal of Orthopsychiatry*; Shenk et al (2016), *Journal of Pediatric Psychology*; Scott et al (2010), *Archives of General Psychiatry*

Prospectively Ascertained Child Maltreatment and Its Association With *DSM-IV* Mental Disorders in Young Adults

Kate M. Scott, PhD, MA Appl(Clin Psych); Don R. Smith, MA; Pete M. Ellis, PhD, BMBCh

Table 6. *DSM-IV* Disorder Groups Among Young Adults With Child Protection Agency History Compared With Those Without[a]

DSM-IV Mental Disorder Group	Child Protection Agency Group No. (%)	SE	Comparison Group Including Retrospectively Reported Childhood Maltreatment[b] No. (%)	SE	Including Retrospectively Reported Childhood Maltreatment[b] Unadjusted OR (95% CI)	Adjusted OR (95% CI)[c]	Excluding Retrospectively Reported Childhood Maltreatment[b] Unadjusted OR (95% CI)	Adjusted OR (95% CI)[c]
12-Month Disorders								
Any mood disorder	44 (20.94)	3.80	227 (11.90)	1.10	1.96 (1.19-3.23)[d]	1.86 (1.12-3.08)[d]	2.47 (1.47-4.13)[d]	2.38 (1.37-4.14)[d]
Any anxiety disorder	80 (35.74)	5.02	345 (17.92)	1.26	2.55 (1.62-4.00)[d]	2.41 (1.47-3.97)[d]	2.96 (1.87-4.69)[d]	2.92 (1.73-4.91)[d]
Any substance use disorder	38 (16.98)	3.13	186 (8.70)	0.88	2.15 (1.32-3.49)[d]	1.71 (1.01-2.88)[d]	2.55 (1.55-4.21)[d]	2.29 (1.31-4.01)[d]
Any disorder	103 (50.54)	5.03	540 (29.02)	1.81	2.55 (1.62-4.00)[d]	2.32 (1.39-3.85)[d]	2.96 (1.87-4.69)[d]	2.83 (1.68-4.80)[d]
Any 2 disorders	28 (12.13)	3.13	130 (6.11)	0.68	2.12 (1.15-3.92)[d]	1.40 (0.72-2.73)	2.54 (1.35-4.76)[d]	1.55 (0.75-3.21)
Any ≥3 disorders	28 (13.27)	3.03	110 (5.44)	0.68	2.66 (1.49-4.75)[d]	2.67 (1.47-4.87)[d]	3.71 (2.00-6.89)[d]	4.47 (2.29-8.75)[d]
Lifetime Disorders								
Any mood disorder	75 (32.91)	3.95	399 (20.23)	1.25	1.93 (1.31-2.85)[d]	1.80 (1.21-2.68)[d]	2.50 (1.67-3.74)[d]	2.31 (1.52-3.50)[d]
Any anxiety disorder	99 (43.72)	5.22	498 (25.47)	1.46	2.27 (1.47-3.52)[d]	2.04 (1.24-3.33)[d]	2.84 (1.82-2.44)[d]	2.68 (1.61-4.46)[d]
Any substance use disorder	93 (39.68)	4.32	389 (18.15)	1.12	2.97 (2.02-4.37)[d]	2.38 (1.55-3.65)[d]	3.73 (2.51-5.55)[d]	3.11 (1.97-4.91)[d]
Any disorder	136 (64.66)	5.99	795 (43.83)	2.05	2.34 (1.37-4.01)[d]	2.12 (1.20-3.75)[d]	2.91 (1.69-5.00)[d]	2.80 (1.58-4.97)[d]
Any 2 disorders	36 (17.68)	4.04	214 (10.43)	0.88	1.84 (1.05-3.25)[d]	1.30 (0.67-2.53)	2.28 (1.28-4.04)[d]	1.54 (0.77-3.08)
Any ≥3 disorders	67 (28.77)	4.13	247 (11.35)	0.94	3.16 (2.03-4.90)[d]	2.86 (1.79-4.56)[d]	4.19 (2.64-6.66)[d]	3.80 (2.29-6.33)[d]

Increase in Effect Size Magnitude:

Past Year Disorder - 22%

Lifetime Disorder - 32%

Contamination in the Prospective Study of Child Maltreatment and Female Adolescent Health

Chad E. Shenk,[1,2] PHD, Jennie G. Noll,[1] PHD, James L. Peugh,[3,4] PHD, Amanda M. Griffin,[1] MS, and Heather E. Bensman,[3] PSYD

Table III. The Relative Risk of Child Maltreatment on Female Adolescent Health

Outcome	No control of contamination-baseline model (N = 498)		Contamination controlled-multimethod strategy (N = 394)	
	RR	95% CI	RR	95% CI
Teenage births				
Unadjusted	1.80**	1.17–2.78	2.89**	1.47–5.66
Adjusted[a]	1.66*	1.06–2.61	2.21*	1.06–4.63
Obesity				
Unadjusted	1.16	0.88–1.52	1.51*	1.04–2.21
Adjusted[b]	1.16	0.90–1.50	1.47*	1.03–2.08
Major depression				
Unadjusted	1.59	0.99–2.57	4.04**	1.64–9.97
Adjusted[b]	1.28	0.79–2.08	2.95*	1.22–7.16
Past-month cigarette use				
Unadjusted	2.01***	1.51–2.66	2.64***	1.74–3.99
Adjusted[b]	1.36*	1.06–1.74	1.68**	1.21–2.35

Increase in Effect Size Magnitude:
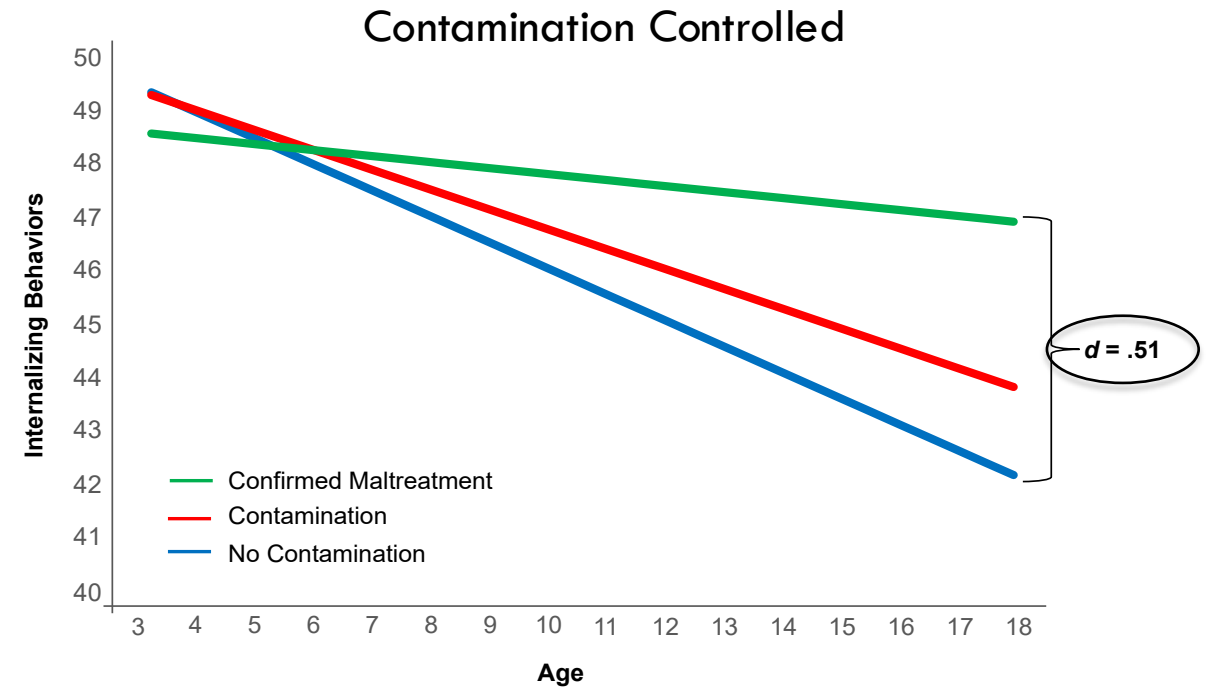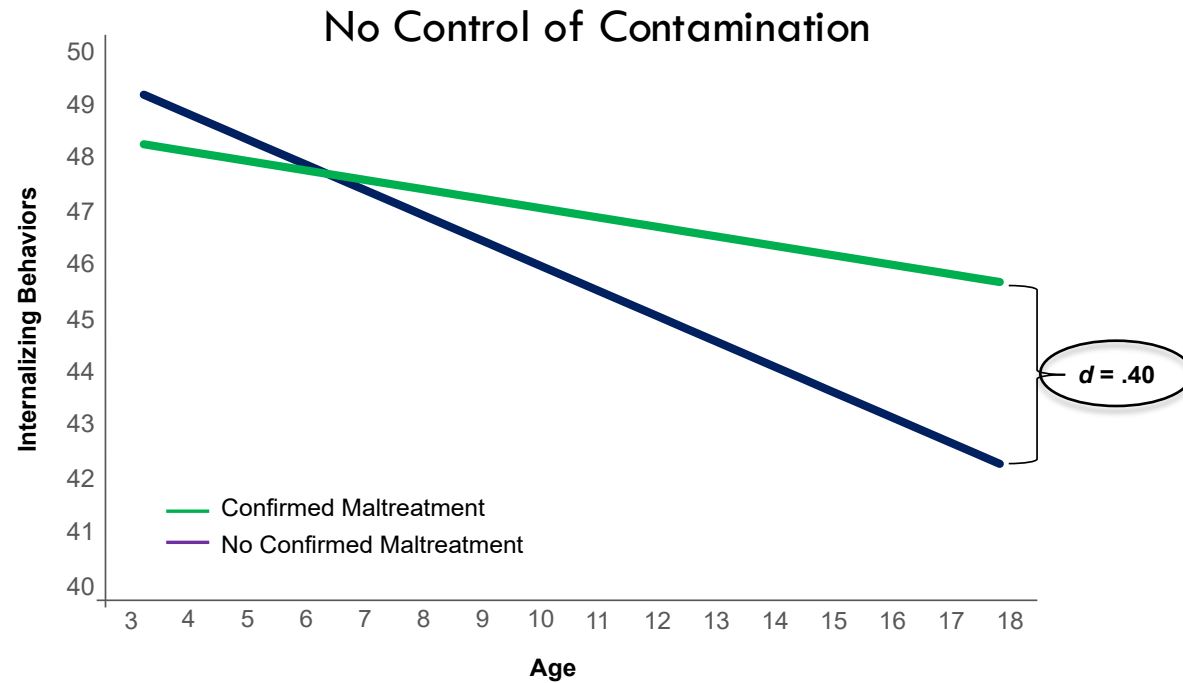
Teenage Births - 33%

Obesity - 27%

Major Depression - 130%

Cigarette Use - 24%

Controlling contamination in child maltreatment research: Impact on effect size estimates for child behavior problems measured throughout childhood and adolescence

Chad E. Shenk[1,2] (iD), Joseph R. Rausch[3,4], Kenneth A. Shores[5], Elizabeth K. Allen[1] and Anneke E. Olson[1]

Increase in Effect Size Magnitude:

Internalizing behaviors - 28%; Externalizing behaviors - 53%

Synthetic Control Methods

Causal inference for observational longitudinal, time series data

Combination of matching and difference-in-differences approaches

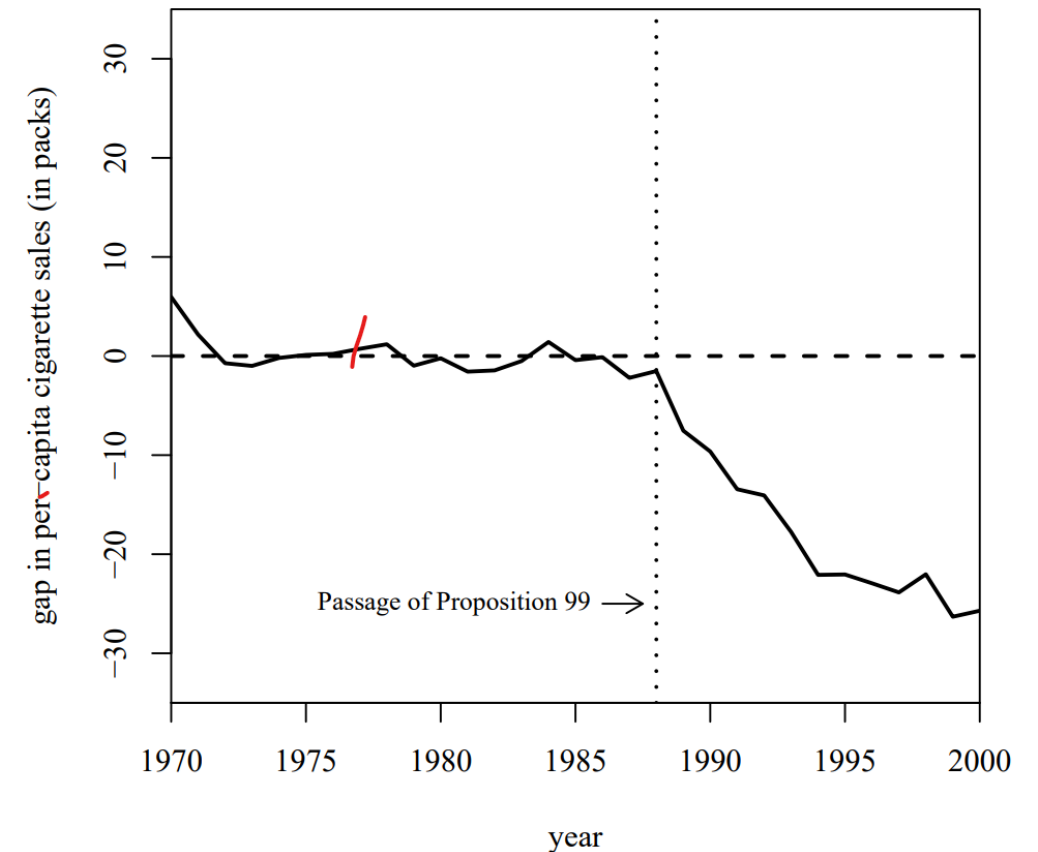Creates synthetic control group of what treated unit would look like had they never been exposed

Synthetic control is weighted average of non-treated units, where weights minimize the squared differences with the treated units pre-exposed observed scores

Abadie (2021), *Journal of Economic Literature*; Abadie et al (2010), *Journal of the American Statistical Association*

Synthetic Control Methods

Average Treatment Effect of the Treated (ATT) is estimated

Model estimates are unstandardized mean differences between treated unit(s) and the synthetic control

An ATT of 5 would mean the treated unit is 5 points higher than the synthetic control estimate

Abadie et al (2010), *Journal of the American Statistical Association*

Replicating and Improving Prior Research

Longitudinal Studies of Child Abuse and Neglect (LONGSCAN)

- Confirmed child maltreatment (n = 657)
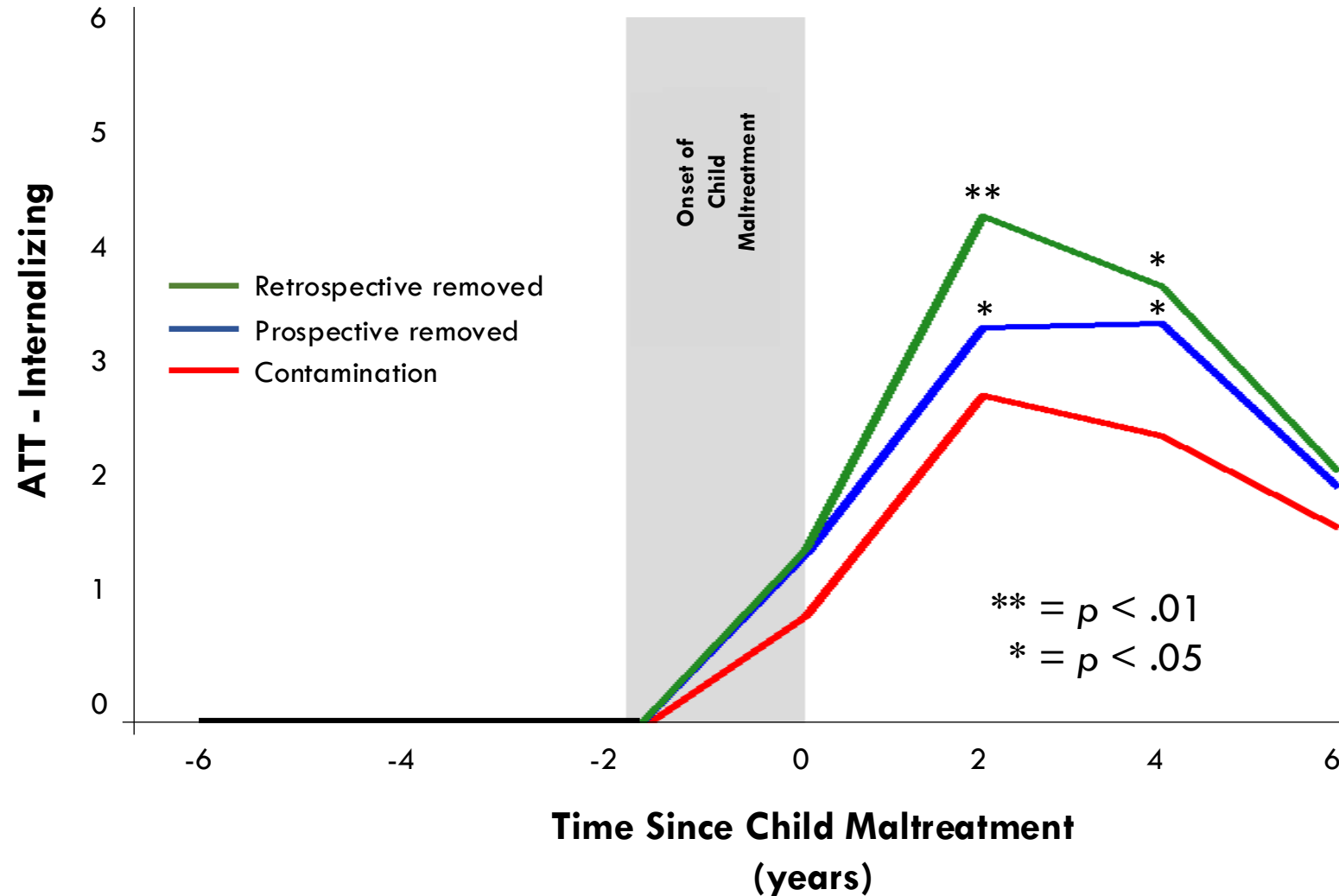
- Unconfirmed child maltreatment (n = 697)

Contamination

- Self-report of maltreatment in control condition (65.1%)

- Measured prospectively from age 12, retrospectively at age 18

Trajectories of child behavior problems

- Raw scores for both internalizing and externalizing behaviors

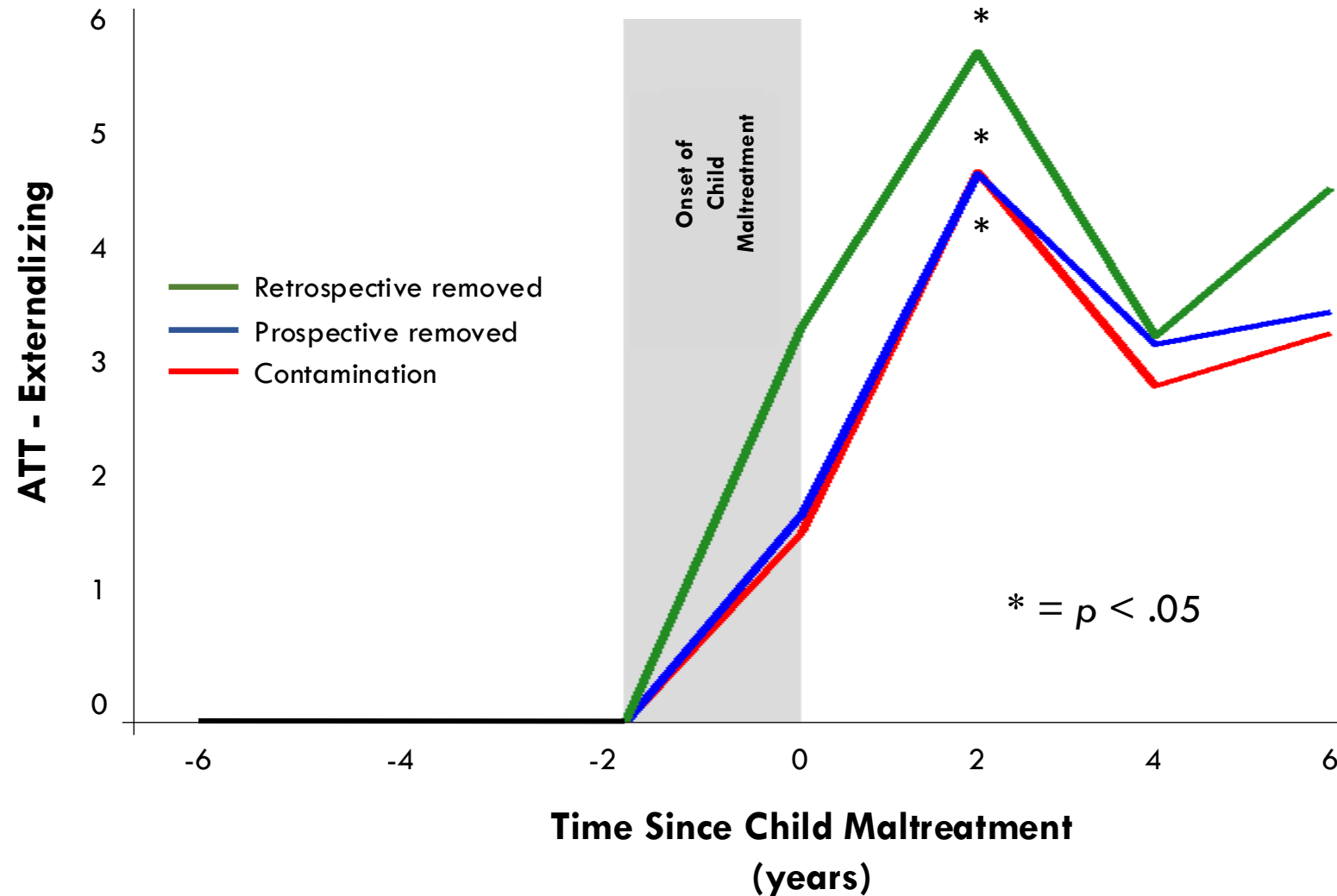- Measured repeatedly from ages 4 to 18

Synthetic Control Methods

Synthetic Control Methods

Bringing it all home…

Contamination:

Is a feature, not a bug, in child maltreatment research

Truncates the significance and magnitude of causal estimates

Retrospective reports appear to create largest degree of bias

Bringing it all home…

<u>Synthetic control models:</u>

Novel causal estimation for non-randomized research
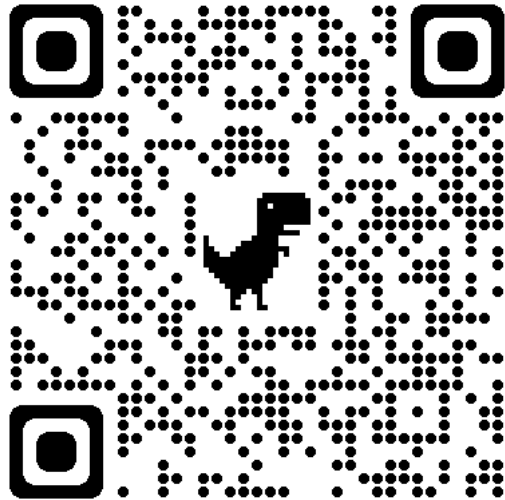
Repeated observations <u>prior to</u> child maltreatment

Missing data not accommodated well

Thank you!

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