



A classroom interior featuring rows of wooden desks and chairs. Large windows on the left provide a view of a bright blue sky with white clouds. A black chalkboard is mounted on the wall to the right. The central focus is a red rectangular overlay containing the title and author's name.

Sex Education & Sexual Activity. Is there a link?

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Motivation

- A topic of interest
 - Own experience
 - An important issue that has been debated for a lengthy amount of time
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Do schools that include comprehensive sex education have higher rates of sexual active adolescents?

Who is of interest?

- Looking at Schools and Adolescent Students
- Schools: Within United States
- Students: Middle and High School

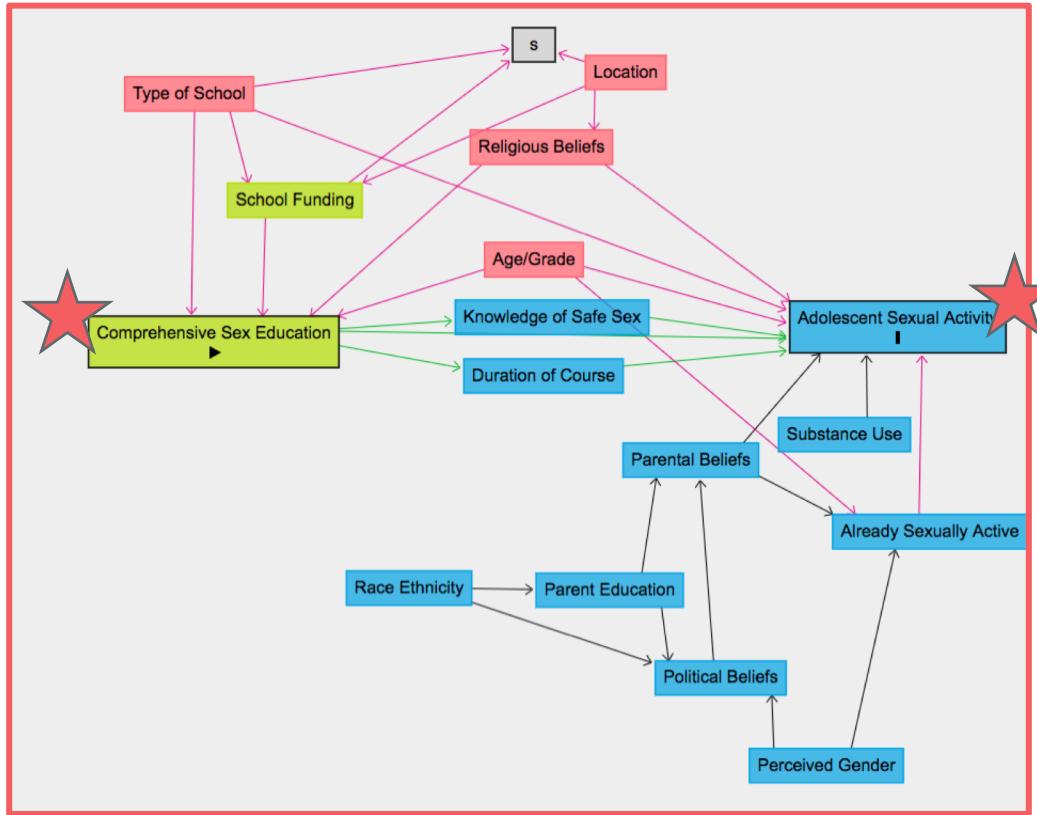
What is the overall goal?

- Help with advising whether or not schools should implement comprehensive sex education

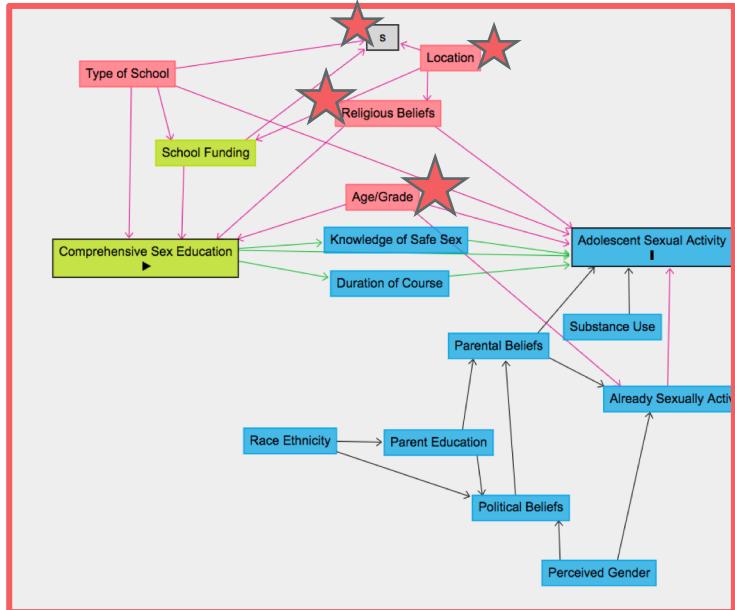
Variables of Interest

Type of School (Charter, Private, etc.)	Religious Beliefs	Age/Grade
Location	Political Beliefs	Race/Ethnicity
School Funding	Perceived Gender	Perceived Gender
Duration of Course	Knowledge of Safe Sex	Parental Beliefs
Already Active	Substance Use	Parent Education
Comprehensive Sex Education	Adolescent Sexual Activity	

General DAG



IP Weighting



Goals:

- Identify our population
- Remove confounding by creating a “pseudo-population”
- Fit a marginal structural model
- Make sure each individual received the appropriate weight

What is the average causal effect of comprehensive sex education from schools that provided data on sexual activity?

Part 1: Modeling to Obtain Weights

Step 1: Find the de-separating set: Age/Grade, S, School Funding, Type of School

Step 2: Fit an appropriate treatment propensity score model

Step 3: Create the treatment propensity scores

Step 4: Form inverse probability weights

```
ps_treat_mod <-
(education[treatment] ~
poly(Grade,2) + factor(Type of
School) + poly(School Funding,2))

ps_treat <- dplyr::case_when(
dataset$sexualactivity==1 ~
predict(ps_treat_mod, type =
"response"),
dataset$sexualactivity==0 ~ 1-
predict(ps_treat_mod, type =
"response"))

dataset$weights_treat <- 1/ps_treat
```

Part 2: Obtaining Summaries

Step 5: Fit our marginal structural models

Step 6: Obtain model summary and 95% confidence intervals

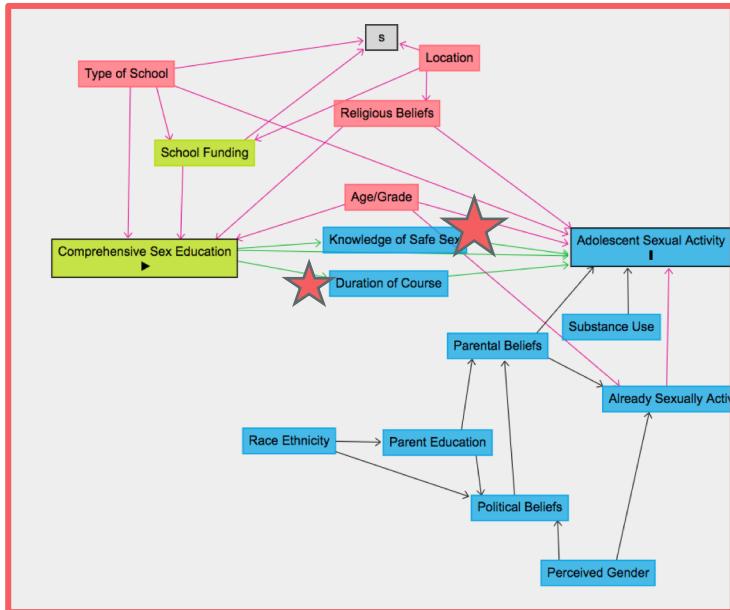
Step 7: Interpretations!

```
msm_fit <- geeglm(sexualactivity ~ education, data = dataset, weights = weight1, id = schooldistrict, corstr = "independence" )
```

```
summary(msm_fit)
```

```
mean_estimate + c(qnorm(0.025), qnorm(0.975))*Std.err
```

Mediation Analysis

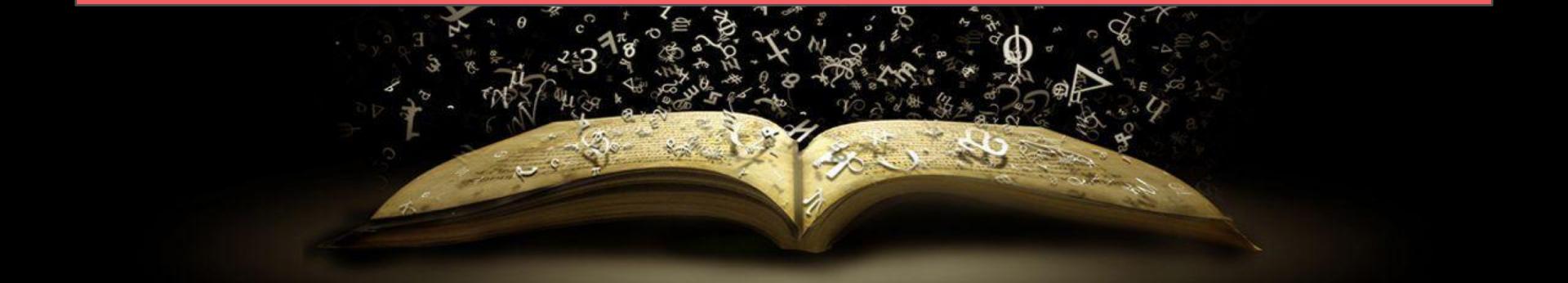


Goals:

- Understand direct and indirect pathways from treatment to outcome
- Understand the effect of mediator variables on treatment and outcome



Is the effect of the framing treatment mediated
more by the duration of the course or by the
amount of knowledge of safe sex?



Part 1: Modeling

Step 1: Identify all of our necessary variables

Step 2: Fit appropriate models

```
knowledge_mod <- glm(knowledge ~  
education + Agegrade + typeofschool +  
religiousbeliefs, data = dataset)  
  
out_mod <- lm(sexualactivity ~ knowledge  
+ education + poly(Agegrade,2) +  
typeofschool + religiousbeliefs, data =  
dataset)  
  
course_mod <- glm(DurationofCourse ~  
education + Agegrade + typeofschool +  
religiousbeliefs, data = dataset)  
  
out_mod <- lm(sexualactivity ~  
DurationofCourse + education +  
poly(Agegrade,2) + typeofschool +  
religiousbeliefs, data = dataset)
```

Part 2: Simulation

Step 3: Perform simulation to estimate mediation effects

Step 4: Interpret output

```
mediate_out <-  
  mediate(knowledge_mod, out_mod,  
  treat = "education", mediator =  
  "knowledge", robustSE = TRUE, sims  
  = 1000)  
  
summary(mediate_out)
```

Part 3: Interpreting Results

Quasi-Bayesian Confidence Intervals

	Estimate	95% CI Lower	95% CI Upper	p-value	
ACME (control)	0.127861	0.035138	0.22	0.006	**
ACME (treated)	0.127848	0.035794	0.22	0.006	**
ADE (control)	0.006869	-0.075335	0.09	0.848	
ADE (treated)	0.006856	-0.081682	0.09	0.848	
Total Effect	0.134717	-0.000106	0.25	0.052	.
Prop. Mediated (control)	0.926828	0.023210	2.99	0.050	*
Prop. Mediated (treated)	0.931565	0.024946	2.84	0.050	*
ACME (average)	0.127855	0.035344	0.22	0.006	**
ADE (average)	0.006862	-0.078817	0.09	0.848	
Prop. Mediated (average)	0.929196	0.024078	2.91	0.050	*
<hr/>					
Signif. codes:	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' '
Sample Size Used:	265				

Simulations: 1000

Part 4: Repeating Process & Conclusions

Step 5: Repeating the analysis
for other model

- Duration of Course : 87%
- Knowledge of safe sex : 90%

"We then have evidence to say that the **effect of comprehensive sex education on adolescent sexual activity is mediated more by a student's knowledge** of safe sex rather than the duration of the course."



Causal Discovery:

- 1) All possible edges present
- 2) Use regression models to do a conditional independence test
- 3) Check the p-value to decide whether an edge can be kept or erased
- 4) Repeat iterations until we are left with a skeleton

Quasi-Experimental Design

Goals:

- Used to assess the effectiveness of an intervention
- Mimics Randomized Trial

Interrupted Time Series

Step 1: Model

$$E[Y] = \beta_0 + \beta_1 T + \beta_2 I + \beta_4 A + \beta_5 AT + \beta_6 AI + \beta_7 AIT$$

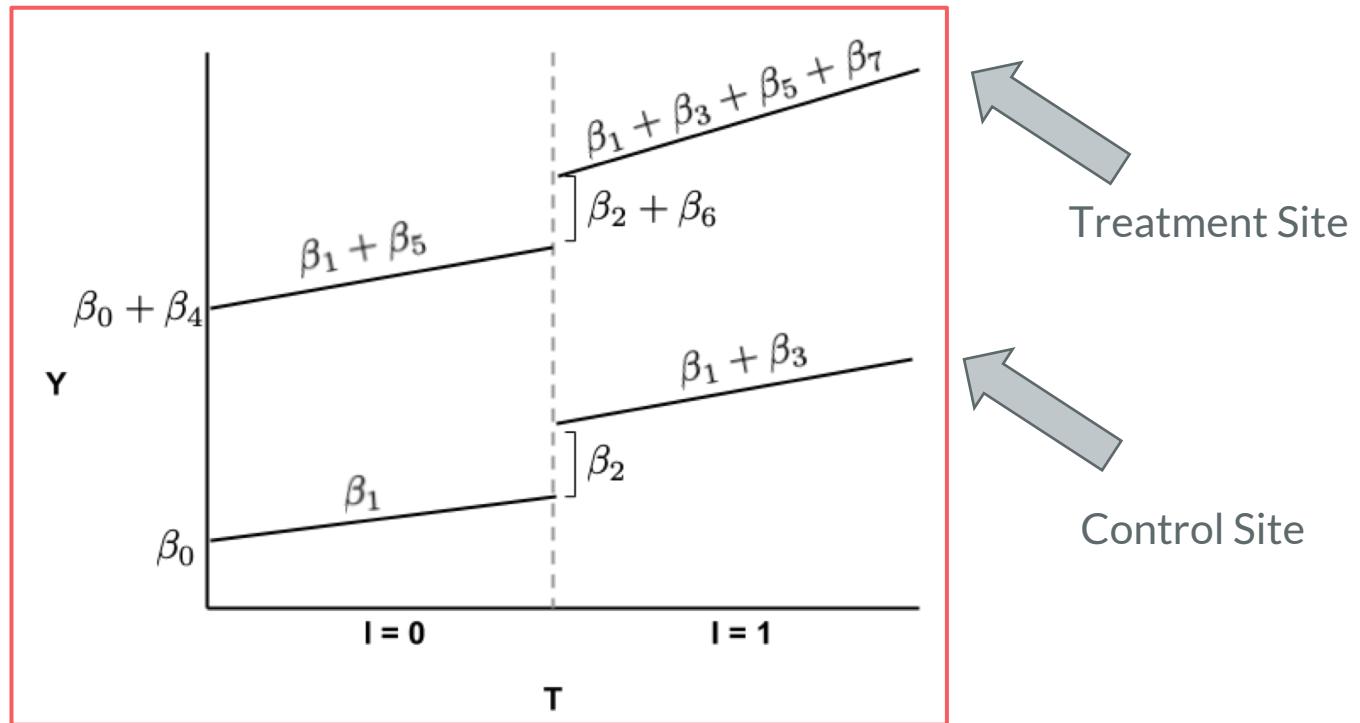
Y : Outcome/Response Variable

T: Time

I: 1 if the time period post-intervention, 0 for pre-intervention

A: 1 for treatment sites receiving the intervention, 0 for control sites

Step 2: Visualization



Step 3: Summarizing

$$E[Y] = \beta_0 + \beta_1 T + \beta_2 I + \beta_4 A + \beta_5 AT + \boxed{\beta_6 AI} + \boxed{\beta_7 AIT}$$

Y : Outcome/Response Variable

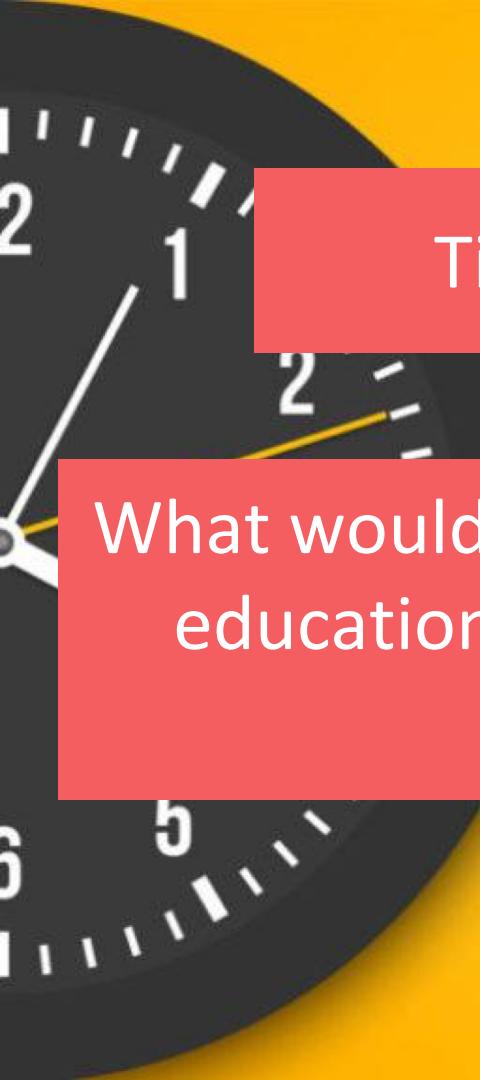
T: Time

I: 1 if the time period post-intervention, 0 for pre-intervention

A: 1 for treatment sites receiving the intervention, 0 for control sites

Limitations:

- Another event can happen
- There are many aspects to consider that rely a lot on solid contextual knowledge and expertise



Time-Varying Treatment Setting

What would the outcome be if the comprehensive sex education was over four years instead of another combination?



Final Thoughts

Thank You! Questions?